20 June 2014 Reference No. 147613051-001-R-Rev3

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RAPID HEALTH ASSESSMENT AND PRELIMINARY REPORT ON MONITORING PROGRAM BASED ON INFORMATION AND DATA AVAILABLE TO 15 JUNE 2014

Dear John

Summary

This rapid assessment is based on data collected in a two week period. Samples were collected from shallow soils and tank water and ambient air monitoring was undertaken from one measuring station. This included analysis of 149 samples (58 tank water, 91 surface soils (including 15 road samples)) for antimony and other metals. It also included ambient air monitoring program (PM_{10}, metals, $PM_{2.5}$).

The key findings of environmental monitoring:

- Regional soil antimony levels are naturally elevated. This is the reason antimony is mined in Costerfield. At present this rapid assessment does not attribute antimony concentrations in urine, soil, water or any other media to any source natural, historical or current.
- Antimony was the key metal measured above guideline levels. At 33 of 34 residential properties antimony concentrations in tank water were greater than the Australian Drinking Water Guideline. For soil, 13 of 34 residential properties reporting an exceedance of the provisional antimony investigation level.
- *Preliminary air monitoring results* - indicate low particulate levels (PM_{10} and $PM_{2.5}$). Antimony was measured within these particulates with a maximum ambient air concentration of 0.011 micrograms per cubic metre.

What do these findings mean for Health?

- Using conservative assumptions the rapid assessment finds that for both adults and children **adverse health effects are unlikely.**
- **Further investigations and a comprehensive risk assessment are warranted** to inform ways to reduce antimony exposures to residents.

Preamble

In order to respond to community concerns regarding antimony exposure in Costerfield, Golder Associates was engaged as an independent expert by a Reference Group of State Government Agencies to conduct an environmental monitoring program and a human health risk assessment.

Recognising the need for a rapid assessment addressing immediate health concerns, this letter report details:

- Rapid health advice to assess potential adverse effects as a consequence of exposure to antimony. This advice is informed by results of a monitoring program comprising:
  - A preliminary sampling and analysis of tank water at residences within Costerfield. A factual report is provided in Appendix A
  - A preliminary sampling and analysis of surface soil at residences within Costerfield. A factual report is provided in Appendix B
  - A preliminary air monitoring program at a location within the Costerfield community. A factual report is provided in Appendix C
  - Data gathering exercise. Information and data to inform the rapid assessment and planning for the comprehensive risk assessment was provided by:
    - Government Agencies. Regional environmental monitoring data was provided by a number of government agencies.
    - Mandalay Resources. Data on the mining operations, and environmental monitoring was provided by the company.

The monitoring program was developed to meet the objectives of the Reference Group Scope of Works. It was conducted in a manner consistent with relevant Australian Sampling and Analysis guidelines. Surface soil and water analytical results were reported and carried out in National Association of Testing Authorities (NATA) accredited laboratories using NATA endorsed analytical methods. Air quality sampling and analysis was conducted in accordance with Golder's NATA Laboratory Accreditation (Number 1910). Quality assurance procedures were undertaken.

Further comprehensive risk assessment will incorporate the results of additional testing and data analysis.

Key Points available on 16 June 2014:

1. Mandalay Resource process antimony ore in the form of Stibnite. This is converted from rock to a fine powder before being further concentrated within an operating plant.

2. Stibnite (antimony trisulphide, Sb_2S_3, CAS Number 1345-04-6) is a black crystalline solid and is sparsely soluble in water. It is a trivalent species of antimony (Grund 2012).

3. Stibnite (antimony trisulphide) is categorised by the European Chemicals Agency Database on Registered Substances as "Non Hazardous" (ECHA 2014). Consistent with this, the International Agency for Research on Cancer (IARC) evaluation on the evidence for the carcinogenicity of Stibnite concluded (IARC 1989) that there is insufficient evidence to categorise Stibnite as a carcinogen (Group 3). Antimony and other antimony compounds are hazardous substances. In particular antimony trioxide has been evaluated by IARC as Group 2B possibly carcinogenic to humans. This evaluation was based on evidence in experimental animals that antimony trioxide caused lung tumours following high exposures to antimony dust (IARC 1989).

4. The skin is a good barrier to metal compounds. There is no evidence that antimony is absorbed through skin at an appreciable rate. Dermal absorption of antimony following bathing in tank water (for example) is therefore expected to be a minor pathway for exposure.

5. Antimony exists in a number of forms depending on environmental conditions, particularly pH and oxygen content. Typically antimony is present as a pentavalent or trivalent oxide form (Takaoka 2005).

6. The Victorian Department of Health has produced a fact sheet on the toxicity of antimony. This is provided in Appendix D of this report as a reference guide.

7. For the Costerfield monitoring program, 149 samples (58 tank water, 91 surface soils) were analysed for a range of metals including antimony and another seven metals. Ambient air monitoring involved PM_{10} samples, analysed for 12 metals, including antimony, $PM_{2.5}$ samples, deposited dust samples, analysed for metals and insoluble solids and continuous PM_{10} measured using an indicative instrument. The surface soil samples included 15 road dust samples.

8. The monitoring program identified antimony as the key metal measured above guideline levels.

9. Elevated levels of antimony were widespread in tank water and soil. Of the 58 tank water samples, 52 reported antimony concentrations greater than the Australian Drinking Water Guideline (3 micrograms per litre). For soil, twenty-two of 91 surface samples reported antimony at concentrations greater than the preliminary health investigation level (200 milligrams per kilogram).

10. The form of antimony present from tank water is a soluble form. The total and filtered antimony concentrations in tank water were comparable. It should be noted that antimony concentrations of samples taken from inside the tanks were comparable to concentrations from the tap.

11. Interim air monitoring results collected to date demonstrated low particulate levels (PM_{10} and $PM_{2.5}$). Antimony was measured within the PM_{10} samples with a maximum ambient air concentration of 0.011 micrograms per normal cubic metre.

12. Survey data that pre-dates current mining operations indicates high regional soil concentrations of antimony in the Costerfield region. Given the geological / mineralogy of the region, together with historical mining activities since the 1860's, the elevated antimony soil concentrations are not unexpected.

13. A preliminary and limited statistical assessment of soil data (collected within the Study Area, as well as regional data within a 5 kilometre radius), indicated that the Study Area antimony concentrations in soil are higher than the regional values (Arne 2009). Whether this is due to current mining operations or historical mining has not been determined as part of this rapid health assessment.

14. A preliminary review of Mandalay dust deposition gauge data indicated that nuisance standards were exceeded on frequent occasions particularly in the areas with prevailing wind from the processing operations (west and north).

15. The health significance of the measured elevated antimony in tank water and surface soil is considered in this rapid health assessment.

16. A comprehensive risk assessment informed by additional data will assess exposure pathways and distinguish potential sources of contamination in more detail.

What does a Rapid Health Assessment entail?

Rapid Health Assessment is an objective and scientific approach based on limited data to assess potential adverse effects as a consequence of exposure. This rapid assessment uses information collected within a two week period and risk calculations to consider health issues to Costerfield residents.

The rapid assessment makes a number of conservative assumptions to err on the side of caution. It also assesses two scenarios:

Scenario 1: Residents are exposed to antimony via inhalation of ambient particulates, incidental ingestion of soil and **use tank water as their primary drinking water source** on a daily basis.

Scenario 2: Residents are exposed to antimony via inhalation of ambient particulates, incidental ingestion of soil to soil and ambient air. **Residents do not use tank water as their primary drinking water**.

The results are presented for both scenarios and for each property (de-identified for privacy reasons) for:

- Adults weighing 100 kilograms (frequently observed weight)
- Adults weighing 70 kilograms (approximate average weight of Australians)
- Children weighing 30 kilograms (approximately 5 years of age)
- Children weighing 15 kilograms (i.e.2 year old toddler)
- Children weighing 10 kilograms (i.e. 1 year old infant)

What are the key steps in the Rapid Assessment?

There are three key steps:

Step 1 – Estimate Intake of antimony

Step 2 – Compare Estimated Intake to a Tolerable Daily Intake of antimony

Step 3 – Assess Margin between the Estimated Intake and Intakes suspected or known to cause adverse health effects

Step 1 – Estimate Intake (Intake based on rapid measurements in soil, water, air)

The estimated intake is the amount of antimony taken into the body by ingestion and inhalation. It is expressed either as micrograms of antimony per person per day or micrograms of antimony per kilogram body-weight per day. The estimate is based on the maximum concentrations of antimony measured in drinking water, soil and ambient air. In addition the estimate uses conservative assumptions about consumption rates. It does not include averaging terms based on exposure frequency (part of the day, number of days per year, number of years). That is, the estimated intake assumes that people are exposed to the maximum measured concentration, assuming a 24 hour exposure. Such an estimate is intended to err of the side of caution.

Step 2 – Compare Estimated Intake to a 'Tolerable daily intake'

The tolerable daily intake (TDI) is defined as the amount of daily intake of a substance that can occur over a lifetime without appreciable lifetime health risk. It is typically expressed in units of micrograms per kilogram body-weight per day (WHO 1994).

The World Health Organisation reviewed the toxicology of antimony in 2003 and determined that a tolerable daily intake for humans over a lifetime is 6 µg/kg bw (6 micrograms per kilogram body-weight). This translates to:

- 600 micrograms antimony per day for a 100 kilogram man or woman
- 420 micrograms antimony per day for a 70 kilogram man or woman

- 180 micrograms antimony per day for a 30 kilogram child (5-7 year old)
- 90 micrograms antimony per day for a 15 kilogram child (approximately 18 -36 month old)
- 60 micrograms antimony per day for a 10 kilogram child (approximately 1 year old)

The tolerable daily intake is derived to err on the side of caution. It is derived:

- within an objective scientific process called risk assessment to enable decisions concerning the protection of human health. That is, a tolerable daily intake is not the boundary of when adverse health effects are likely to occur.
- in a manner that provides protection of human health following average daily exposure in the ambient environment for a lifetime.
- to be protective of identified and proven sensitive subpopulations within the general population.
- in a clear and transparent fashion following a comprehensive review and evaluation of available information on the biological effects of a substance.

Step 3 – Assess Margin between Intakes at which health effects are known and the Estimated Intake

The main intake pathway of antimony for this assessment was oral exposure via drinking water and incidental ingestion of soil. A number of reviews on the toxicology of antimony have been published and document effects in humans and in animal studies. From these reviews the following can be stated:

- Single oral doses of antimony at concentrations of 30,000 to 60,000 micrograms cause vomiting and other intestinal symptoms such as nausea and abdominal pain. These doses are equivalent to 430 to 850 micrograms of antimony per kilogram bodyweight for a 70 kilogram adult. Antimony-based medicine (tartar emetic) for inducing vomiting was historically used in medicine.
- In humans, antimony is used in medicine to treat severe parasite related diseases (Leishmaniosis). The World Health Organisation recommends a schedule of injections in the muscle or veins of 20,000 micrograms pentavalent antimony per kilogram body-weight per day for 10–20 days. This is based on a maximal daily dose of 850,000 micrograms antimony per day (Berman 1988, WHO 1984). Side effects have been noted. Antimony can cause cardiac toxicity when given by injection at doses higher than 20,000 micrograms per kilogram pentavalent antimony.
- The World Health Organisation in its recent review of the toxicology of antimony following oral administration decided that the lowest no observed adverse effect level was 6000 micrograms per kilogram body-weight per day. At higher doses (45,000 micrograms per kilogram body-weight) marked but reversible loss of body-weight gain occurred, together with slight changes to liver and spleen, probably related and in conjunction with distinctly reduced food and water intake at this dose.

In order to err on the side of caution the no observed effect level selected by the World Health Organisation was used to compare to the estimated intakes from the Costerfield monitoring program.

Results of Step 2: Do Estimates of Exposure Exceed the Tolerable daily intake?

Results for both Scenario 1 (soil, tank water and air exposure) and Scenario 2 (soil and air but no tank water exposure) for each Residence are displayed in Figure 1 and Figure 2 respectively. The results show:

- For adults the estimated intakes of antimony are below (1.6 to 250 times less than) the tolerable daily intake.

- For a 1 year old child (10 kg) the estimated intakes of antimony in 9 of the 34 residences in Scenario 1 (tank water used as a drinking water source) is above (up to 5 times greater than) **the tolerable daily intake for a 10 kg child.**
- For a 1 year old child (10 kg) the estimated intakes of antimony in 7 of the 34 residences in Scenario 2 (tank water **not** used as a drinking water source) is above (close to 5 times greater than) **the tolerable daily intake for a 10 kg child.**
- For 2 year old children (15 kg) the estimated intakes of antimony in six of the 34 residences in Scenario 1 (tank water used as a drinking water source) **is above** (up to 3.5 times greater than) **the tolerable daily intake for a 15 kg child.**
- For 2 year old children (15 kg) the estimated intakes of antimony in three of the 34 residences in Scenario 2 (tank water **not** used as a drinking water source) **is above** (close to 3.5 times greater than) **the tolerable daily intake for a 15 kg child.**
- For 5 year old children (30 kg), the estimated intakes of antimony in three of the 34 residences in Scenario 2 (tank water not used as drinking water) is **above** (up to 3.3 times greater than) **the tolerable daily intake for a 30 kg child.**
- For 5 year old children (30 kg), the estimated intakes of antimony in two of the 34 residences in Scenario 2 (tank water not used as drinking water) is **above** (3 times greater than) **the tolerable daily intake for a 30 kg child.**

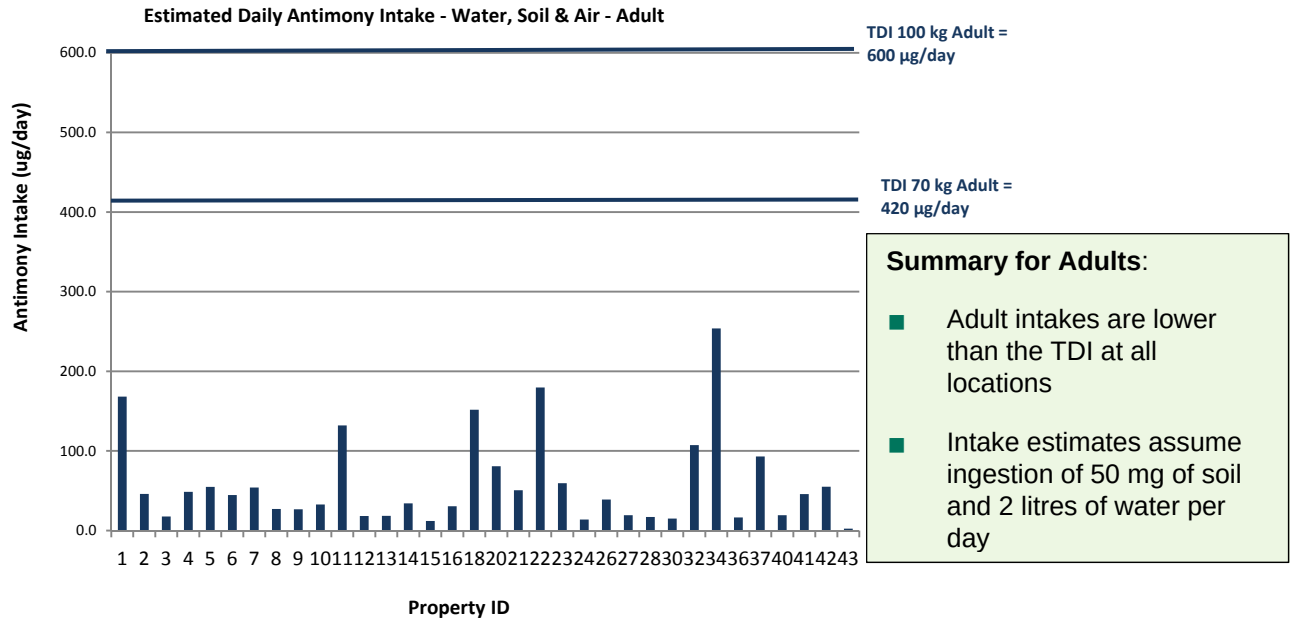
Conclusions for Step 2

The results do not mean people are at risk of adverse health effects. This is addressed in Step 3.

The results do mean a more thorough understanding of the environmental levels of antimony and potential exposure routes is necessary. It also means measures may be necessary to reduce intake in children. **It does not mean children will experience adverse health effects (refer to Step 3).**

Figure 1: Scenario 1: Comparison of Estimated Daily Intake to Tolerable Daily Intake (Estimated intake assumes ingestion of soil, water and inhalation of particulates in air).

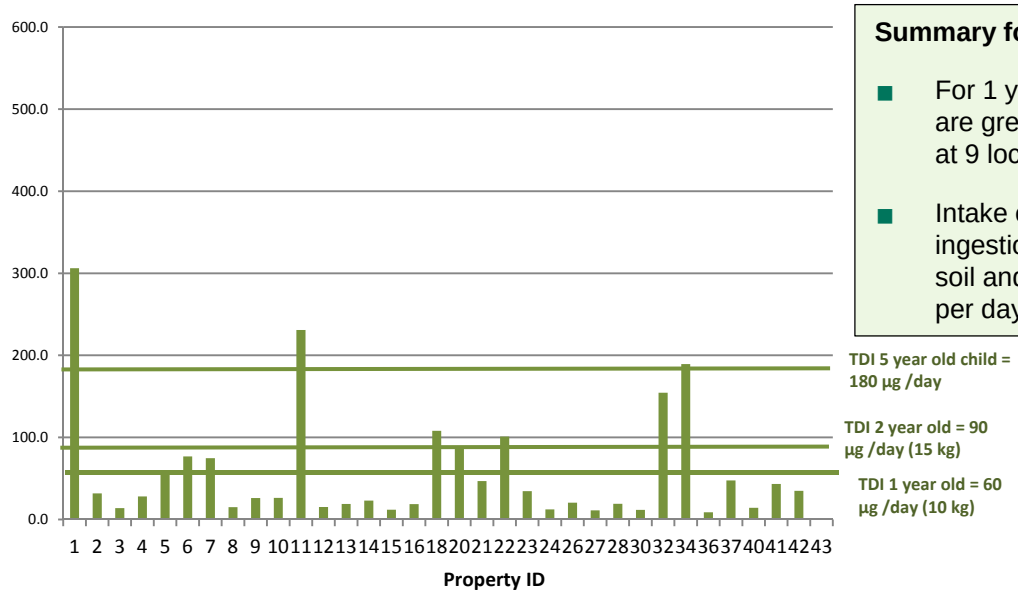
1A: Adults. Intakes expressed in micrograms per day (µg/day) compared to the tolerable daily intake (TDI) for an adult (male or female) weighing 70 or 100 kilograms (kg)



Summary for Adults:

- Adult intakes are lower than the TDI at all locations
- Intake estimates assume ingestion of 50 mg of soil and 2 litres of water per day

1B: Children. Intakes expressed in micrograms per day compared to the tolerable daily intake (TDI) for 1 year, 2 year and 5 year old children



Summary for Children:

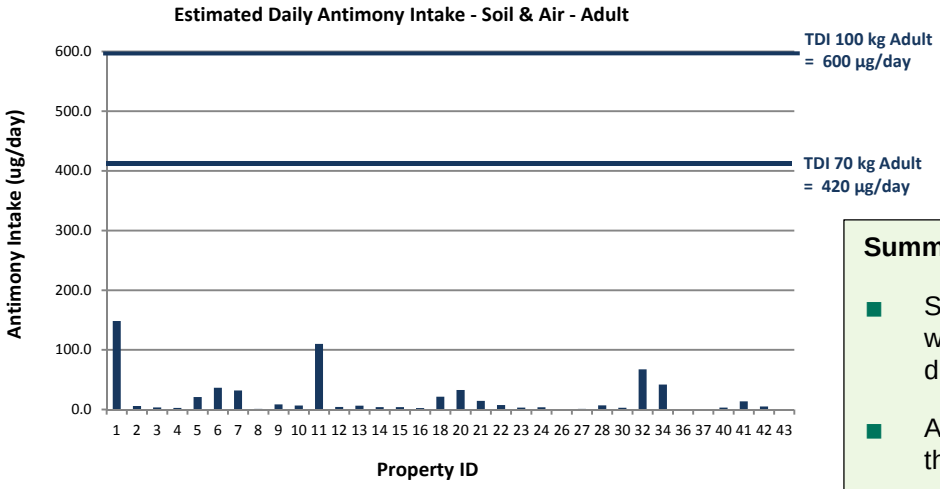
- For 1 year olds, intakes are greater than the TDI at 9 locations.
- Intake estimates assume ingestion of 100 mg of soil and 1 litre of water per day

Notes: TDI = Safe average intake or tolerable daily intake; µg/day = micrograms of antimony per day; kg = kilograms; ID = individual identifier

Scenario 1 intakes are based on intakes from tank water (drinking water), soil (ingesting soil) and air (inhaling particles). Soil and water contributions differ between properties depending on the soil and water concentration measured. For children (all ages assessed) tank water contributes between 3.3% and 96.5% of intake.

Figure 2:Scenario 2 Comparison of Estimated Daily Intake to Tolerable Daily Intake (Estimated intake assumes ingestion of soil, and inhalation of particulates in air).

2A: Adults. Intakes expressed in micrograms per day (µg/day) compared to the tolerable daily intake (TDI) for an adult (male or female) weighing 70 or 100 kilograms (kg)

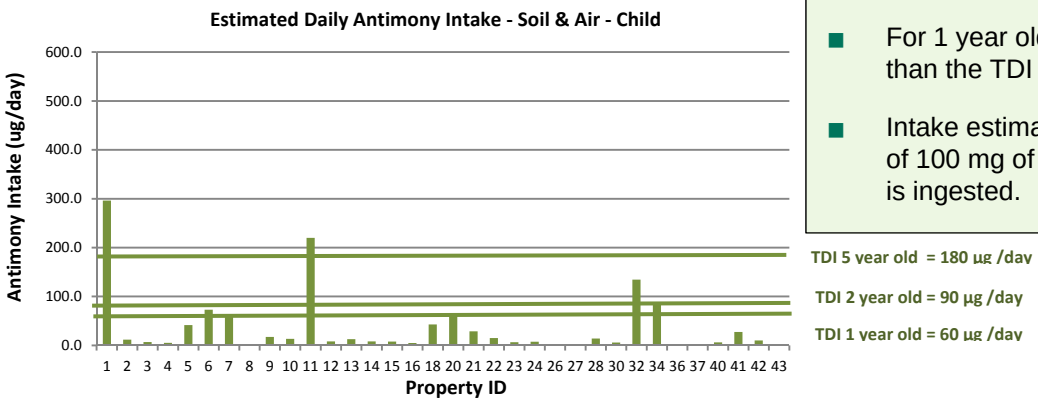


Summary for Adults:

- Scenario 2 assumes tank water is not used for drinking purposes.
- Adult intakes are lower than the TDI at all locations
- Intake estimates assume ingestion of 50 mg of soil.

Notes: TDI = Safe average intake or tolerable daily intake;
µg/day = micrograms of antimony per day; kg = kilograms; ID = individual identifier

2B: Children. Intakes expressed in micrograms per day compared to the tolerable daily intake (TDI) for 1 year, 2 year and 5 year old children



Scenario 2 Summary for Children:

- For 1 year olds, intakes are greater than the TDI at 7 locations.
- Intake estimates assume ingestion of 100 mg of soil and no tank water is ingested.

Notes: TDI = Safe average intake or tolerable daily intake; µg/day = micrograms of antimony per day; kg = kilograms; ID = individual identifier

Scenario 2 allows people to assess the contribution of soil because practically all of the intake is due to soil. This is because Scenario 2 assumes tank water is not used for drinking purposes. All intakes are lower than those for Scenario 1. However at some properties (1, 11, 32, 34), Scenario 2 shows that soil is an important contributor to exposure.

Results of Step 3 - Are Adverse Effects Likely in Children?

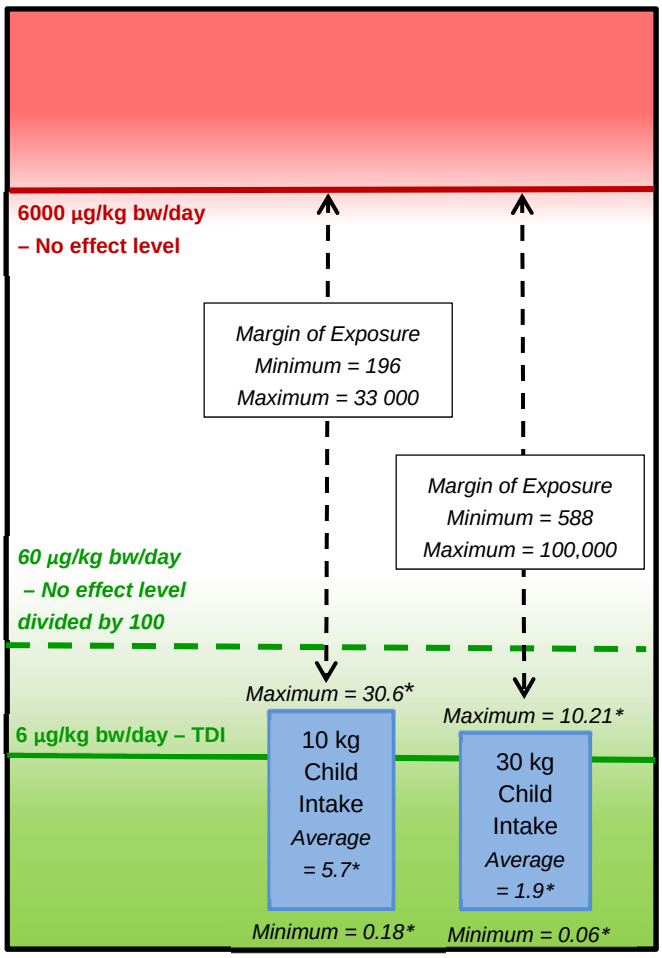
The likelihood of adverse effects occurring due to chemical intake is judged by the margin between the adverse effect level and the estimated intake. This is called the margin of exposure. Given that the estimated intakes of antimony for adults were all below the tolerable daily intake (i.e. a minimum margin of 1000 fold) this assessment step was only performed for children. In this instance a margin of less than 100 is interpreted as an immediate concern for adverse health effects.

The margins of exposures for children were found to be greater than 100. The margins of exposures for Scenario 1 (tank water used as drinking water) were found to range between 196 and 99 000 fold. The margins of exposures for Scenario 2 (tank water not used as drinking water) were found to range between 202 and 222 000. **Therefore adverse effects are not expected to occur at the estimated intakes**.

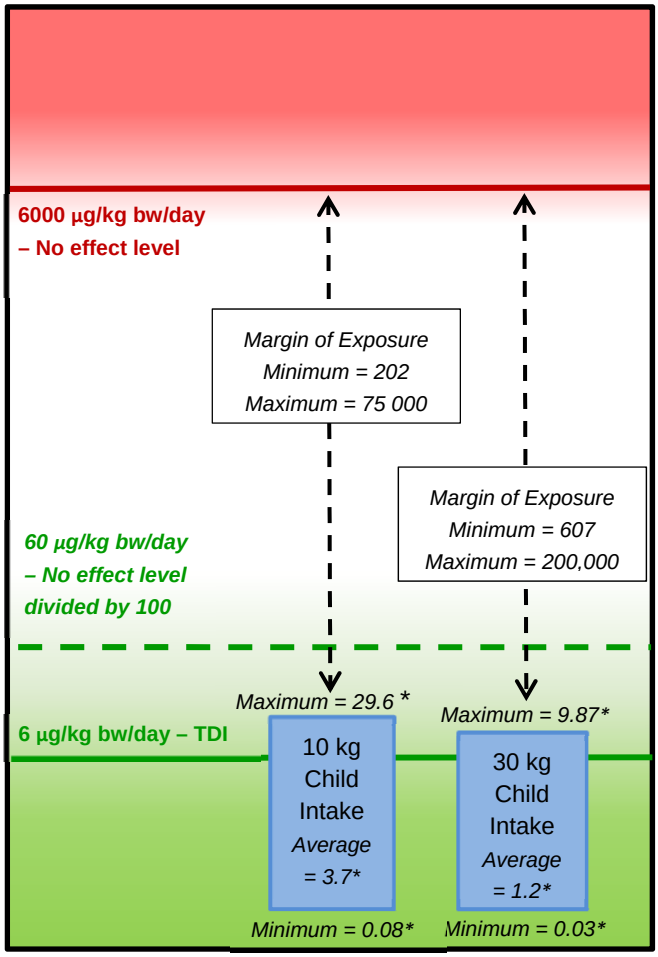
Figure 3 provides a comparison of the child margins of exposure for both Scenario 1 and 2.

Figure 3: Results of "Step 3" – Margin of Exposure

A) Scenario 1: Residents Use Tank Water as Sole Drinking Water Source



B) Scenario 2: Residents Do Not Use Tank Water for Drinking Water



Notes:
** Units = µg/ kg bw/day*
µg/ kg bw/day = micrograms per kilogram body weight per day; kg = kilograms
TDI = Safe average intake or tolerable daily intake
A margin of less than 100 indicates potential for adverse health effects

In Summary

Based on the results of the monitoring program, the rapid assessment indicates that health effects are not expected in residents from antimony exposure in Costerfield. Further assessment of exposure pathways and ambient air levels are necessary to consider the plausibility of other exposure routes and confirm the current findings.

In the meantime residents should take steps to reduce their potential exposure to antimony from environmental sources.

What do the results of this Rapid Assessment mean for urine levels?

Antimony levels in urine are a measure of the levels of antimony in the body. If antimony levels in the environment are elevated then the amount of antimony taken into the body will be elevated and the levels in urine will also be elevated.

Elevated antimony concentrations in urine are a marker of exposure and not human health impact. Urine levels can be elevated and still not result in human health effects.

Conservative Aspects of this Rapid Assessment

The Costerfield area is naturally high in antimony. That is why there is a mine in Costerfield. Mining activities over 150 years are likely to have added antimony to surface soils. The rapid assessment does not consider the origin of the elevated soil concentrations of antimony. These could be of natural origin, historical mining related or due to current mining operations.

The rapid assessment assumes:

- Children eat 100 milligrams of soil each day while they play at a residential property. Children play in the area where the maximum soil concentration was measured. In addition no averaging period was assigned to this exposure. For instance a child may only play outside on a proportion of the number of days per year and live at the residences for certain number of years. The exposure frequency and duration have not been considered.
- People (both adults and children) drink tank water as their sole source of drinking water (for Scenario 1). Once again, no averaging period was assigned to the exposure.

Data Gaps

- The levels and sources of antimony in local air are not well understood.
- Antimony in ambient air (and therefore tank water) may be elevated due to elevated levels in soil (a major contributor to the elevated intakes in Costerfield). Further investigation is needed to characterise ambient soil background concentrations not effected by mining occurrence and with depth.
- There is a need to consider other sources of antimony exposure, such as diet.
- The rapid assessment does not consider impacts on stock, pets or wildlife.
- Some of the toxicological aspects of antimony need further assessment. For instance:
  - The current assessment assumes 70% of the antimony in soil is available for uptake by the human body. This could be considerably different (likely to be a lower value) in practice.
  - The latest revision of the Australian Drinking Water Guideline for Antimony (3 micrograms per litre) was in 1996. In 2003 the World Health Organisation based on a review of more recent toxicology studies set a drinking water guideline value at 20 micrograms per litre.

Strategies to Reduce Exposure

Most residences within Costerfield are likely to have low exposures. There are a small number of residences that if children were present every day there would be a need to reduce exposure levels. Measures to reduce exposure could include:

- Using drinking water that complies with the drinking water standard
- reducing indoor dust
- reducing soil exposures (e.g. replace soil in play areas and garden beds).

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Yours sincerely

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Attachments: Limitations
Appendix A: Tank Water Monitoring – Factual Report
Appendix B: Soil Sampling - Factual Report
Appendix C: Laboratory Report
Appendix D: Copy of Department of Health Community Fact Sheet for Antimony May 2014

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APPENDIX A

Tank Water Monitoring – Factual Report

16 June 2014 Reference No. 147613051-003-L-Rev0

Mr John Mitas
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TANK WATER MONITORING FACTUAL REPORT, COSTERFIELD

Dear John

1.0 INTRODUCTION

Golder Associates Pty Ltd (Golder) was commissioned by the Department of State Development, Business and Innovation (DSDBI) to undertake a preliminary assessment of drinking water sourced from rainwater tanks at residential properties located in Costerfield, Victoria (the assessment area).

2.0 OBJECTIVE AND SCOPE OF WORKS

The objective of this study was to undertake a preliminary assessment of antimony levels in drinking water supplied by domestic rainwater tanks within the assessment area. The scope of works comprised:

- Collection of 58 water samples at 33 properties within the assessment area and 1 property outside of Costerfield. Water samples were collected at each premise from accessible sampling points including;
  - kitchen taps
  - taps on rainwater tanks &/or
  - outdoor taps
- Anecdotal information indicates that some of the rainwater tanks are topped up by an alternative water source.
- The preliminary assessment was conducted in a manner consistent with relevant water sampling standards:
  - Australian/New Zealand Standard 5667.1 (1998) *Water Quality – Sampling Part 1: Guidance on the design of sampling programs, sampling techniques and the preservation and handling of samples*.
  - Australian/New Zealand Standard 5667.5 (1998) *Water Quality – Sampling Part 5: Guidance on sampling of drinking water and water used for food and beverage processing*.
- Laboratory analysis of samples for total dissolved solids, pH, sulphate, total and dissolved metals (including antimony, arsenic, cadmium, copper, iron, lead, nickel and zinc).
- The laboratory results were screened against national and international drinking water guidelines:

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- National Water Quality Management Strategy *Australian Drinking Water Guidelines 6 Version 2.0*, 2011 (ADWG, 2011).
- World Health Organisation *Guidelines for Drinking Water Quality*, 2011 (WHO 2011).

Further detail on the methodology and drinking water guidelines adopted is presented in **Attachment A**.

3.0 DATA QUALITY ASSURANCE AND QUALITY CONTROL

The field and laboratory procedures implemented for quality assurance/quality control (QA/QC) along with a discussion of the QA/QC results are presented in **Attachment B**.

Quality control samples collected as part of the sampling program included collection of field duplicates and field splits at a rate of at least 5 per cent, collection of rinsate blanks and container blanks. The laboratories implemented a Quality Control (QC) program including analysis of internal spikes, duplicates and method blanks.

The data quality objective for the program was a completeness target of 95%. An overall completeness of 97.8% was achieved, satisfying the overall data quality objective for the program. Golder considers that the overall data quality generated during the assessment is of sufficient quality upon which to base decisions for this assessment.

4.0 RESULTS

A total of 58 samples were collected and submitted to ALS Environmental Laboratories for analytical testing. The analytical results have been tabulated and screened against relevant drinking water guidelines. The results for all chemicals tested for are presented in **Table A** attached to this report.

A summary of antimony results are presented in Table 1 below.

Table 1: Summary of antimony analytical results

Laboratory analysis	Range of reported results	Number of samples analysed	Drinking water guidelines	Number of samples exceeding drinking water guidelines
Total antimony	<0.001 - 0.106 mg/L	58	WHO 2011 (0.020 mg/L)	17
			ADWG 2011 (0.003 mg/L)	53
Dissolved antimony	<0.001 - 0.110 mg/L		WHO 2011 (0.020 mg/L)	19
			ADWG 2011 (0.003 mg/L)	52

WHO 2011 – World Health Organisation; ADWG 2011 - Australian Drinking Water Guidelines.

The preliminary assessment of antimony results for water sourced from domestic rainwater tanks within the assessment area found:

- Antimony was generally detected above the adopted Australian drinking water guideline (ADWG 2011).
- Approximately one third of the antimony results are above the adopted World Health Organisation (WHO 2011) drinking water guideline.
- Reported total and dissolved concentrations are comparable indicating that antimony is predominantly present in a dissolved form.
- Exceedances of the Australian drinking water guideline were reported for the 33 residential properties sampled within the Costerfield area. The single property sampled outside the Costerfield area did not report antimony levels above the Australian drinking water guideline.

5.0 LIMITATIONS

Your attention is drawn to the document - "Limitations", which is included in **Attachment C** of this letter. The statements presented in this document are intended to advise you of what your realistic expectations of this report should be. The document is not intended to reduce the level of responsibility accepted by Golder, but rather to ensure that all parties who may rely on this report are aware of the responsibilities each assumes in so doing.

6.0 CLOSURE

If you have any questions please do not hesitate to contact the undersigned.

Yours sincerely

GOLDER ASSOCIATES PTY LTD

Nic Foot
Senior Environmental Engineer

Christian Wallis
Principal Environmental Scientist

SH:NF/CJW/nw

CC: The Government Reference Group

Attachments: Table A – Analytical Results
Attachment A – Sampling Methodology
Attachment B – Data Quality Assurance and Quality Control
Attachment C – Limitations

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								Heavy Metals												Sample Quality Parameters			
								Antimony	Antimony (Filtered)	Arsenic	Arsenic (Filtered)	Cadmium	Cadmium (Filtered)	Copper	Copper (Filtered)	Iron	Iron (Filtered)	Lead	Lead (Filtered)	Nickel	Nickel (Filtered)	Zinc	Zinc (Filtered)	pH (Field)	pH (Lab)	Total Dissolved Solids @180°C	Sulphate (as SO4) (Filtered)
								mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	pH_Units	pH_Units	mg/L	mg/L
LOR								0.001	0.001	0.001	0.001	0.0001	0.0001	0.001	0.001	0.05	0.05	0.001	0.001	0.001	0.001	0.005	0.005		0.01	10	1
ADWG 2011 Aesthetic														1	1	0.3	0.3					3	3	6.5-8.5	6.5-8.5	600	250
ADWG 2011 Health								0.003	0.003	0.01	0.01	0.002	0.002	2	2			0.01	0.01	0.02	0.02						500
WHO Guidelines for Drinking Water Quality (2011)								0.02	0.02	0.01	0.01	0.003	0.003	2	2			0.01	0.01	0.07	0.07	3	3				
				Field Observations																							
Property_ID	Field_ID	Sampled_Date_Time	Sample_Type	Appearance	Odour	SDG																					
1	1/5001_20140603	3/06/2014	tank tap	clear	none	EM1405428		0.01	0.008	<0.001	<0.001	0.0073	0.0042	0.006	0.004	<0.05	<0.05	0.003	0.002	0.001	0.001	4.71	3.54	-	6.96	30	<1
2	2/5001_20140604	4/06/2014	kitchen tap	clear	none	EM1405497		0.02	0.021	<0.001	<0.001	0.0005	0.0004	0.022	0.016	<0.05	<0.05	<0.001	<0.001	<0.001	0.002	2.31	1.94	7.37	7	28	1
2	2/5003_20140604	4/06/2014	outside tap	red brown particulates	none	EM1405497		0.019	0.022	<0.001	<0.001	0.0005	0.0004	0.21	0.052	<0.05	<0.05	0.016	0.001	0.001	<0.001	2.54	2.23	7.66	7.14	28	2
3	3/5001_20140603	3/06/2014	within tank	red brown particulates	none	EM1405428		0.007	0.004	<0.001	<0.001	0.0008	0.0006	<0.001	<0.001	<0.05	<0.05	0.004	<0.001	<0.001	<0.001	5.73	5.8	-	6.88	28	<1
4	4/5001_20140603	3/06/2014	tank tap	clear	none	EM1405428		0.023	0.021	<0.001	<0.001	0.0001	<0.0001	0.005	0.005	<0.05	<0.05	<0.001	<0.001	<0.001	<0.001	1.92	1.76	-	6.7	27	<1
5	5/5001_20140603	3/06/2014	within tank	clear	none	EM1405428		0.017	0.015	<0.001	<0.001	<0.0001	<0.0001	<0.001	0.002	<0.05	0.08	<0.001	<0.001	<0.001	<0.001	0.417	0.391	-	7.62	63	<1
5	5/5002_20140603	3/06/2014	kitchen tap	clear	none	EM1405428		0.017	0.016	<0.001	<0.001	<0.0001	<0.0001	0.007	0.01	<0.05	<0.05	<0.001	<0.001	<0.001	<0.001	0.392	0.371	-	7.72	65	<1
6	6/5001_20140604	4/06/2014	within tank	clear	none	EM1405497		0.003	0.003	<0.001	<0.001	<0.0001	<0.0001	0.002	0.006	<0.05	<0.05	0.003	0.002	<0.001	<0.001	2.11	1.12	7.11	6.63	23	<1
6	6/5002_20140604	4/06/2014	kitchen tap	clear	none	EM1405497		0.002	0.001	<0.001	<0.001	<0.0001	0.0001	0.128	0.235	0.43	0.1	0.004	0.008	0.006	0.004	1.76	1.57	7.27	6.71	20	<1
7	7/5001_20140603	3/06/2014	kitchen tap	clear	none	EM1405428		0.005	0.003	<0.001	<0.001	0.0007	<0.0001	0.292	0.048	0.17	<0.05	0.004	<0.001	<0.001	<0.001	3.89	1.11	-	6.9	36	<1
7	7/5002_20140603	3/06/2014	outside tap	clear	none	EM1405428		0.011	0.011	<0.001	<0.001	0.0004	0.0002	0.071	0.034	<0.05	<0.05	<0.001	<0.001	<0.001	<0.001	2.36	1.88	-	7	33	<1
8	8/5001_20140603	3/06/2014	kitchen tap	clear	none	EM1405428		0.006	0.005	<0.001	<0.001	<0.0001	<0.0001	0.044	0.071	<0.05	<0.05	0.001	<0.001	<0.001	0.001	1.36	1.37	-	7.48	208	26
8	8/5002_20140603	3/06/2014	within tank	particulate matter in base of bailer	none	EM1405428		0.013	0.006	<0.001	<0.001	<0.0001	<0.0001	0.016	0.005	0.66	<0.05	0.017	<0.001	<0.001	<0.001	0.298	0.389	-	7.19	303	24
9	9/5001_20140602	2/06/2014	within tank	some black particulates	none	EM1405374		0.006	0.009	0.004	0.004	0.0002	0.0002	0.003	0.004	<0.05	<0.05	0.001	<0.001	<0.001	<0.001	0.797	0.615	-	6.87	12	<1
9	9/5002_20140602	2/06/2014	kitchen tap	clear	none	EM1405374		0.009	0.008	0.002	0.002	0.0001	0.0001	0.095	0.174	<0.05	<0.05	<0.001	<0.001	<0.001	<0.001	0.673	0.629	-	6.78	<10	<1
10	10/5002_20140604	4/06/2014	kitchen tank	clear	none	EM1405497		0.007	0.006	<0.001	<0.001	0.0002	<0.0001	0.684	0.14	<0.05	<0.05	0.001	0.002	<0.001	0.002	2.02	1.29	6.87	6.69	14	<1
10	10/5001_20140604	4/06/2014	within tank	clear	none	EM1405497		0.013	0.013	0.002	0.002	<0.0001	<0.0001	0.007	0.004	<0.05	<0.05	<0.001	<0.001	<0.001	<0.001	0.511	0.138	6.81	5.8	<10	<1
11	11/5001_20140605	5/06/2014	outside tap	clear	none	EM1405562		0.011	0.012	<0.001	<0.001	0.0002	0.0002	0.313	0.24	<0.05	<0.05	0.003	0.002	<0.001	<0.001	1.13	1.21	7.17	7.47	110	2
12	12/5001_20140604	4/06/2014	kitchen tap	clear	none	EM1405497		0.007	0.007	<0.001	<0.001	<0.0001	<0.0001	0.051	0.047	<0.05	<0.05	0.001	0.002	<0.001	<0.001	0.53	0.612	7.13	7.38	195	22
13	13/5001_20140603	3/06/2014	kitchen tap	clear	none	EM1405428		0.006	0.005	<0.001	<0.001	0.0004	0.0003	0.019	0.022	<0.05	0.08	0.001	<0.001	<0.001	<0.001	1.2	1.3	-	7.26	58	<1
13	13/5002_20140603	3/06/2014	within tank	clear	none	EM1405428		0.006	0.005	<0.001	<0.001	0.0001	<0.0001	<0.001	<0.001	<0.05	<0.05	<0.001	<0.001	<0.001	<0.001	0.605	0.608	-	7.28	48	<1
14	14/5001_20140603	3/06/2014	kitchen tap	clear	none	EM1405428		0.014	0.014	<0.001	<0.001	<0.0001	<0.0001	0.052	0.026	<0.05	<0.05	0.001	<0.001	0.001	0.001	1.98	1.62	-	7.19	56	1
14	14/5002_20140603	3/06/2014	tank tap	black particulate matter observed	none	EM1405428		0.015	0.014	<0.001	<0.001	0.0002	<0.0001	0.122	0.004	0.13	<0.05	0.01	<0.001	0.001	0.001	2.28	1.74	-	7.17	55	<1
15	15/5003_20140604	4/06/2014	within tank	clear	none	EM1405497		0.004	0.004	<0.001	<0.001	0.0002	0.0001	<0.001	0.002	<0.05	<0.05	0.002	0.002	<0.001	0.001	5.68	4.44	7.07	6.86	26	1
15	15/5001_20140604	4/06/2014	kitchen tap	clear	none	EM1405497		0.002	0.002	<0.001	<0.001	<0.0001	<0.0001	0.004	0.008	<0.05	<0.05	<0.001	<0.001	<0.001	<0.001	0.414	0.337	7.3	7.08	21	2
16	16/5001_20140602	2/06/2014	kitchen tap	clear	none	EM1405374		0.004	0.006	<0.001	<0.001	0.0008	0.0004	0.084	0.045	<0.05	<0.05	0.001	<0.001	0.002	0.001	0.811	0.805	-	6.94	12	<1
16	16/5002_20140602	2/06/2014	tank tap	clear	none	EM1405374		0.014	0.013	<0.001	<0.001	0.0003	0.0002	0.063	0.017	<0.05	<0.05	0.003	0.001	<0.001	0.001	0.336	0.31	-	3.79	20	<1
18	18/5001_20140603	3/06/2014	within tank	clear, trace black particulate matter	none	EM1405428		0.065	0.046	<0.001	<0.001	<0.0001	<0.0001	0.018	0.01	<0.05	<0.05	<0.001	<0.001	<0.001	<0.001	1.78	1.3	-	7.31	71	<1
18	18/5002_20140603	3/06/2014	kitchen tap	clear	none	EM1405428		0.059	0.053	<0.001	<0.001	<0.0001	<0.0001	0.34	0.216	<0.05	<0.05	0.004	0.004	<0.001	<0.001	1.86	1.61	-	7.28	55	<1
20	20/5001_20140604	4/06/2014	within tank	clear	none	EM1405497		0.021	0.024	<0.001	<0.001	<0.0001	<0.0001	<0.001	0.004	<0.05	<0.05	<0.001	<0.001	<0.001	<0.001	0.143	0.178	6.94	7.77	34	1
20	20/5002_20140604	4/06/2014	kitchen tap	clear	none	EM1405497		0.024	0.027	<0.001	<0.001	<0.0001	0.0001	0.019	0.027	<0.05	<0.05	<0.001	<0.001	<0.001	<0.001	0.352	0.441	7.01	7.08	21	1
21	21/5001_20140603	3/06/2014	tank tap	clear	none	EM1405428		0.015	0.011	<0.001	<0.001	<0.0001	<0.0001	0.24	0.325	<0.05	<0.05	<0.001	<0.001	<0.001	<0.001	2.81	4.85	-	6.91	40	<1
21	21/5002_20140603	3/06/2014	kitchen tap	clear	none	EM1405428		0.018	0.014	<0.001	<0.001	0.0001	<0.0001	2.17	1.02	<0.05	<0.05	0.005	0.002	<0.001	<0.001	0.413	0.22	-	6.71	29	<1
22	22/5004_20140605	5/06/2014	within tank	clear	none	EM1405562		0.086	0.087	<0.001	<0.001	<0.0001	<0.0001	0.001	0.002	<0.05	<0.05	<0.001	<0.001	<0.001	<0.001	1.23	1.44	6.05	7.38	90	1
22	22/5001_20140603	3/06/2014	tank tap	clear	none	EM1405428		0.047	0.043	<0.001	<0.001	0.0002	<0.0001	0.008	0.006	<0.05	<0.05	0.006	0.004	<0.001	<0.001	0.385	0.32	-	7.57	69	<1
22	22/5002_20140603	3/06/2014	within tank	clear	none	EM1405428		0.045	0.02	<0.001	<0.001	0.0001	0.0002	0.002	0.034	<0.05	<0.05	0.005	0.002	<0.001	<0.001	0.269	0.862	-	7.63	76	<1
22	22/5003_20140605	5/06/2014	within tank	pale yellow	none	EM1405562		0.061	0.065	<0.001	<0.001	<0.0001	<0.0001	0.055	0.028	<0.05	<0.05	<0.001	<0.001	<0.001	<0.001	0.342	0.253	NA	4.62	26	1
23	23/5001_20140605	5/06/2014	within tank	clear	none	EM1405562		0.022	0.022	<0.001	<0.001	<0.0001	<0.0001	0.011	0.008	<0.05	<0.05	<0.001	<0.001	<0.001	<0.001	0.284	0.27	6.55	6.92	67	4
23	23/5002_20140605	5/06/2014	outside tap	pale yellow	none	EM1405562		0.028	0.012	<0.001	<0.001	<0.0001	<0.0001	0.086	0.078	0.35	0.22	0.003	0.001	0.001	0.003	0.088	0.257	6.55	6.86	201	6
24	24/5001_20140605	5/06/2014	tank tap	clear	none	EM1405562		0.005	0.005	<0.001	<0.001	0.0095	0.0068	0.008	0.007	<0.05	<0.05	0.002	0.001	<0.001	0.001	3.29	2.85	6.93	6.8	59	2
26	26/5001_20140603	3/06/2014	outside tap	clear	none	EM1405428		0.019	0.022	<0.001	<0.001	<0.0001	<0.0001	0.03	0.114	<0.05	<0.05	0.006	0.009	<0.001	0.002	0.865	0.983	-	6.54	29	<1
27	27/5001_20140604	4/06/2014	within tank	clear	none	EM1405497		0.009	0.009	<0.001	<0.001	0.0008	0.0005	0.004	0.005	<0.05	<0.05	<0.001	<0.001	<0.001	0.001	0.635	0.463	7.13	6.83	18	<1
27	27/5002_20140604	4/06/2014	kitchen tap	clear	none	EM1405497		0.008	0.009	<0.001	0.001	0.0003	<0.0001	0.056	0.017	<0.05	<0.05	0.001	<0.001	0.001	0.001	0.287	0.084	7.24	5.71	<10	<1
28	28/5001_20140604	4/06/2014	within tank	clear	none	EM1405497		0.004	0.005	<0.001	<0.001	0.0001	0.0001	<0.001	0.004	<0.05	<0.05	0.002	0.001	<0.001	<0.001	2.6	2.88	7.04	7.14	56	<1
30	30/5001_20140605	5/06/2014	within tank	clear	none	EM1405562		0.006	0.004	<0.001	0.001	<0.0001	<0.0001	0.007	0.01	0.14	0.08	0.006	0.005	0.002	0.002	1.98	2.12	6.11	6.38	96	<1
32	32/5001_20140605	5/06/2014	outside tap	clear	none	EM1405562		0.02	0.021	<0.001	<0.001	<0.0001	<0.0001	0.021	0.011	<0.05	<0.05	<0.001	<0.001	<0.001	<0.001	0.058	0.109	7.24	7.53	204	<1
34	34/5002_20140605	5/06/2014	outside tap	clear	none	EM1405562		0.099	0.107	<0.001	<0.001	<0.0001	<0.0001	0.64	0.092	<0.05	<0.05	0.002	<0.001	<0.001	<0.001	0.966	0.941	5.83	6.95	70	5
34	34/5001_20140605	5/06/2014	within tank	clear	none	EM1405562		0.106	0.11	<0.001	<0.001	0.0001	<0.0001	<0.001	0.002	<0.05	<0.05	0.001	<0.001	<0.001	<0.001	0.926	0.654	6.08	4.52	72	2
36	36/5001_20140602	2/06/2014	kitchen tap	clear	none	EM1405374		0.008	0.004	<0.001	<0.001	0.0001	<0.0001	0.074	0.071	<0.05	<0.05	<0.001	<0.001	<0.001	<0.001	6.68	6.37	-	6.94	18	<1
37	37/5001_20140605	5/06/2014	kitchen tap	clear	none	EM1405562		0.036	0.038	<0.001	<0.001	<0.0001	0.0001	1.42	0.647	0.09	<0.05	0.003	0.006	0.001	0.003	5.77	4.21	7	6.94	58	<1
37	37/5003_20140605	5/06/2014	within tank	clear	none	EM1405562		0.038	0.039	<0.001	<0.001	<0.0001	<0.0001	0.001	0.006	0.1	0.06	<0.001	<0.001	<0.001	<0.001	3.57	2.79	6.91	6.84	48	<1
40	40/5002_20140602	2/06/2014	within tank	slight yellow containing fibrous material	none	EM1405374		0.007	0.007	<0.001	<0.001	<0.0001	<0.0001	0.518	0.203	<0.05	<0.05	0.004	0.004	0.001	0.001	0.135	0.082	7.37	6.64	15	<1
40	40/5001_20140602	2/06/2014	kitchen tap	clear	none	EM1405374		0.008	0.008	<0.001	<0.001	<0.0001	<0.0001	0.006	0.008	<0.05	<0.05	<0.001	<0.001	<0.001	0.001	0.069	0.046	-	6.08	<10	<1
41	41/5001_20140604	4/06/2014	tank tap	clear	none	EM1405497		0.015	0.015	<0.001	<0.001	0.0004	0.0004	0.008	0.014	<0.05	<0.05	<0.001	<0.001	<0.001	<0.001	0.42	0.529	7.35	7.25	70	2
42	42/5001_20140605	5/06/2014	within tank	clear	none	EM1405562		0.025	0.026	<0.001	<0.001	<0.0001	<0.0001	0.002	0.003	<0.05	<0.05	<0.001	<0.001	<0.001	<0.001	<0.005	0.006	7.18	7.2	51	<1
42	42/5002_20140605	5/06/2014	kitchen tap	clear	none	EM1405562		0.025	0.027	<0.001	<0.001	<0.0001	<0.0001	0.022	0.021	<0.05	<0.05	<0.001	<0.001	<0.001	<0.001	<0.005	<0.005	7.21	7.18	50	1
43	43/5002_20140605	5/06/2014	kitchen tap	clear	none	EM1405562		<0.001	<0.001	<0.001	<0.001	<0.0001	<0.0001	1.27	0.056	<0.05	<0.05	<0.001	<0.001	<0.001	<0.001	0.035	<0.005	5.7	6.43	10	<1
43	43/5001_20140605	5/06/2014	within tank	clear	none	EM1405562		<0.001	<0.001	<0.001	<0.001	<0.0001	<0.0001	0.007	0.004	<0.05	<0.05	<0.001	<0.001	<0.001	<0.001	<0.005	<0.005	5.85	5.31	<10	<1
Statistical Summary																											
Number of Results								69	69	69	69	69	69	69	69	69	69	69	69	69	69	69	69	41	69	69	69
Number of Detects								67	67	3	5	35	28	62	67	10	7	36	27	12	22	66	66	41	69	63	26
Minimum Concentration								<0.001	<0.001	<0.001	<0.001	<0.0001	<0.0001	<0.001	<0.001	<0.05	<0.05	<0.001	<0.001	<0.001	<0.001	<0.005	<0.005	5.7	3.79	<10	<1
Minimum Detect								0.002	0.001	0.002	0.001	0.0001	0.0001	0.001	0.002	0.09	0.06	0.001	0.001	0.001	0.001	0.035	0.006	5.7	3.79	10	1
Maximum Concentration								0.106	0.11	0.004	0.004	0.0098	0.0097	2.17	1.02	0.66	0.22	0.017	0.009	0.006	0.005	6.68	6.37	7.66	7.77	303	26
Maximum Detect								0.106	0.11	0.004	0.004	0.0098	0.0097	2.17	1.02	0.66	0.22	0.017	0.009	0.006	0.005	6.68	6.37	7.66	7.77	303	26
Average Concentration								0.019	0.019	0.00059	0.00061	0.00055	0.00043	0.15	0.077	0.061	0.033	0.0022	0.0014	0.00069	0.00088	1.6	1.5	6.9	6.8	53	2
Median Concentration								0.013	0.011	0.0005	0.0005	0.0001	0.00005	0.019	0.017	0.025	0.025	0.001	0.0005	0.0005	0.0005	0.926	0.941	7.02	6.94	36	0.5
Standard Deviation								0.022	0.022	0.00049	0.00049	0.0018	0.0015	0.36	0.16	0.12	0.028	0.0031	0.0018	0.00071	0.00084	1.6	1.6	0.47	0.72	55	4.8
Number of Guideline Exceedances								63	61	0	0	3	3	3	1	4	0	2	0	0	0	12	10	6	10	0	0
Number of Guideline Exceedances(Detects Only)								63	61	0	0	3	3	3	1	4	0	2	0	0	0	12	10	6	10	0	0

ATTACHMENT A

Sampling Methodology

ATTACHMENT A
SAMPLING METHODOLOGY

Item	Description
Sample Date	2, 3, 4 and 5 June 2014. The following weather observations were made during the sampling event: ■ 2 June 2014 – overcast ■ 3 June 2014 – overcast, light showers in the morning ■ 4 June 2014 – foggy in the morning, sunny afternoon ■ 5 June 2014 – overcast (ground conditions very wet from overnight rain)
Adopted Sampling Guidelines	■ **Australian/New Zealand Standard 5667.1 (1998) Water Quality – Sampling Part 1: Guidance on the design of sampling programs, sampling techniques and the preservation and handling of samples.** This Standard provides general principles to be applied in sampling for the physical, chemical, microbiological or radiological analysis of waters and waste waters, including bottom sediment and sludges, for the purposes of process control, quality characterization, identification of sources of pollution and the monitoring of background levels. The guidance on sampling procedures provided in this Standard is generally applicable. Where alternative procedures are used they are to be demonstrated to be at least as reliable as those provided in this Standard or that they will achieve the objectives of the sampling and analysis program. ■ **Australian/New Zealand Standard 5667.5 (1998) Water Quality – Sampling Part 5: Guidance on sampling of drinking water and water used for food and beverage processing.** This is Part 5 in a series of Standards on the sampling of waters, waste waters, sediments and sludges. The objective this series of standards is to provide parties interested in monitoring and techniques, preservation, handling and transport of samples for the purposes of process control, quality characterisation, identification of sources of pollution, compliance with water quality guidelines or standards, and other activities. This part of the series provides detailed principles to be applied to the sampling of drinking water and water used for food and beverage processing.
Sample Points	■ **Rainwater tank** (sample collected within the tank). ■ **Kitchen tap** (sample collected when a resident was present to provide access). ■ **Rainwater tank tap** (collected when a tap was present and a sample could not be collected from within the tank due to logistical constraints). ■ **Outdoor tap** (collected when a garden tap was present and a resident was not present to provide access to the kitchen tap).
Number of Primary Samples Collected	■ **Rainwater tank** – 22 samples ■ **Kitchen tap** – 21 samples ■ **Rainwater tank tap** - 8 samples

Item	Description
	■ **Outdoor tap** – 7 samples
Rainwater tank sample collection methodology	Tank water samples were collected within the tank at approximately 30 cm to 50 cm below the water surface using a high density polyethylene foot valve and tubing. Water was transferred directly into sample bottles from the tubing with no contact between tubing and bottles. All hosing and foot valves were stored in clean packaging prior to use from the supplier and the sampling equipment was replaced between rainwater tanks.
Tap sample collection methodology	■ **Initial draw off (all tap sample points) –** water was collected from the initial draw off water as this was considered to represent the sample with the highest potential sediment load. ■ **Post flush (10 tap sample points) –** samples were collected after 2 to 3 minutes of water flow as per Australian/New Zealand Standard 5667.5 to assess the effect of flush out of stale water. The comparison of results from each sample collection methodology is discussed further in item 'comparison of pre and post flush tap samples' in Attachment B.
Field Data	At 20 sample points, the pH and conductivity was measured in a bucket using a water quality meter.
Record of Sample Location	Sampling locations were recorded with hand-held GPS with +/- 10 m accuracy.
Sample Storage	Samples were transferred into appropriately preserved bottles supplied by the NATA accredited laboratory.
Sample Delivery	The samples were transferred into chilled, insulated containers and delivered to the laboratory under Chain of Custody (CoC) procedures.
Laboratory for Water Analysis	The laboratory engaged as the primary laboratory for the analysis was ALS Environmental Pty Ltd which is registered by the National Association of Testing Authority (NATA) for the analyses performed. The secondary laboratory selected for quality assurance testing was MGT Eurofins.
Laboratory Analytical Schedule	Selected samples were designated for analysis of total dissolved solids, pH, sulphate, total and dissolved metals (including antimony, arsenic, cadmium, copper, iron, lead, nickel and zinc).
Adopted Assessment Criteria	■ **World Health Organisation *Guidelines for Drinking Water Quality*, 2011 (WHO Guidelines).** The Guidelines provide the recommendations of the World Health Organisation for managing the risk from hazards that may compromise the safety of drinking-water. The Guidelines describe reasonable minimum requirements of safe practice to protect the health of consumers and derive numerical "guideline values" for constituents of water of indicators of water quality. The Guidelines state that when defining mandatory limits, it is preferable to consider the Guidelines in the context of location or national environmental, social, economic and cultural conditions. ■ **National Water Quality Management Strategy *Australian Drinking Water Guidelines 6 Version 2.0*, 2011 (ADWG).** The ADWG are derived so as to take account of the needs of an individual through a normal lifetime, including

Item	Description
	changes in sensitivity that may occur between life stages. The ADWG includes both health related guideline values and aesthetic guideline values. ▪ **Health related guideline values:** concentration or measure of a water quality characteristic that, based on present knowledge, does not result in any significant risk to the health of the consumer over a lifetime of consumption. ***The adopted antimony value is a health related guideline value.*** ▪ **Aesthetic related guideline values:** concentration or measure of a water quality characteristic that is associated with acceptability of water to the consumer; for example, appearance, taste, odour.

\\golder.gds\gap\melbourne\jobs\env\2014\147613051 - costerfield\correspondence out\147613051-003-l_tank water factual report\147613051-003-l-rev0_ready for pdf\04_attachment a sampling methodology docx_cjw.docx

ATTACHMENT B

Data Quality Assurance and Quality Control

Item	Description
QA/QC Objectives	
Data Quality Measures and Objectives	The data quality measures for the assessment are as follows: ■ ***Accuracy:*** A measure of the closeness of the results to the actual results. Accuracy is assessed through the comparison of results produced by the primary and secondary laboratories for the same sample and by the measuring of the extent to which an analytical result reflects the known concentration as measured by the recovery obtained from internal laboratory spikes. ■ ***Precision:*** A measure of the repeatability of results by the laboratory. This is assessed through the analysis of duplicates both internally and externally. ■ ***Completeness:*** The percentage of acceptable data obtained compared to the amount of data needed to achieve a particular level of confidence in the results. The following data quality objectives (DQOs) have been set for this project: ■ primary samples and field duplicates recording Relative Percentage Differences (RPDs) less than 30% for inorganics and less than 50% for organics; ■ primary samples and primary laboratory internal duplicates recording RPDs less than 30% for inorganics and less than 50% for organics; ■ accuracy in spike samples to range between 70% and 130% (for organics and other inorganics); ■ rinsate blanks and primary laboratory method blanks below practical quantitation limits (PQLs), or equal or less than background levels, wherever justified; ■ overall data quality completeness of 95% or greater. The primary and secondary duplicate results for chemical data were compared with primary sample results using RPDs. RPDs were calculated according to the following formula: $$\%RPD = \mathrm{ABS}\left\{\left[\frac{A-B}{A+B}\right] * 200\right\}$$ Where: ABS – absolute number A – concentration of the primary laboratory result per analyte B – concentration of corresponding duplicate result. RPD values can range from 0% (indicating perfect correlation between results) to 200% (indicating complete divergence in results).
QA/QC Methodology	

Item	Description
QA/QC Sample Collection	The following QA/QC samples were collected: ■ Primary duplicate samples at a frequency of 10.3% against primary samples. ■ Secondary duplicate samples at a frequency of 6.9% against secondary samples. ■ A total of 11 rinsate samples from clean plastic equipment used in the sampling process including tubing, foot valves, filters and syringers. The purpose of the rinsates was to assess the potential for antimony, if a component of the sample material, to leach into the sample. ■ One container blank using a preserved sample bottle provided by ALS Environmental for total and dissolved metals analysis. This blank was undertaken to assess the potential for antimony, if present in the bottle composition, to leach from the sample bottle into the sample. ■ Ten water samples from taps following after 2 to 3 minutes of water flow as per Australian/New Zealand Standard 5667.5 to assess the effect of flush out of stale water. It is noted that AS/NZS 5667.1 recommends taking a transport blank (also known as trip blank) to estimate the amount of contamination introduced during the transport and storage of samples from the time of sampling until the time of analysis. Given that the chemicals of interest are not volatile and samples were stored in sealed containers, this contamination pathway did not warrant investigation.
Minimisation of cross-contamination	Golder staff used new nitrile gloves for collection of each water sample and decontaminated reusable equipment between each sampling point.
Sample Handling and Preservation	Water samples were collected into laboratory supplied vessels containing appropriate preservatives for the selected analysis. The collected samples were immediately placed in a chilled and insulated container with ice and stored in this manner prior to and during transit to the laboratory.
Equipment Calibration	The water quality meter was calibrated prior to use for each day of sampling. A copy of the calibration certificates is provided at the back of this attachment.
Laboratory internal QC	The quality of the laboratory data generated was supported with appropriate laboratory Quality Control (QC) samples and assessed using standard methods. Internal laboratory QC samples including method blanks, laboratory duplicates, matrix spikes, laboratory control sample spikes and surrogate spikes were analysed as part of the quality assurance program.
QA/QC Results	
Summary of Groundwater QA/QC Results	

QC Sample Type	Number of Results NOT Meeting Data Quality	Total Number of Results (Individual Analytes)	Percentage Meeting Data Quality Objectives

Item	Description

	Objectives		
Primary Duplicates	4	114	96.5%
Secondary Duplicates	8	76	89.5%
Rinsates	0	176	100%
Internal Duplicates	8	271	97.0%
Matrix Spikes	0	100	100%
Method Blanks	0	163	100%
Overall Completeness	20	900	**97.8%**

Discussion of results

- Six primary duplicate and four secondary duplicate samples were analysed during the assessment and a total 58 primary water samples analysed. This equates to an analysis frequency of 10.3% and 6.9% for collection of primary and secondary duplicates respectively. This complies with the specified collection rate of 5%. Primary and secondary analytical results are presented in Table B-1 at the back of this attachment.
- Of the 114 primary duplicate analytes, four returned RPDs above 50%, representing a conformance level of 97.8%.
- Of the 104 secondary duplicate analytes, 8 returned RPDs above 50%, representing a conformance level of 89.5%. Non-conformances, with RPDs ranging between 51% and 152%, were observed for metals including total cadmium, total iron, total lead, total zinc and filtered copper. Five of the 8 RPD non-conformances were between 51% and 67%. It is considered unlikely that the non-conformance will affect the overall quality or outcome of the assessment and is not related to reporting of antimony.
- None of the 176 rinsate analysis results reported levels above the laboratory limit of reporting. This represents compliance of 100.0% indicating that the plastics used during water sampling were an unlikely source of antimony detected in the water samples.
- A review of the RPDs for the Internal Duplicate tests indicates that 8 of the 271 tests conducted did not produce results within the desired 30% RPD conformance limit. This result represents a compliance of 97.0%. Non-conformances were observed for Antimony, Copper, Lead and Zinc. Three non-conformances were observed for the chemical of interest, Antimony, each with an RPD of 66%. This RPD is attributed to the low levels of detection in the samples. The exceedance is not considered to impact on the overall quality or outcome of the assessment.

Item	Description
	■ A review of the 100 Matrix Spike results indicates that all analyses provided a recovery beyond 70-130%, representing a conformance level of 100%. ■ A review of the Method Blank tests indicates that all of the 163 laboratory internal blanks analytes were below laboratory reporting limit, representing compliance of 100%. The achieved QA/QC completeness of 97.8% is above the overall completeness objective of 95%. Based on this, it is considered that the overall data quality generated during the assessment of water by Golder Associates is of sufficient quality upon which to base decisions for this assessment.
Additional Quality Assurance Checks	
Comparison of pre and post flush tap samples	■ Total antimony concentrations: ▪ three post flush samples reported higher concentrations than pre flush samples by between 0.001 and 0.002 mg/L; ▪ three post flush samples reported lower concentrations than the pre flush samples; and ▪ four samples reported the same concentration. ■ Dissolved antimony concentrations: ▪ three post flush samples reported higher concentrations than pre flush samples by 0.001 mg/L; ▪ seven samples reported the same concentration. Based on the above summary, Golder Associates considers that the time at which a sample is collected from the tap does not impact upon the quality of the data collected. The pre flush samples are therefore considered appropriate for the objectives of the sampling and analysis program.
Comparison of field and laboratory reported pH	pH was measured in the field and laboratory for 41 samples. The results are presented in Table A and are summarised below. ■ 26 laboratory reported pH was less than the field reported pH. The difference in pH ranged between 0.03 units and 1.56 units. ■ 15 laboratory reported pH was greater than the field reported pH. The difference in pH ranged between 0.02 units and 1.33 units.
Comparison of dissolved antimony concentrations to total dissolved antimony concentrations	■ 20 of the dissolved concentrations were greater than the total dissolved concentrations, in 20 of the 58 samples analysed. The difference between the total and dissolved antimony concentrations ranged between 0.001 mg/L and 0.008 mg/L and is attributable to the following factors: ▪ Laboratory reported measurement of uncertainty of approximately +/-13% for dissolved and total antimony concentrations in water. The reported measurement of uncertainty is a factor in all laboratory analysis undertaken and the reported uncertainty in this case is acceptable for the objectives of the assessment.

Item	Description
	▪ Separate sample bottles are filled for the analysis of total and dissolved antimony. There will be slight variations in water composition between each sample bottle.

Gas Detection Air Sampling & Monitoring Environmental & Water Quality Monitoring
air-met scientific pty ltd
ABN 73 006 849 949
Ph 1300 137 067

Multi Parameter Water Meter

Instrument YSI Quatro Pro Plus
Serial No. 12D101326

Item	Test	Pass	Comments
Battery	Charge Condition	✓	
	Capacity	✓	
	Recharge OK?	✓	
Switch/keypad	Operation	✓	
Display	Intensity	✓	
	Operation (segments)	✓	
	Seal	✓	
Connectors	Condition	✓	
Sensor	1. pH	✓	
	2. mV	✓	
	3. Conductivity	✓	
	4. D.O	✓	
	5. Temp	✓	
Alarms	Beeper	✓	
	Settings	✓	
Software	Version	✓	
Data logger	Operation	✓	
Download	Operation	✓	
Other tests:			

Certificate of Calibration

This is to certify that the above instrument has been calibrated to the following specifications:

Sensor	Serial no	Standard Solutions	Certified	Solution Bottle Number	Instrument Reading
1. pH 7.00		pH 7.00		LA2261	7
2. pH 4.00		pH 4.00		LG1394	4
3. EC		2.760mS		LA1343	2.760mS
4. Temp		22.5°C		TESTO 720	21.5°C
5. Redox (mV)		228mV		LC1282/LC1281	236.8mV
6. DO		0 ppm		960	0 ppm

Calibrated by: **Hans Huysmans**

Calibration date: **26-May-14**

Next calibration due: **22-Nov-14**

Water Quality Meter Calibration Sheet

Job: 14761305-1

Date and time: 4/6/2014 0715

Name: SARAH HERTESS

Signature:

Phase/Task Number: —

WQ meter make/model: YSI Pro (airmet hire)

WQ meter serial number: 12D101328

Certificate Number*: 20140604_SKH

* use unique identifier (e.g YYYYMMDD_"technician's initials")

Parameter	Standard Solution	Pre-calibration reading	Acceptable range	Calibration Required (Y/N)	Post Calibration Reading
Temperature	10.9 °C	11.0	± 0.5 °C	—	—
pH	(4)	3.95	3.9 - 4.1	Y	4.0
	7	7.01	6.9 - 7.1	N	—
	~~10~~	—	9.9 – 10.1	—	—
Conductivity	~~0~~	—	0.0 - 0.1 mS/cm	—	—
	2.76 mS/cm @ 25 °C	—	± 5%	—	—
	2.02 mS/cm @ ~~11~~ °C	1.95	± 5%	N	—
Dissolved Oxygen	0% Saturation Solution	0	± 0.1 ppm	N	—
	Ambient Air 11.6	10.6	± 0.5 ppm of value on Table A overleaf	N	—
Redox	241 mV @ 25 °C	250	± 10 mV	N	—

GAP Form No. 61
RL1
November 2013

Water Quality Meter Calibration Sheet

Golder Associates

Job	147613051	Task Number	-
Date and time	5/6/14 7.20cm	WQ meter make/model:	YSI Pro (airmet hire)
Name:	Freya Aman	WQ meter serial number:	12D101326
Signature:		Certificate Number*	20140605_FRA

* use unique identifier (e.g YYYYMMDD_"technicians initials")

Parameter	Standard Solution	Precalibration reading	Acceptable range	Calibration Required (Y/N)	Post Calibration Reading
Temperature	11.3 °C	11.5	± 0.5 °C	-	-
pH	(4)	3.90	~~9.9 - 10.1~~	Y	3.99
	7	7.13	6.9 - 7.1	Y	7.00
	~~10~~	-	3.9 - 4.1	-	
Conductivity	~~0~~	-	0.0 - 0.1 mS/cm	-	
	2.76 mS/cm @ 25°c °C	1.98	± 5%	N	
	~2.02 @ 11°c mS/cm @ °C		± 5%		
Dissolved Oxygen	0% Saturation	0	± 0.1 ppm	N	
	Ambient Air 16.7.14	10.2	± 0.5 ppm of value on Table A overleaf	N	
Redox	241 mS/cm @ 25°c °C	253	± 10 mV	~~249~~ Y	249. (@11°c)

Comments (including any additional repairs or services performed)

Primary Duplicates

			SDG	EM1405428	EM1405428		EM1405428	EM1405428		EM1405428	EM1405428		EM1405428	EM1405428	
			Field_ID	14/5001_20140603	14/5801_20140603	RPD	14/5002_20140603	14/5802_20140603	RPD	3/5001_20140603	3/5801_20140603	RPD	13/5001_20140603	13/5801_20140603	RPD
			Sampled_Date-Time	3/06/2014 15:00	3/06/2014 15:00		3/06/2014 15:00	3/06/2014 15:00		3/06/2014 15:00	3/06/2014 15:00		3/06/2014 15:00	3/06/2014 15:00	
Chem_Group	ChemName	Units	EQL												
Heavy Metals	Antimony	mg/l	0.001 : 0.005 (Interlab)	0.014	0.014	0	0.015	0.015	0	0.007	0.005	33	0.006	0.006	0
	Antimony (Filtered)	mg/l	0.001 : 0.005 (Interlab)	0.014	0.014	0	0.014	0.014	0	0.004	0.004	0	0.005	0.005	0
	Arsenic	mg/l	0.001	<0.001	<0.001	0	<0.001	<0.001	0	<0.001	<0.001	0	<0.001	<0.001	0
	Arsenic (Filtered)	mg/l	0.001	<0.001	<0.001	0	<0.001	<0.001	0	<0.001	<0.001	0	<0.001	<0.001	0
	Cadmium	mg/l	0.0001 : 0.0002 (Interlab)	<0.0001	0.0001	0	**0.0002**	**<0.0001**	**67**	0.0008	0.0009	12	0.0004	0.0004	0
	Cadmium (Filtered)	mg/l	0.0001 : 0.0002 (Interlab)	<0.0001	<0.0001	0	<0.0001	<0.0001	0	0.0006	0.0006	0	0.0003	0.0003	0
	Copper	mg/l	0.001	0.052	0.063	19	**0.122**	**0.024**	**134**	<0.001	<0.001	0	0.019	0.012	45
	Copper (Filtered)	mg/l	0.001	0.026	0.03	14	**0.004**	**0.002**	**67**	<0.001	<0.001	0	0.022	0.019	15
	Iron	mg/l	0.05	<0.05	<0.05	0	0.13	0.08	48	<0.05	<0.05	0	<0.05	<0.05	0
	Iron (Filtered)	mg/l	0.05	<0.05	<0.05	0	<0.05	<0.05	0	<0.05	<0.05	0	0.08	0.09	12
	Lead	mg/l	0.001	0.001	0.001	0	**0.01**	**0.003**	**108**	0.004	0.004	0	0.001	0.001	0
	Lead (Filtered)	mg/l	0.001	<0.001	<0.001	0	<0.001	<0.001	0	<0.001	<0.001	0	<0.001	0.001	0
	Nickel	mg/l	0.001	0.001	0.001	0	0.001	0.001	0	<0.001	<0.001	0	<0.001	<0.001	0
	Nickel (Filtered)	mg/l	0.001	0.001	<0.001	0	0.001	<0.001	0	<0.001	<0.001	0	<0.001	<0.001	0
	Zinc	mg/l	0.005 : 0.001 (Interlab)	1.98	1.96	1	2.28	2.08	9	5.73	5.77	1	1.2	1.16	3
	Zinc (Filtered)	mg/l	0.005 : 0.001 (Interlab)	1.62	1.87	14	1.74	1.93	10	5.8	5.76	1	1.3	1.39	7
Sample Quality Parameters	pH (Lab)	pH_Units	0.01 : 0.1 (Interlab)	7.19	7.18	0	7.17	7.19	0	6.88	6.92	1	7.26	7.25	0
	Total Dissolved Solids @180°C	mg/l	10	56	61	9	55	62	12	28	38	30	58	65	11
	Sulphate (as SO4) (Filtered)	mg/l	1	1	<1	0	<1	<1	0	<1	<1	0	<1	<1	0

*RPDs have only been considered where a concentration is greater than 0 times the EQL.
**High RPDs are in bold (Acceptable RPDs for each EQL multiplier range are: 50 (0-10 x EQL); 50 (10-30 x EQL); 50 (> 30 x EQL)
***Interlab Duplicates are matched on a per compound basis as methods vary between laboratories. Any methods in the row header relate to those used in the primary laborator

Primary Duplicates

			SDG	EM1405428	EM1405428		EM1405428	EM1405428	
			Field_ID	4/5001_20140603	4/5801_20140603	RPD	13/5002_20140603	13/5802_20140603	RPD
			Sampled_Date-Time	3/06/2014 15:00	3/06/2014 15:00		3/06/2014 15:00	3/06/2014 15:00	
Chem_Group	ChemName	Units	EQL						
Heavy Metals	Antimony	mg/l	0.001 : 0.005 (Interlab)	0.023	0.023	0	0.006	0.006	0
	Antimony (Filtered)	mg/l	0.001 : 0.005 (Interlab)	0.021	0.021	0	0.005	0.005	0
	Arsenic	mg/l	0.001	<0.001	<0.001	0	<0.001	<0.001	0
	Arsenic (Filtered)	mg/l	0.001	<0.001	<0.001	0	<0.001	<0.001	0
	Cadmium	mg/l	0.0001 : 0.0002 (Interlab)	0.0001	<0.0001	0	0.0001	<0.0001	0
	Cadmium (Filtered)	mg/l	0.0001 : 0.0002 (Interlab)	<0.0001	<0.0001	0	<0.0001	<0.0001	0
	Copper	mg/l	0.001	0.005	0.005	0	<0.001	<0.001	0
	Copper (Filtered)	mg/l	0.001	0.005	0.005	0	<0.001	<0.001	0
	Iron	mg/l	0.05	<0.05	<0.05	0	<0.05	<0.05	0
	Iron (Filtered)	mg/l	0.05	<0.05	<0.05	0	<0.05	<0.05	0
	Lead	mg/l	0.001	<0.001	<0.001	0	<0.001	<0.001	0
	Lead (Filtered)	mg/l	0.001	<0.001	<0.001	0	<0.001	<0.001	0
	Nickel	mg/l	0.001	<0.001	<0.001	0	<0.001	<0.001	0
	Nickel (Filtered)	mg/l	0.001	<0.001	<0.001	0	<0.001	<0.001	0
	Zinc	mg/l	0.005 : 0.001 (Interlab)	1.92	1.92	0	0.605	0.593	2
	Zinc (Filtered)	mg/l	0.005 : 0.001 (Interlab)	1.76	1.06	50	0.608	0.626	3
Sample Quality Parameters	pH (Lab)	pH_Units	0.01 : 0.1 (Interlab)	6.7	7.32	9	7.28	7.26	0
	Total Dissolved Solids @180°C	mg/l	10	27	30	11	48	56	15
	Sulphate (as SO4) (Filtered)	mg/l	1	<1	<1	0	<1	<1	0

*RPDs have only been considered where a concentration is greater than 0 times the EQL.
**High RPDs are in bold (Acceptable RPDs for each EQL multiplier range are: 50 (0-10 x EQL); 50 (10-30 x EQL); 50 (> 30 x EQL)
***Interlab Duplicates are matched on a per compound basis as methods vary between laboratories. Any methods in the row header relate to those used in the primary laborator

Secondary Dulplicates

			SDG	EM1405428	Interlab_D		EM1405428	Interlab_D		EM1405428	Interlab_D		EM1405428	Interlab_D	
			Field_ID	3/5001_20140603	3/5901_20140603	RPD	13/5001_20140603	13/5901_20140603	RPD	14/5001_20140603	14/5901_20140603	RPD	4/5001_20140603	4/5901_20140603	RPD
			Sampled_Date-Time	3/06/2014 15:00	3/06/2014 15:00		3/06/2014 15:00	3/06/2014 15:00		3/06/2014 15:00	3/06/2014 15:00		3/06/2014 15:00	3/06/2014 15:00	
Chem_Group	ChemName	Units	EQL												
Heavy Metals	Antimony	mg/l	0.001 : 0.005 (Interlab)	0.007	<0.005	33	0.006	<0.005	18	0.014	0.01	33	0.023	0.015	42
	Antimony (Filtered)	mg/l	0.001 : 0.005 (Interlab)	0.004	<0.005	22	0.005	<0.005	0	0.014	0.01	33	0.021	0.015	33
	Arsenic	mg/l	0.001	<0.001	<0.001	0	<0.001	<0.001	0	<0.001	<0.001	0	<0.001	<0.001	0
	Arsenic (Filtered)	mg/l	0.001	<0.001	<0.001	0	<0.001	<0.001	0	<0.001	<0.001	0	<0.001	<0.001	0
	Cadmium	mg/l	0.0001 : 0.0002 (Interlab)	0.0008	0.0006	29	**0.0004**	**0.0002**	**67**	<0.0001	<0.0002	0	**0.0001**	**<0.0002**	**67**
	Cadmium (Filtered)	mg/l	0.0001 : 0.0002 (Interlab)	0.0006	0.0006	0	0.0003	0.0003	0	<0.0001	<0.0002	0	<0.0001	<0.0002	0
	Copper	mg/l	0.001	<0.001	0.001	0	0.019	0.017	11	0.052	0.063	19	0.005	0.007	33
	Copper (Filtered)	mg/l	0.001	<0.001	0.001	0	0.022	0.016	32	**0.026**	**0.048**	**59**	0.005	0.007	33
	Iron	mg/l	0.05	**<0.05**	**0.32**	**146**	**<0.05**	**0.12**	**82**	**<0.05**	**0.37**	**152**	<0.05	<0.05	0
	Iron (Filtered)	mg/l	0.05	<0.05	<0.05	0	0.08	<0.05	46	<0.05	<0.05	0	<0.05	<0.05	0
	Lead	mg/l	0.001	**0.004**	**0.008**	**67**	0.001	0.001	0	0.001	0.001	0	<0.001	<0.001	0
	Lead (Filtered)	mg/l	0.001	<0.001	<0.001	0	<0.001	0.001	0	<0.001	<0.001	0	<0.001	<0.001	0
	Nickel	mg/l	0.001	<0.001	<0.001	0	<0.001	<0.001	0	0.001	0.001	0	<0.001	<0.001	0
	Nickel (Filtered)	mg/l	0.001	<0.001	<0.001	0	<0.001	<0.001	0	0.001	0.001	0	<0.001	<0.001	0
	Zinc	mg/l	0.005 : 0.001 (Interlab)	**5.73**	**9.7**	**51**	1.2	1.3	8	1.98	2	1	1.92	2	4
	Zinc (Filtered)	mg/l	0.005 : 0.001 (Interlab)	5.8	7.4	24	1.3	1.3	0	1.62	2	21	1.76	2	13
Sample Quality Parameters	pH (Lab)	pH_Units	0.01 : 0.1 (Interlab)	6.88	6	14	7.26	6.5	11	7.19	6.6	9	6.7	6.4	5
	Total Dissolved Solids @180°C	mg/l	10	28	31	10	58	59	2	56	76	30	27	36	29
	Sulphate (as SO4) (Filtered)	mg/l	1	<1			<1			1			<1		

*RPDs have only been considered where a concentration is greater than 0 times the EQL.
**High RPDs are in bold (Acceptable RPDs for each EQL multiplier range are: 50 (0-10 x EQL); 50 (10-30 x EQL); 50 (> 30 x EQL)
***Interlab Duplicates are matched on a per compound basis as methods vary between laboratories. Any methods in the row header relate to those used in the primary laborator

ATTACHMENT C

Limitations

LIMITATIONS

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APPENDIX B

Soil Monitoring – Factual Report

16 June 2014 Reference No. 147613051-004-L-Rev0

Mr John Mitas
Chair of Government Reference Group
Operations General Manager
Department of State Development, Business and Innovation
Level 9, 121 Exhibition Street
Melbourne, 3000
Victoria

SOIL MONITORING FACTUAL REPORT, COSTERFIELD

Dear John

1.0 INTRODUCTION

Golder Associates Pty Ltd (Golder) was commissioned by the Department of State Development, Business and Innovation (DSDBI) to undertake a preliminary assessment of shallow surface soils in Costerfield, Victoria (the assessment area).

2.0 OBJECTIVE AND SCOPE OF WORKS

The objective of this study was to undertake a preliminary assessment of antimony levels in shallow soils within the assessment area from domestic surface soils and along roadways. The scope of works undertaken comprised:

- Collection of a total of 91 soil samples including:
  - 66 shallow soil samples from exposed soil at 33 properties within the assessment area and 1 property outside the Costerfield area;
  - 10 deeper soil samples (up to 20 cm to 30 cm below ground level) at selected shallow soil locations; and
  - 15 shallow soil samples were collected from roadways.
- The preliminary assessment program was conducted in a manner consistent with the following:
  - GoV (2002). *State Environment Protection Policy (Prevention and Management of Contamination of Land). Victorian Government Gazette, No. S 95*. Government of Victoria (GoV), June 2002.
  - NEPC (2013). *Amended National Environment Protection Measure (Assessment of Site Contamination) 1999*. National Environment Protection Council (NEPC), May 2013.
  - Australian Standard (AS) 4482.1-2005 (1997). *Guide to the investigation and sampling of sites with potentially contaminated soil. Part 1: Non-volatile and semi-volatile compounds*.
- Assessment of analytical results against site specific screening levels developed during Department of Health (DHS) Personal Communication and Golder calculations consistent with the NEPC 2013.

Further detail on the methodology and assessment criteria is presented in **Attachment A**.

3.0 DATA QUALITY ASSURANCE AND QUALITY CONTROL

The field and laboratory procedures implemented for quality assurance/quality control (QA/QC) along with a discussion of the QA/QC results are presented in **Attachment B**.

Quality control samples collected as part of the sampling program included collection of field duplicates and field splits at a rate of at least 5 per cent, collection of rinsate blanks and container blanks. The laboratories implemented a Quality Control (QC) program including analysis of internal spikes, duplicates and method blanks.

Results for the overall QC completeness assessment are provided below in Table 2.

Table 1: Summary of QC Data Completeness

QC Sample Type	Number of Results NOT Meeting Data Quality Objectives	Total Number of Results (Individual Analytes)	Percentage Meeting Data Quality Objectives
Primary Duplicates	4	40	90%
Secondary Duplicates	6	50	88%
Rinsates	0	39	100%
Internal Duplicates	1	117	99.1%
Matrix Spikes	0	17	100%
Method Blanks	0	55	100%
Overall Completeness	11	318	96.5%

Discussion on the completeness of each QC sample type is presented in **Attachment C**. The achieved overall completeness of 96.5% is above the overall completeness objective of 95%. Based on this outcome, Golder considers that the overall data quality generated during the assessment is of sufficient quality upon which to base decisions for this assessment.

4.0 RESULTS

A total of 91 samples were collected and submitted to ALS Environmental Laboratories for analysis. The analytical results have been tabulated and screened against guideline criteria. This data is presented in **Table A**.

As antimony is the main chemical of interest. A summary of the analytical results is presented in **Table 1** below.

Table 2: Summary of antimony analytical results

Sample Location	Sample depth	Number of samples	Range of reported results (mg/kg)	Adopted screening criterion	Number of samples exceeding adopted health screening level
Residential Properties	Surface scrape	66	<5 -4,230	site specific criterion (200 mg/kg)	17
	Subsurface	10	<5 - 2310		2
Roads	Surface scrape	15	<5 - 3540		3
TOTAL		91			22

The preliminary assessment of antimony results collected from surface soils within the assessment area found:

- Approximately one third of the reported antimony results are above the site specific health screening criterion.
- Antimony levels exceeded site specific health screening criterion in at least one soil sample at 13 of the 34 properties sampled. The single property sampled outside the Costerfield area did not report antimony levels above the site specific health screening criterion.
- Antimony levels exceeded site specific health screening criterion at 3 of 15 roadways sampled.

5.0 LIMITATIONS

Your attention is drawn to the document - "Limitations", which is included in Attachment C of this letter. The statements presented in this document are intended to advise you of what your realistic expectations of this report should be. The document is not intended to reduce the level of responsibility accepted by Golder, but rather to ensure that all parties who may rely on this report are aware of the responsibilities each assumes in so doing.

6.0 CLOSURE

If you have any questions please do not hesitate to contact the undersigned.

Yours sincerely

GOLDER ASSOCIATES PTY LTD

Nic Foot
Senior Environmental Engineer

Christian Wallis
Principal Environmental Scientist

NF/CJW/nf

CC: The Government Reference Group

Attachments: Table A – Analytical Results
Attachment A – Sampling Methodology
Attachment B – Data Quality Assurance and Quality Control
Attachment C - Limitations

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Golder Associates

Table A: Analytical Results

Soil Monitoring
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						Unknown	Exchangable Cations				Heavy Metals					Other	Sample Quality Parameters			
						PH_CACL2	Exchangeable Calcium	Exchangeable Magnesium	Exchangeable Potassium	Exchangeable Sodium	Aluminium	Antimony	Arsenic	Iron	Manganese	CEC	Electrical Conductivity @ 25°C	Sulphate (as SO4)	Total Organic Carbon	Moisture
						pH Unit	%	%	%	%	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	meq/kg	uS/cm	mg/kg	mg/kg	%
LOR						0.1	0.1	0.1	0.1	0.1	50	5	5	50	5	1	1	50	200	1
NEPM 2013 HIL- Residential A Soil												200	100		3800					
Property ID	**Field_ID**	**Sampled_Date_Time**	**Sample_Point**	**Sample Description**	**SDG**															
1	1/4001_20140603	3/06/2014	surface	Clayey SILT, Brown, trace organics	EM1405428	5.9	-	-	-	-	9,680	697	126	82,500	533	-	19	-	-	41.7
1	1/4002_20140603	3/06/2014	surface	sandy SILT, dark brown, some organic matter	EM1405428	6.1	-	-	-	-	6,780	4,230	186	34,700	189	-	90	-	-	38.2
2	2/4001_20140604	4/06/2014	surface	silty CLAY, med plasticity, red-brwon, trace fine grained gravel	EM1405497	5	-	-	-	-	10,800	126	16	59,900	76	-	428	-	-	17.2
2	2/4002_20140604	4/06/2014	surface	silty CLAY, med plasticity, brown	EM1405497	5.3	-	-	-	-	14,300	168	22	63,700	157	-	36	<50	-	26.4
2	2/4003_20140604	4/06/2014	subsurface	Silty CLAY, med-high plasticity, orange-brown	EM1405497	4.5	-	-	-	-	22,300	<5	6	40,000	42	-	14	60	-	24.3
3	3/4001_20140603	3/06/2014	surface	Clayey SILT, Brown, trace organics	EM1405428	4.6	-	-	-	-	9,720	97	18	36,800	110	-	36	-	-	17.6
3	3/4002_20140603	3/06/2014	surface	Clayey SILT, Brown, trace organics and charcoal fragments	EM1405428	4.8	-	-	-	-	8,170	76	15	33,800	261	-	53	-	-	20.1
4	4/4001_20140603	3/06/2014	surface	clayey SILT, dark brown with some medium grained sand	EM1405428	6.6	-	-	-	-	4,480	8	<5	7,980	714	-	1,390	-	-	49.4
4	4/4002_20140603	3/06/2014	surface	clayey SILT, brown, trace fine grained sand	EM1405428	5.5	-	-	-	-	3,900	72	9	6,590	128	-	7	-	-	15.1
5	5/4001_20140603	3/06/2014	surface	Clayey SILT. Brown, trace organics	EM1405428	5.3	-	-	-	-	7,100	592	68	19,800	132	-	16	-	-	27.6
5	5/4002_20140603	3/06/2014	surface	sandy SILT, dark brown, some organic matter	EM1405428	4.6	-	-	-	-	2,640	125	<5	4,240	438	-	31	-	-	48.7
6	6/4001_20140604	4/06/2014	surface	sandy clayey SILT, brown, trace f-m grained gravel	EM1405497	4.7	-	-	-	-	7,660	1,040	115	32,000	184	-	12	-	-	22.6
6	6/4002_20140604	4/06/2014	surface	sandy clayey SILT, brown, trace f-m grained gravel	EM1405497	4.7	-	-	-	-	10,700	181	31	50,700	302	-	13	-	-	29
7	7/4001_20140603	3/06/2014	surface	sandy gravelly SILT	EM1405428	6.2	-	-	-	-	8,610	908	124	69,600	131	-	20	-	-	17.3
7	7/4002_20140603	3/06/2014	surface	silty sandy GRAVEL	EM1405428	5.4	-	-	-	-	11,500	10	<5	14,600	91	-	20	-	-	8.8
8	8/4001_20140603	3/06/2014	surface	Clayey SILT, brown	EM1405428	4.4	-	-	-	-	11,800	<5	7	22,500	1,170	-	24	-	-	19.9
8	8/4002_20140603	3/06/2014	surface	sandy SILT with some clay, dark brown, trace organics	EM1405428	5.4	-	-	-	-	7,740	28	12	17,500	697	-	176	<50	-	14.8
8	8/4003_20140603	3/06/2014	subsurface	sandy SILT, brown with some clay	EM1405428	7.3	-	-	-	-	7,000	189	45	20,000	452	-	376	250	-	10.2
9	9/4001_20140602	2/06/2014	surface	sandy SILT, brown- black, fine to medium grained sand with trace organics	EM1405374	5.3	-	-	-	-	7,140	244	27	19,000	318	-	48	-	-	49.9
9	9/4003_20140602	2/06/2014	surface	sandy SILT, brown- black, fine to medium grained sand, some med grained angular gravel, with trace organics	EM1405374	4.5	2.2	1.2	0.4	<0.1	9,020	200	14	44,800	141	38	29	<50	46,700	23.8
10	10/4001_20140604	4/06/2014	surface	clayey SILT, brown, trace sand	EM1405497	4.8	-	-	-	-	6,540	190	11	15,800	77	-	14	-	-	21.6
10	10/4002_20140604	4/06/2014	surface	clayey SILT, brown, trace sand	EM1405497	5.2	-	-	-	-	6,250	44	6	11,800	299	-	12	-	-	23.6
10	10/4003_20140604	4/06/2014	subsurface	Clayey gravelly SILT, pale brown, fine-med grain gravel	EM1405497	4.5	-	-	-	-	6,100	10	22	67,300	16	-	21	-	-	9
11	11/4001_20140605	5/06/2014	surface	sandy SILT , brown, med grained sand, trace organics	EM1405562	5.6	-	-	-	-	3,740	3,140	236	8,860	125	-	25	-	-	23.9
11	11/4002_20140605	5/06/2014	surface	sandy SILT, dark brown, some organic matter	EM1405562	5.2	-	-	-	-	1,280	89	<5	3,770	351	-	53	-	-	43.7
12	12/4001_20140604	4/06/2014	surface	gravelly SAND, dark brown, fine grained gravel with some silt	EM1405497	6.6	-	-	-	-	3,770	35	23	7,340	140	-	142	-	-	15.5
12	12/4002_20140604	4/06/2014	surface	sandy SILT with some clay, brown, med-grained sand	EM1405497	6.9	-	-	-	-	5,650	116	34	32,400	380	-	44	-	-	12.6
13	13/4001_20140603	3/06/2014	surface	clayey SILT, brown, with some organics	EM1405428	5.5	-	-	-	-	5,060	182	16	8,260	436	-	36	<50	-	37.8
13	13/4002_20140603	3/06/2014	surface	clayey SILT, brown, with some organics	EM1405428	6	-	-	-	-	4,320	26	25	37,600	1,180	-	114	-	-	33.8
14	14/4001_20140603	3/06/2014	surface	sandy SILT, dark brown, high organic content	EM1405428	7.1	-	-	-	-	13,400	114	10	21,500	610	-	141	-	-	44.7
14	14/4002_20140603	3/06/2014	surface	clayey SILT, brown, some organic matter	EM1405428	5.3	-	-	-	-	6,870	73	19	16,100	128	-	50	-	-	31.4
15	15/4001_20140604	4/06/2014	surface	sandy SILT, dark brown, some fine grained gravel, trace clay	EM1405497	7.4	-	-	-	-	5,660	50	12	13,300	298	-	164	-	-	29.6
15	15/4002_20140604	4/06/2014	surface	sandy SILT, dark brown, trace clay and subrounded medium grained gravel	EM1405497	6.1	-	-	-	-	6,780	112	33	36,700	328	-	41	-	-	35.7
16	16/4001_20140602	2/06/2014	surface	sandy SILT, brown, fine grain sand, trace clay	EM1405374	6.5	9.2	1.8	0.6	<0.1	5,080	20	8	11,200	306	115	50	<50	31,800	26.5
16	16/4002_20140602	2/06/2014	surface	sandy SILT, brown, fine grain sand, trace clay	EM1405374	4.7	-	-	-	-	4,850	67	11	22,100	235	-	13	-	-	22.7
18	18/4001_20140603	3/06/2014	surface	sandy CLAY, brown, fine grain sand	EM1405428	5.1	-	-	-	-	6,000	613	72	27,900	264	-	14	-	-	27.6
18	18/4002_20140603	3/06/2014	surface	sandy SILT, brown, fine grained sand	EM1405428	5.5	-	-	-	-	5,490	195	20	23,500	299	-	58	<50	-	28.6
18	18/4003_20140603	3/06/2014	subsurface	clayey SILT, pale brown	EM1405428	6.3	-	-	-	-	7,430	10	14	31,400	100	-	22	<50	-	8.3
20	20/4001_20140604	4/06/2014	surface	clayey SILT, grey brown, trace organics	EM1405497	5.5	-	-	-	-	6,100	930	106	24,000	228	-	57	-	-	37
20	20/4002_20140604	4/06/2014	surface	clayey SILT, grey brown	EM1405497	6.4	-	-	-	-	3,910	600	37	10,200	323	-	136	-	-	13.5
20	20/4003_20140604	4/06/2014	subsurface	clayey SILT, grey brown	EM1405497	5.7	-	-	-	-	7,310	791	79	55,500	42	-	28	-	-	17
21	21/4001_20140603	3/06/2014	surface	sandy SILT, dark brown, coarse sand, some organic matter	EM1405428	5.3	-	-	-	-	4,120	331	28	25,400	197	-	108	-	-	31.9
21	21/4002_20140603	3/06/2014	surface	sandy SILT, dark brown, coarse sand, trace organic matter	EM1405428	6.4	-	-	-	-	4,450	410	21	8,640	493	-	179	<50	-	44.5
21	21/4003_20140603	3/06/2014	subsurface	sandy SILT, dark brown, coarse sand	EM1405428	6.4	-	-	-	-	7,330	2,310	367	23,600	236	-	89	<50	-	15.5
22	22/4001_20140603	3/06/2014	surface	silty SAND, coarse grained, dark brown, organics	EM1405428	5.4	-	-	-	-	2,700	11	5	3,030	95	-	24	<50	-	47.3
22	22/4002_20140603	3/06/2014	surface	sandy SILT, brown, fine-med grain sand	EM1405428	4.8	-	-	-	-	3,540	212	13	6,810	160	-	19	-	-	33.8
23	23/4001_20140605	5/06/2014	surface	sandy SILT, dark brown, coarse sand	EM1405562	4.4	-	-	-	-	4,750	92	12	24,000	77	-	16	-	-	37
23	23/4002_20140605	5/06/2014	surface	clayey SILT, dark brown trace coarse grain sand	EM1405562	4.7	-	-	-	-	5,090	60	7	12,300	124	-	22	-	-	28.2
24	24/4001_20140605	5/06/2014	surface	clayey SILT, brown, fine - med grain gravels	EM1405562	4.1	-	-	-	-	8,340	104	9	32,900	42	-	30	-	-	15
24	24/4002_20140605	5/06/2014	surface	clayey SILT, brown, fine - med grain gravels	EM1405562	4.7	-	-	-	-	9,330	14	8	34,300	42	-	21	-	-	16.5
26	26/4001_20140603	3/06/2014	surface	clayey SILT, brown, trace organics	EM1405428	4.6	-	-	-	-	9,970	18	7	31,200	304	-	10	-	-	12.7
26	26/4002_20140603	3/06/2014	surface	clayey SILT, red brown, with gravel	EM1405428	4.2	-	-	-	-	8,690	20	8	33,200	60	-	4	-	-	12.9
27	27/4001_20140604	4/06/2014	surface	clayey SILT, brown, trace organics	EM1405497	4.9	-	-	-	-	3,230	9	<5	5,250	40	-	22	-	-	23.8
27	27/4002_20140604	4/06/2014	subsurface	clayey SILT, brown	EM1405497	4.4	-	-	-	-	11,000	<5	7	18,300	72	-	44	-	-	18.4
27	27/4003_20140604	4/06/2014	surface	clayey SILT, brown, trace organics	EM1405497	5.4	-	-	-	-	4,110	30	5	7,510	277	-	104	-	-	35.9
27	27/4004_20140604	4/06/2014	subsurface	clayey SILT, brown	EM1405497	6.3	-	-	-	-	4,760	16	7	9,500	157	-	84	-	-	15.4
28	28/4001_20140604	4/06/2014	surface	clayey SILT, dark brown, trace organics	EM1405497	6	-	-	-	-	4,730	199	9	9,140	229	-	53	-	-	37.9
28	28/4002_20140604	4/06/2014	surface	clayey SILT, brown, trace organics	EM1405497	4.5	-	-	-	-	3,720	51	<5	6,790	335	-	140	<50	-	35.7
28	28/4003_20140604	4/06/2014	subsurface	clayey SILT, brown, trace organics	EM1405497	4	-	-	-	-	4,190	90	6	7,740	216	-	121	<50	-	11.3
30	30/4001_20140605	5/06/2014	surface	clayey SILT, brown, some fine-med grain gravel	EM1405562	6.8	-	-	-	-	3,050	15	<5	7,450	205	-	323	-	-	19.3
30	30/4002_20140605	5/06/2014	surface	clayey SILT, dark brown, organics	EM1405562	5.3	-	-	-	-	3,470	80	8	17,700	183	-	202	-	-	35.8
32	32/4001_20140605	5/06/2014	surface	sandy SILT, brown, med grain sand, trace clay	EM1405562	4.5	-	-	-	-	4,570	1,920	148	30,100	86	-	8	-	-	22.8
32	32/4002_20140605	5/06/2014	surface	clayey gravelly SILT, brown, fine grain gravel	EM1405562	5.6	-	-	-	-	6,360	62	18	46,500	154	-	19	-	-	15.5
32	32/4003_20140605	5/06/2014	subsurface	clayey SILT, pale brown	EM1405562	3.9	-	-	-	-	6,230	<5	10	36,200	34	-	38	-	-	8.2
34	34/4001_20140605	5/06/2014	surface	silty clayey SAND, brown, fine grain sand	EM1405562	5.5	-	-	-	-	4,380	1,190	93	26,200	142	-	22	-	-	20.4
34	34/4002_20140605	5/06/2014	surface	clayey Sandy SILT, dark brown, organic matter	EM1405562	5.5	-	-	-	-	5,580	1,060	59	16,700	212	-	26	-	-	36.8
36	36/4001_20140602	2/06/2014	surface	silty CLAY, dark red brown	EM1405374	6.2	-	-	-	-	9,080	<5	5	15,700	1,650	-	60	-	-	27.5
36	36/4002_20140602	2/06/2014	surface	silty CLAY, dark brown	EM1405374	5.4	-	-	-	-	4,250	10	<5	8,590	1,150	-	32	-	-	42
37	37/4001_20140605	5/06/2014	surface	snady clayey SILT, brown, fine -med grain sand	EM1405562	4.2	-	-	-	-	4,340	22	8	21,800	44	-	43	-	-	14.1
37	37/4002_20140605	5/06/2014	surface	snady clayey SILT, brown, fine -med grain sand with trace fine grain gravel	EM1405562	5.3	-	-	-	-	4,680	19	7	15,400	130	-	24	-	-	18.2
40	40/4001_20140602	2/06/2014	surface	sandy SILT, red brown, fine grain sand	EM1405374	4.2	-	-	-	-	9,820	87	10	33,600	162	-	14	-	-	13.8
40	40/4002_20140602	2/06/2014	surface	sandy SILT, red brown, fine grain sand with organics	EM1405374	6.5	-	-	-	-	4,680	<5	21	12,700	162	-	63	-	-	20.2
41	41/4001_20140604	4/06/2014	surface	sandy SILT, dark brown, coarse grain sand, trace organics	EM1405497	6.2	-	-	-	-	5,710	126	22	21,500	132	-	55	-	-	38.9
41	41/4002_20140604	4/06/2014	surface	clayey SILT, orange brown	EM1405497	5.2	-	-	-	-	9,420	389	56	48,100	119	-	20	-	-	16.9
42	42/4001_20140605	5/06/2014	surface	clayey SILT, dark brown, trace medium grain sand, trace organics	EM1405562	5.8	-	-	-	-	3,100	141	10	7,420	235	-	99	-	-	37.9
43	43/4001_20140605	5/06/2014	surface	sandy SILT, pale brown, med grained sand, trace organics	EM1405562	4.2	-	-	-	-	2,930	<5	<5	3,250	23	-	35	-	-	10.9
R1	R1/4001_20140605	5/06/2014	roadway	sandy SILT, medium grained sand, pale brown, trace fine grained gravel	EM1405562	6.2	-	-	-	-	2,310	3,540	68	28,700	242	-	38	-	-	14.7
R10	R10/4001_20140604	4/06/2014	roadway	sandy SILT, dark and pale brown, trace fine grained gravel, trace clay	EM1405497	6.3	-	-	-	-	6,110	14	<5	35,900	330	-	64	-	-	17.4
R11	R11/4001_20140605	5/06/2014	roadway	silty SAND, dark brown	EM1405562	7.7	-	-	-	-	3,530	19	<5	33,000	304	-	490	-	-	7.1
R12	R12/4001_20140604	4/06/2014	roadway	silty, gravelly SAND, coarse sand, fine to medium grained gravel, brown	EM1405497	7.3	-	-	-	-	6,770	9	15	45,900	252	-	140	-	-	9.9

					Unknown	Exchangable Cations				Heavy Metals					Other	Sample Quality Parameters			
					PH_CACL2	Exchangeable Calcium	Exchangeable Magnesium	Exchangeable Potassium	Exchangeable Sodium	Aluminium	Antimony	Arsenic	Iron	Manganese	CEC	Electrical Conductivity @ 25°C	Sulphate (as SO4)	Total Organic Carbon	Moisture
					pH Unit	%	%	%	%	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	meq/kg	uS/cm	mg/kg	mg/kg	%
LOR					0.1	0.1	0.1	0.1	0.1	50	5	5	50	5	1	1	50	200	1
NEPM 2013 HIL- Residential A Soil											200	100		3800					
Property ID	**Field_ID**	**Sampled_Date_Time**	**Sample_Point**	**Sample Description**	**SDG**														
R13	R13/4001_20140604	4/06/2014	roadway	gravelly SAND, coarse grained sand, fine to medium grained gravel, pale brown	EM1405497	6.6	-	-	-	-	2,380	<5	<5	6,040	34	-	11	-	-	5.3
R14	R14/4001_20140605	5/06/2014	roadway	silty SAND, coarse grained, pale yellow brown, trace fine grained gravel	EM1405562	7.8	-	-	-	-	4,870	<5	<5	38,200	282	-	47	-	-	12.4
R15	R15/4001_20140605	5/06/2014	roadway	sandy SILT, medium to coarse grained, dark brown, some fine gravel	EM1405562	5.8	-	-	-	-	4,670	43	<5	28,900	219	-	21	-	-	17.6
R2	R2/4001_20140605	5/06/2014	roadway	silty SAND, coarse grained, pale yellow brown, trace fine grained gravel	EM1405562	6.8	-	-	-	-	3,540	14	<5	5,110	32	-	58	-	-	11.8
R3	R3/4001_20140605	5/06/2014	roadway	sandy SILT, yellow brown, medium to coarse grained, trace fine to medium grained gravel	EM1405562	6.3	-	-	-	-	8,800	22	10	35,800	112	-	20	-	-	18.8
R4	R4/4001_20140604	4/06/2014	roadway	silty SAND, medium to coarse grained, angular, pale brown, some fine to medium grained gravel	EM1405497	6.5	-	-	-	-	6,370	<5	<5	13,200	76	-	16	-	-	9.9
R5	R5/4001_20140605	5/06/2014	roadway	sandy SILT, pale brown, medium grained sand, trace fine grained gravel	EM1405562	7.2	-	-	-	-	3,720	1,330	48	37,100	232	-	180	-	-	15.2
R6	R6/4001_20140604	4/06/2014	roadway	sandy SILT, dark brown, trace fine grained gravel, trace clay	EM1405497	7.5	-	-	-	-	4,440	9	<5	35,500	334	-	74	-	-	7.8
R7	R7/4001_20140604	4/06/2014	roadway	sandy SILT, brown, some fine grained gravel, trace clay	EM1405497	7	-	-	-	-	5,690	124	44	48,800	143	-	245	-	-	12.6
R8	R8/4001_20140604	4/06/2014	roadway	sandy SILT, dark brown, fine to medium grained sand, trace organic matter	EM1405497	6	-	-	-	-	9,260	229	13	34,500	381	-	72	-	-	42.7
R9	R9/4001_20140604	4/06/2014	roadway	clayey SILT, dark and pale brown, trace fine grained gravel	EM1405497	6.4	-	-	-	-	7,550	108	8	34,400	312	-	95	-	-	38.5
Statistical Summary																			
Number of Results						91	2	2	2	2	91	91	91	91	91	2	91	14	2	91
Number of Detects						91	2	2	2	0	91	81	74	91	91	2	91	2	2	91
Minimum Concentration						3.9	2.2	1.2	0.4	<0.1	1280	<5	<5	3030	16	38	4	<50	31800	5.3
Minimum Detect						3.9	2.2	1.2	0.4	ND	1280	8	5	3030	16	38	4	60	31800	5.3
Maximum Concentration						7.8	9.2	1.8	0.6	<0.1	22300	4230	367	82500	1650	115	1390	250	46700	49.9
Maximum Detect						7.8	9.2	1.8	0.6	ND	22300	4230	367	82500	1650	115	1390	250	46700	49.9
Average Concentration						5.6					6355	340	32	25240	260		86	44		24
Median Concentration						5.5	5.7	1.5	0.5	0.05	5690	80	12	22500	197	76.5	38	25	39250	20.4
Standard Deviation						0.96					3127	739	55	16848	268		164	60		12
Number of Guideline Exceedances						0	0	0	0	0	0	22	8	0	0	0	0	0	0	0
Number of Guideline Exceedances(Detects Only)						0	0	0	0	0	0	22	8	0	0	0	0	0	0	0

ATTACHMENT A

Sampling Methodology

ATTACHMENT A
SAMPLING METHODOLOGY

Item	Description
Sample Date	2, 3, 4 and 5 June 2014. The following weather observations were made during the sampling event: ■ 2 June 2014 – overcast ■ 3 June 2014 – overcast, light showers in the morning ■ 4 June 2014 – foggy in the morning, sunny afternoon ■ 5 June 2014 – overcast (ground conditions very wet from overnight rain)
Adopted Sampling Guidelines	■ **Australian/New Zealand Standard 4482.1 (2005) Guide to the investigation and sampling of sites with potentially contaminated soil. Part 1: Non-volatile and semi-volatile compounds.** This standard was prepared as part of a series on the identification, analytical methods and investigation procedures for the assessment of soil. The objective of this standard is to derive the information which may be required to satisfy regulatory authorities, although additional detail may be required in some locations. ■ **National Environment Protection (Assessment of Site Contamination) Amendment Measure 2013 (No.1).** This guidance is recognised as the primary national guidance document for the assessment of site contamination in Australia. The purpose of the guideline is to 'establish a nationally consistent approach to the assessment of site contamination to ensure sound environmental management practices by the community which includes regulators, site assessors, environmental auditors, landowners, developers and industry'.
Sample Points	■ **Surface samples:** Exposed soil near main dwelling on accessed properties. ■ **Subsurface samples:** Subsurface soil within assessment area, samples collected 20 cm below the ground surface with one exception where sample was collected 10 cm below the ground surface (a deeper sample was not able to be collected due to hard ground conditions). ■ **Roadway samples:** Exposed soil on dirt roadways within the assessment area.
Number of Primary Soil Samples Collected	■ **Surface samples** – 66 samples ■ **Subsurface samples** – 10 samples ■ **Roadway samples** – 15 samples
Soil collection methodology	■ **Surface and Roadway samples**: To represent exposed soil, the ground surface was gently scraped with either by a gloved hand or clean trowel to collect surface soil. ■ **Subsurface samples**: A hole was dug to half the required depth using a clean shovel. A clean trowel was then used to excavate to required depth. Sample was collected using the trowel and/or gloved hands.

Item	Description
	■ Trowels and shovels were decontaminated between each soil sampling location by first removing any soil adhered to the trowel and shovel, washing the equipment in a bucket with phosphate-free detergent using brushes then rinsed in another bucket of laboratory supplied de-ionised water. ■ Nitrile gloves were replaced between each soil sampling location.
Record of Sample Location	Sampling locations were recorded with hand-held GPS with +/- 10 m accuracy.
Sample Storage	Soil samples were placed in new jars supplied by the laboratory, jars were labelled with a unique identifier.
Sample Delivery	The samples were transferred into chilled, insulated containers and delivered to the laboratory under Chain of Custody (CoC) procedures.
Laboratory for Soil Analysis	The laboratory engaged as the primary laboratory for the analysis was ALS Environmental Pty Ltd which is registered by the National Association of Testing Authority (NATA) for the analyses performed. The secondary laboratory selected for quality assurance testing was MGT Eurofins.
Laboratory Analytical Schedule	Selected samples were designated for analysis of soil pH, electrical conductivity and metals (including antimony, arsenic, aluminium, iron and manganese). Sulphate, total organic carbon (TOC) and cation exchange capacity (CEC) were also analysed for selected samples. At the time of reporting, the analysis had not been reported.
Adopted Assessment Criteria	■ **National Environment Protection (Assessment of Site Contamination) Measure (NEPM), 2013 Health Investigation Levels - Residential A Soil (HIL A).** 'Residential A' soil represents that in areas of low density residential land. ▪ The soil screening criteria were selected based on the objectives of the State Environment Protection Policy (Prevention and Management of Contamination of Land) (Land SEPP).The soil assessment criteria adopted for the protected beneficial use of 'Human Health' in low density residential areas is the NEPM 2013 HIL A. Other beneficial uses of land are not considered in this assessment. ▪ It is noted that an exceedance of the adopted human health criteria does not necessarily indicate an unacceptable risk to human health in relation to the respective land use scenario. Rather, an exceedance would trigger the need for further assessment to understand the risk (under the amended NEPM 2013) and possibly the need for a site-specific human health risk assessment which would evaluate the relevant exposure setting and associated risks. ▪ Victorian Department of Human Services Personal Correspondence Tuesday 10 June 2014 detailed a residential oil guideline of 100-300mg/kh for antimony when people are exposed via soil and drinking water. The recently adopted NEPM (2013) includes a calculator for estimating HIL values for substances. Using the tolerable daily intake of 0.006mg/kg the calculated value is 200mg/kg.

ATTACHMENT B

Data Quality Assurance and Quality Control

Item	Description
QA/QC Objectives	
Data Quality Measures and Objectives	The data quality measures for the assessment are as follows: ■ ***Accuracy:*** A measure of the closeness of the results to the actual results. Accuracy is assessed through the comparison of results produced by the primary and secondary laboratories for the same sample and by the measuring of the extent to which an analytical result reflects the known concentration as measured by the recovery obtained from internal laboratory spikes. ■ ***Precision:*** A measure of the repeatability of results by the laboratory. This is assessed through the analysis of duplicates both internally and externally. ■ ***Completeness:*** The percentage of acceptable data obtained compared to the amount of data needed to achieve a particular level of confidence in the results. The following data quality objectives (DQOs) have been set for this project: ■ primary samples and field duplicates recording Relative Percentage Differences (RPDs) less than 30% for inorganics and less than 50% for organics; ■ primary samples and primary laboratory internal duplicates recording RPDs less than 30% for inorganics and less than 50% for organics; ■ accuracy in spike samples to range between 70% and 130% (for organics and other inorganics); ■ rinsate blanks and primary laboratory method blanks below practical quantitation limits (PQLs), or equal or less than background levels, wherever justified; ■ overall data quality completeness of 95% or greater. The primary and secondary duplicate results for chemical data were compared with primary sample results using RPDs. RPDs were calculated according to the following formula: $$\%RPD = \mathrm{ABS}\left\{\left[\frac{A-B}{A+B}\right]*200\right\}$$ Where: ABS – absolute number A – concentration of the primary laboratory result per analyte B – concentration of corresponding duplicate result. RPD values can range from 0% (indicating perfect correlation between results) to 200% (indicating complete divergence in results).

<table>
<tr><th>Item</th><th>Description</th></tr>
<tr><td colspan="2">QA/QC Methodology</td></tr>
<tr><td>QA/QC Sample Collection</td><td>The following QA/QC samples were collected:
■ Primary and secondary duplicate samples at a frequency of 5.4% against primary samples.
■ Three rinsate samples collected off of reusable trowel; one sample for each of the three days the trowel was used in soil collection.</td></tr>
<tr><td>Minimisation of cross-contamination</td><td>Golder staff used new nitrile gloves for collection of each soil sample and decontaminated reusable equipment between each location.</td></tr>
<tr><td>Sample Handling and Preservation</td><td>Soil samples were collected into laboratory supplied jars with appropriate Polytetrafluoroethylene lined lids. The collected samples were immediately placed in a chilled and insulated container with ice and stored in this manner prior to and during transit to the laboratory.</td></tr>
<tr><td>Laboratory Internal QC</td><td>The quality of the laboratory data generated was supported with appropriate laboratory Quality Control (QC) samples and assessed using standard methods. Internal laboratory QC samples including method blanks, laboratory duplicates, matrix spikes, laboratory control sample spikes and surrogate spikes were analysed as part of the quality assurance program.</td></tr>
<tr><td colspan="2">QA/QC Results</td></tr>
<tr><td>Summary of Water QA/QC Results</td><td>
<table>
<tr><th>QC Sample Type</th><th>Number of Results NOT Meeting Data Quality Objectives</th><th>Total Number of Results (Individual Analytes)</th><th>Percentage Meeting Data Quality Objectives</th></tr>
<tr><td>Primary Duplicates</td><td>4</td><td>40</td><td>90%</td></tr>
<tr><td>Secondary Duplicates</td><td>6</td><td>50</td><td>88%</td></tr>
<tr><td>Rinsates</td><td>0</td><td>39</td><td>100%</td></tr>
<tr><td>Internal Duplicates</td><td>1</td><td>117</td><td>99.1%</td></tr>
<tr><td>Matrix Spikes</td><td>0</td><td>17</td><td>100%</td></tr>
<tr><td>Method Blanks</td><td>0</td><td>55</td><td>100%</td></tr>
<tr><td>Overall Completeness</td><td>11</td><td>318</td><td>96.5%</td></tr>
</table>
</td></tr>
<tr><td>Discussion of Results</td><td>■ Five primary and five secondary duplicate samples were analysed during the assessment and a total 93 primary soil samples analysed. This equates to an analysis frequency of 5.4% for collection duplicate samples. This complies with the specified collection rate of 5%. Primary and secondary analytical results are presented in Table B-1 at the back of this attachment.
■ Of the 40 primary duplicate analytes, four returned RPDs above 50%, representing a non-conformance level of 90%. The non-conformances were</td></tr>
</table>

Item	Description
	observed for one each for aluminium (RPD of 57), arsenic (RPD of 79), antimony (RPD of 50) and iron (RPD of 61). ■ Of the 50 secondary duplicate analytes, 6 returned RPDs above 50%, representing a non-conformance level of 88%. Non-conformances, with RPDs ranging between 51 and 134, were observed for electrical conductivity (one result, RPD of 52) and metals including arsenic (three results, RPDs of 57, 111 and 117), antimony (one result, RPD of 134), manganese (one result, RPD of 127). ■ The non-conformances observed in both primary and secondary duplicates are likely due to the heterogeneous nature of the surface soil and difficulties obtaining true duplicates from the field splitting process. Due to an objective of taking only a surface sample, a large area of exposed soil was required for collecting duplicate samples. Primary and secondary analytical results are presented in Table B-1 at the back of this attachment. It is considered unlikely that the non-conformance will affect the overall quality or outcome of the assessment. ■ None of the 39 rinsate analysis results reported levels above the laboratory limit of reporting. This represents compliance of 100%. ■ A review of the RPDs for the Internal duplicate tests indicates that 1 of the 117 tests conducted did not produce results within the desired 30% RPD conformance limit. This result represents a compliance of 99.1%. It is considered unlikely that the non-conformance will affect the overall quality or outcome of the assessment. ■ A review of the 17 Matrix Spike results indicates that all analyses provided a recovery beyond 70-130%, representing a conformance level of 100%. ■ A review of the Method Blank tests indicates that all of the 55 laboratory internal blanks analytes were below laboratory reporting limit, representing compliance of 100%. The achieved QA/QC completeness of 95.9% is above the overall completeness objective of 95%. Based on this outcome, it is considered that the overall data quality generated during the assessment of water by Golder is of sufficient quality upon which to base decisions for this assessment.

Primary Duplicates

			SDG	EM1405428	EM1405428		EM1405428	EM1405428		EM1405428	EM1405428		EM1405428	EM1405428		EM1405428	EM1405428	
			Field_ID	14/4001_20140603	14/4801_20140603	RPD	14/4002_20140603	14/4802_20140603	RPD	3/4001_20140603	3/4801_20140603	RPD	13/4001_20140603	13/4801_20140603	RPD	4/4001_20140603	4/4801_20140603	RPD
			Sampled_Date-Time	3/06/2014 15:00	3/06/2014 15:00		3/06/2014 15:00	3/06/2014 15:00		3/06/2014 15:00	3/06/2014 15:00		3/06/2014 15:00	3/06/2014 15:00		3/06/2014 15:00	3/06/2014 15:00	
Chem_Group	**ChemName**	**Units**	**EQL**															
Heavy Metals	Aluminium	mg/kg	50 : 10 (Interlab)	**13400**	**7420**	**57**	6870	7640	11	9720	9710	0	5060	5170	2	4480	5460	20
	Antimony	mg/kg	5 : 10 (Interlab)	114	120	5	73	83	13	**97**	**58**	**50**	182	155	16	8	8	0
	Arsenic	mg/kg	5 : 2 (Interlab)	10	10	0	**19**	**44**	**79**	18	16	12	16	20	22	<5	5	0
	Iron	mg/kg	50 : 5 (Interlab)	21500	20600	4	16100	17000	5	36800	29400	22	**8260**	**15500**	**61**	7980	10700	29
	Manganese	mg/kg	5	610	673	10	128	116	10	110	106	4	436	430	1	714	504	34
Sample Quality Parameters	Electrical Conductivity @ 25°C	uS/cm	1 : 10 (Interlab)	141	127	10	50	66	28	36	38	5	36	37	3	1390	1780	25
	Moisture	%	1 : 0.1 (Interlab)	44.7	40.5	10	31.4	34.4	9	17.6	18.1	3	37.8	37.9	0	49.4	43.3	13
Unknown	PH_CACL2	pH Unit	0.1	7.1	7	1	5.3	5.4	2	4.6	4.7	2	5.5	5.5	0	6.6	6.4	3

*RPDs have only been considered where a concentration is greater than 0 times the EQL.
**High RPDs are in bold (Acceptable RPDs for each EQL multiplier range are: 50 (0-10 x EQL); 50 (10-30 x EQL); 50 (> 30 x EQL)
***Interlab Duplicates are matched on a per compound basis as methods vary between laboratories. Any methods in the row header relate to those used in the primary laborator

Secondary Duplicates

			SDG	EM1405428	Interlab_D		EM1405428	Interlab_D		EM1405428	Interlab_D		EM1405428	Interlab_D		EM1405428	Interlab_D	
			Field_ID	3/4001_20140603	3/4901_20140603	RPD	13/4001_20140603	13/4901_20140603	RPD	4/4001_20140603	4/4901_20140603	RPD	14/4001_20140603	14/4901_20140603	RPD	14/4002_20140603	14/4902_20140603	RPD
			Sampled_Date-Time	3/06/2014 15:00	3/06/2014 15:00		3/06/2014 15:00	3/06/2014 15:00		3/06/2014 15:00	3/06/2014 15:00		3/06/2014 15:00	3/06/2014 15:00		3/06/2014 15:00	3/06/2014 15:00	
Chem_Group	**ChemName**	**Units**	**EQL**															
Heavy Metals	Aluminium	mg/kg	50 : 10 (Interlab)	9720	11000	12	5060	3900	26	4480	7100	45	13400			6870	9100	28
	Antimony	mg/kg	5 : 10 (Interlab)	97	120	21	182	210	14	8	11	32	114			73	110	40
	Arsenic	mg/kg	5 : 2 (Interlab)	**18**	**4.7**	**117**	**16**	**8.9**	**57**	<5	4	22	10			19	18	5
	Iron	mg/kg	50 : 5 (Interlab)	36800	45000	20	8260	10000	19	7980	11000	32	21500			16100	21000	26
	Manganese	mg/kg	5	110	80	32	436	490	12	714	630	13	610			128	110	15
Sample Quality Parameters	Electrical Conductivity @ 25°C	uS/cm	1 : 10 (Interlab)	36	41	13	**36**	**61**	**52**	1390	940	39	141			50	54	8
	Moisture	%	1 : 0.1 (Interlab)	17.6	17	3	37.8	41	8	49.4	49	1	44.7	41	9	31.4	34	8
Unknown	PH_CACL2	pH Unit	0.1	4.6			5.5			6.6			7.1			5.3		

*RPDs have only been considered where a concentration is greater than 0 times the EQL.
**High RPDs are in bold (Acceptable RPDs for each EQL multiplier range are: 50 (0-10 x EQL); 50 (10-30 x EQL); 50 (> 30 x EQL)
***Interlab Duplicates are matched on a per compound basis as methods vary between laboratories. Any methods in the row header relate to those used in the primary laborator

Secondary Duplicates

			SDG	EM1405428	Interlab_D	
			Field_ID	26/4001_20140603	26/4901_20140603	RPD
			Sampled_Date-Time	3/06/2014 15:00	3/06/2014 15:00	
Chem_Group	**ChemName**	**Units**	**EQL**			
Heavy Metals	Aluminium	mg/kg	50 : 10 (Interlab)	9970	13000	26
	Antimony	mg/kg	5 : 10 (Interlab)	**18**	**91**	**134**
	Arsenic	mg/kg	5 : 2 (Interlab)	**7**	<2	**111**
	Iron	mg/kg	50 : 5 (Interlab)	31200	33000	6
	Manganese	mg/kg	5	**304**	**68**	**127**
Sample Quality Parameters	Electrical Conductivity @ 25°C	uS/cm	1 : 10 (Interlab)	10	<10	0
	Moisture	%	1 : 0.1 (Interlab)	12.7	11	14
Unknown	PH_CACL2	pH Unit	0.1			

*RPDs have only been considered where a concentration is greater than 0 times the EQL.
**High RPDs are in bold (Acceptable RPDs for each EQL multiplier range are: 50 (0-10 x EQL); 50 (10-30 x EQL); 50 (> 30 x EQL)
***Interlab Duplicates are matched on a per compound basis as methods vary between laboratories. Any methods in the row header relate to those used in the primary laborator

ATTACHMENT C

Limitations

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APPENDIX C

Interim Air Monitoring – Laboratory Report

13 May 2014 Project No. 147613051-005-L-Rev0

John Mitas
Department of State Development, Business and Innovation
Level 9, 121 Exhibition Street
Melbourne, 3000
VICTORIA

INTERIM AIR MONITORING: LABORATORY REPORT ONE

Dear John,

Golder Associates (Golder) was commissioned by the Department of State Development, Business and Innovation (DSDBI) to undertake interim air quality monitoring at one location in the vicinity of Mandalay Resources gold-antimony operation at Costerfield, Victoria.

The interim monitoring programme scope is summarised in Table 1.

Table 1: Interim Monitoring Programme Scope

Atmospheric Contaminant	Sample Duration	Sample Frequency
PM_{10} [A]	24 hours	One every two days
Particulate metal, measured in the PM_{10} fraction [B]	24 hours	One every two days
$PM_{2.5}$ [C]	24 hours	One every two days
Indicative PM_{10}	Continuous	Continuous
Deposited dust (insoluble solids)	Two weeks	Continuous
Deposited dust (particulate metals) [B]	Two weeks	Continuous

NOTES
A Particulate matter with an equivalent aerodynamic diameter (EAD) less than 10 microns (PM_{10})
B Arsenic, barium, beryllium, cadmium, cobalt, chromium, manganese, nickel, lead, antimony, vanadium, zinc
C Particulate matter with an EAD less than 2.5 microns ($PM_{2.5}$)

The following laboratory report outlines the results from the period 3 June 2014 to 9 June 2014.

The laboratory report is issued in accordance with Golder's National Association of Testing Authorities (NATA) laboratory accreditation, 1910. The results of the tests included in this document are traceable to Australian/national standards. Golder is accredited for compliance with ISO/IEC 17025.

1.0 TEST METHODS

1.1 PM_{10}

Ambient air was drawn at a constant flowrate through a size selective inlet and pre-weighed quartz filter using a High Volume Sampler (HVS). PM_{10} is separated from suspended matter by the size selective inlet and collected on the filter media.

Filter samples were allowed to equilibrate in a temperature and humidity controlled environment before gravimetric analysis.

The weight change of the quartz filter was determined using a Mettler Toledo four figure balance. Control filters were used to check for changes in environmental conditions between weight determinations.

The Mettler Toledo balance was calibrated to comply with NATA specifications (NATA Calibration Report No. BE156143, 26 May 2014).

The method used was in accordance with Golder Test Method *H3: High Volume Sampler (HVS) Operation TSP, PM_{10} and $PM_{2.5}$ Determination – In Ambient Air,* based on Australian Standard AS/NZS 3580.9.6 *Methods for Sampling and Analysis of Ambient Air. Method 9.6: Determination of Suspended Particulate Matter – PM_{10} High Volume Sampler with Size Selective Inlet – Gravimetric Method.*

1.1.1 Particulate Metals (PM_{10} Fraction)

Following gravimetric analysis filter samples were analysed by Inductively Coupled Plasma Mass Spectrometry (ICP-MS) to determine the metals content. Sample analysis was conducted by ALS Sydney, NATA Accreditation No. 825.

1.2 $PM_{2.5}$

Ambient air was drawn at a constant flowrate through a size selective inlet and pre-weighed filter using a High Volume Sampler (HVS). $PM_{2.5}$ is separated from suspended matter by the size selective inlet and collected on the filter media.

Filter samples were allowed to equilibrate in a temperature and humidity controlled environment before gravimetric analysis.

The weight change of the filter was determined using a Mettler Toledo four figure balance. Control filters were used to check for changes in environmental conditions between weight determinations.

The Mettler Toledo balance was calibrated to comply with NATA specifications (NATA Calibration Report No. BE156143, 26 May 2014).

The method used was in accordance with Golder Test Method *H3: High Volume Sampler (HVS) Operation TSP, PM_{10} and $PM_{2.5}$ Determination – In Ambient Air*, based on Australian Standard AS/NZS 3580.9.14 *Methods for Sampling and Analysis of Ambient Air. Method 9.14: Determination of Suspended Particulate Matter – $PM_{2.5}$ High Volume Sampler with Size Selective Inlet – Gravimetric Method*.

1.3 Indicative PM_{10}

Indicative PM_{10} monitoring was conducting using a continuous laser light scattering instrument co-located with the HVS. The measurement technique is not an Australian Standard method, however the indicative results provide a measure of PM_{10} trends and variation during collection of the discrete HVS filter samples.

The instrument was calibrated prior to use and maintenance checks were conducted on a regular basis.

NATA accreditation does not cover indicative instruments.

1.4 Deposited Dust (Insoluble Solids and Metals)

Particles settling from the air are collected in a vessel and contained with any rainwater from the sample period. Sample analysis involves sieving to remove extraneous matter followed by filtration and drying. Insoluble solids content is determined gravimetrically. Metals content is determined by ICP-MS.

2.0 MEASUREMENT UNCERTAINTY

2.1 PM_{10}

AS3580.9.6 estimates the method precision as typically 5 µg/m^3 over the measurement range.

2.1.1 Particulate Metals (PM_{10} Fraction)

The analytical laboratory has not reported a measurement uncertainty for metals determination from HVS filters.

2.2 $PM_{2.5}$

The estimated measurement uncertainty for $PM_{2.5}$ by HVS is ± 5 µg/m^3 over the measurement range.

2.3 Deposited Dust (Insoluble Solids)

The estimated measurement uncertainty for deposited dust (insoluble solids) is ± 0.3 g/m^2/month, at a 95% confidence interval, calculated using a coverage factor of 1.96.

2.3.1 Deposited Dust (Particulate Metals)

The analytical laboratory has not reported a measurement uncertainty for metals determination from dust deposit gauge samples.

3.0 MONITORING LOCATION

The interim air monitoring location is established at a neighbourhood location in a paddock adjacent to the Heathcote-North Costerfield Road. The location is approximately one kilometre north of the Mandalay Resources Brunswick Plant.

Monitoring location details are presented in Table 2.

Table 2: Monitoring Location Details

Element	Monitoring Location
Classification of Area	Neighbourhood
UTM Co-ordinates (m)	302 949 E, 5916 610 S (UTM Zone 55)
Elevation (m)	202
Description	The monitoring location is located in a grassed paddock, approximately 20 m from the nearest building.
Distance from Mandalay Resources	Approximately 1 km
Direction from Mandalay Resources	Approximately north
Extraneous sources	Approximately 90 m from an unsealed road

The monitoring location was selected with consideration of the requirements of Australian Standard AS/NZS 3580.1.1 *Methods for Sampling and Analysis of Ambient Air. Part 1.1: Guide to Siting Air Monitoring Equipment.* An assessment of compliance with the Standard requirements is presented in Table 3.

Table 3: Monitoring Location Compliance Assessment

AS/NZS 3580.1.1 Requirement	Monitoring Location Status	
	PM_{10}, PM_{10} Metals and $PM_{2.5}$	**Deposited Dust**
Height above ground to sampling inlet 1.0 – 5 m	OK	Not applicable
Height above ground to sampling inlet 2.0 ±0.2 m	Not applicable	OK
Clear sky angle 120°	OK	OK
Unrestricted airflow of 270°	OK	Not applicable
Unrestricted airflow of 360°	Not applicable	OK
10 m from the nearest object or dripline of trees that are higher than 2 m below the height of the sample inlet.	OK	OK
No extraneous sources nearby	OK	OK
Greater than 50 m from road	OK	Not applicable

4.0 RESULTS

The interim monitoring programme results are presented in Table 4 and Table 5. Indicative PM_{10} results are presented in Figure 1 with summary statistics presented in Table 6. Deposited dust results are not available for the monitoring period.

Table 4: PM_{10} and PM_{10} Metals Results

Sample Number	**14-449**	**14-450**	**14-451**
Start Date/Time[A]	4/06/2014 00:00	6/06/2014 00:00	8/06/2014 0:00
End Date/Time[A]	4/06/2014 16:48	7/06/2014 0:00	9/06/2014 0:00
Sample Period	16.8 hours[B]	24 hours	24 hours
Size Selective Inlet Manufacturer and Model	PM_{10} Ecotech	PM_{10} Ecotech	PM_{10} Ecotech
Concentration Results (µg/m^3)[C]			
PM_{10}[D]	8.9	6.9	8.9
Arsenic[E]	<0.0005	<0.0004	0.00032
Barium[E]	<0.003	<0.002	<0.002
Beryllium[E]	<0.0005	<0.0004	<0.0004
Cadmium[E]	<0.0005	<0.0004	<0.0004
Cobalt[E]	<0.0005	<0.0004	<0.0004
Chromium[E]	<0.003	<0.002	<0.002
Manganese[E]	<0.0009	0.0019	0.00070
Nickel[E]	<0.0007	0.00045	<0.0005
Lead[E]	<0.002	0.0012	0.00089
Antimony[E]	0.011	0.011	0.0054
Vanadium[E]	<0.004	<0.003	<0.003
Zinc[E]	<0.05	<0.03	<0.03

NOTES
A Eastern standard time
B Sample period was less than the recommended period of 24 hours ± 1 hour due to a power interruption
C Concentration corrected to 0°C and 101.3 kPa
D Sample analysis conducted by Golder, NATA Accreditation Number 1910
E Sample analysis conducted by ALS Sydney, NATA Accreditation Number 825. Laboratory Report Number ES1412728.

Table 5: $PM_{2.5}$ Results

Sample Number	14-444	14-445	14-446
Start Date/Time[A]	4/06/2014 00:00	6/06/2014 00:00	8/06/2014 0:00
End Date/Time[A]	4/06/2014 16:48	7/06/2014 0:00	9/06/2014 0:00
Sample Period	16.8[B]	24 hours	24 hours
Size Selective Inlet Manufacturer and Model	$PM_{2.5}$ Ecotech	$PM_{2.5}$ Ecotech	$PM_{2.5}$ Ecotech
Concentration Results ($\mu g/m^3$)[C]			
$PM_{2.5}$	2.6	2.5	2.8

NOTES
A Eastern standard time
B Sample period was less than the recommended period of 24 hours ± 1 hour due to a power interruption
C Concentration corrected to 0°C and 101.3 kPa. Sample analysis conducted by Golder, NATA Accreditation Number 1910.

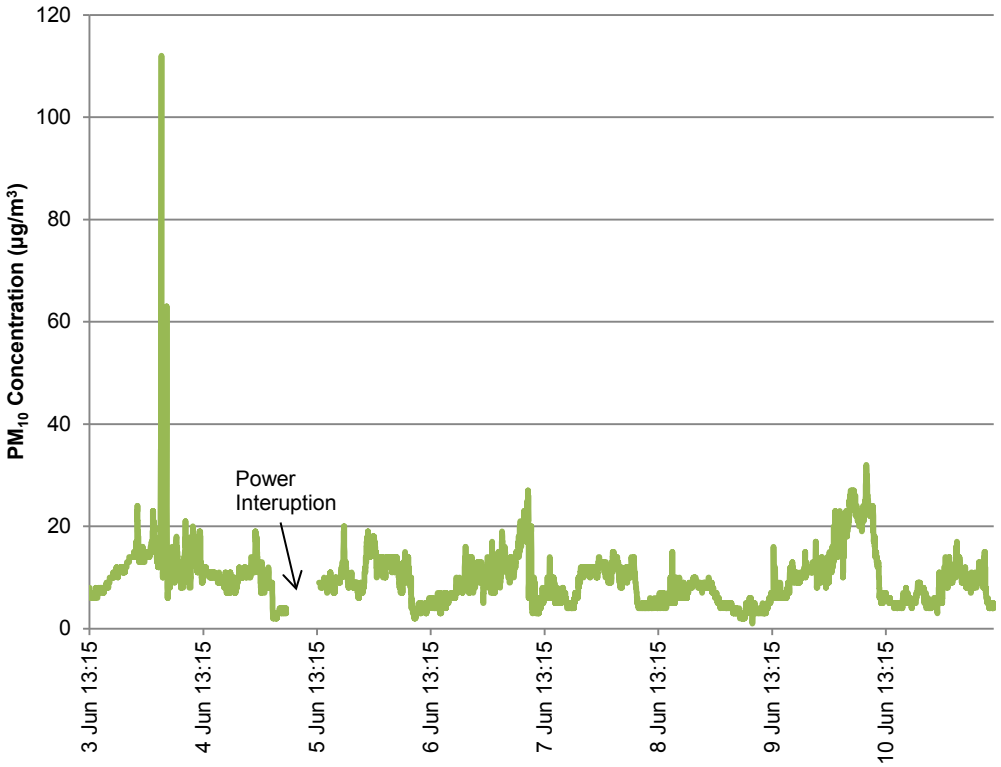

Figure 1: Indicative PM_{10} Results

Table 6: Indicative PM_{10} Summary Statistics

Date	3/06/2014	4/06/2014	5/06/2014	6/06/2014	7/06/2014	8/06/2014	9/06/2014
Start Time[A]	00:00	00:00	00:00	00:00	00:00	00:00	0.00
End Time[A]	23:59	23:59	23:59	23:59	23:59	23:59	23:59
Minimum ($\mu g/m^3$)[B]	6	6	2	2	3	4	1
Average ($\mu g/m^3$)[B]	11	12	9	9	10	8	7
Maximum ($\mu g/m^3$)[B]	24	112	20	19	27	15	17

NOTES
A Eastern standard time
B Summary statistics are calculated from 1 minute averages.

5.0 CLOSURE

Please contact the undersigned if you have any questions regarding this laboratory report.

Yours sincerely,

GOLDER ASSOCIATES PTY LTD

Jacinda Shen
Associate - Air Quality Specialist

JSHEN/MT/jshen

Attachments: Limitations 'GAP Form No. LEG04'

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APPENDIX D

Copy of Department of Health Community Fact Sheet for Antimony May 2014

Antimony

health

Community fact sheet May 2014

What is antimony?

Antimony is a brittle silver-white metal that occurs in soil and rocks in certain parts of the world. It is not found very often or in large amounts, however it enters the environment during the mining or processing of its ores and in the production of antimony metal, alloys and combinations of this metal with other substances.

How is antimony used?

Antimony and its compounds are used to make a variety of products such as:

- Metal alloys where it imparts hardness, strength, anticorrosion and other properties
- Flame retardant treatments for textiles, plastics, rubber and some building materials
- Consumer products including electrical devices, paints, plastics and pottery.
- In some medicines for treating parasitic diseases (usually in animals).

Historically, antimony was once used in medicine to induce vomiting.

Where is antimony found in the general environment?

In soils: Some soils have naturally high levels of antimony. Antimony generally binds strongly to soil particles.

In mine tailings: Antimony is sometimes found in rock containing gold. Gold mining activities bring the rock to the surface where it has been crushed to extract the gold. The leftover crushed rock, known as mine tailings can contain antimony.

In creeks and rivers: Antimony may occur in creeks or rivers where there are high levels of antimony in soil or rocks. Antimony does not appear to accumulate in fish or other aquatic animals. It also does not dissolve well in water and remains attached to particles of dirt.

In air: Airborne dust from metal smelting operations and some dusts in the workplace can have high levels of antimony. Dust from mine tailings and certain soils generally have much lower levels of antimony.

Mining of natural deposits of antimony occurs in a few locations in Australia, In Costerfield, in central Victoria, antimony has been mined with gold at different times since the 1860s. Today, the mine is operated by the company, Mandalay Resources.

How are people exposed to antimony?

As antimony is naturally occurring in the environment, people are exposed to relatively small amounts every day in air, food and water. Most of the antimony in your body comes from food and drinking water. In comparison, small amounts may also come from exposure to dust or soil.

Most antimony taken into the body through the diet leaves the body in the urine or faeces within a few days. Antimony in dust or soil is bound to soil particles, therefore is not well absorbed by the body if swallowed. It is not known whether antimony can be absorbed into the body through the skin.

What levels of antimony exposure are known to affect health?

Most of the studies into the health effects of antimony exposure have looked at worker exposure to high levels of antimony in air, or in people who have swallowed a large dose of medication containing antimony.

In workers: Exposure to high levels in air for a long time can cause irritation to the skin and eyes as well as coughing. Breathing in 2 mg/m^3 (antimony in air) over a long time can cause problems with the lungs (pneumoconiosis); heart problems (high blood pressure, irregular heartbeat); stomach pain, diarrhoea, vomiting and possible reproductive problems. There is insufficient evidence to classify antimony as a human cancer-causing agent.

In medicines: Swallowing a single, high dose of antimony (ie 30 milligrams) can cause nausea and vomiting. Vomiting reduces the amount of antimony taken up by the body.

What levels of antimony in the environment are safe?

The following information is relevant to general population exposures to antimony.

Total daily intake over a lifetime: The World Health Organization has calculated a safe level of antimony that a person can take into the body every day over a lifetime. This value has been determined from studies in animals with conservative safety factors applied to protect human health. This acceptable daily intake is 6 microgram/kg body weight/day[1].

An adult weighing 70 kg can take into their body 420 micrograms of antimony per day without effect. A one year old child weighing 10kg can take into their body 60 micrograms of antimony per day without effect.

Drinking water: The Australian Drinking Water Guideline (ADWG) value for antimony is 3 micrograms/L.

Soils: There is no Australian Guideline level for antimony in soil.

What can you do if you live in a high antimony area?

Drinking water:

If you have access to a reticulated drinking water supply, use this water for drinking and cooking.
In areas without reticulated water, residents can maintain rainwater quality by cleaning gutters using a first flush diverter, and inspecting and cleaning the rainwater tank regularly. Generally, adults and children should not drink water or use water for cooking if it contains antimony above the ADWG of 3 micrograms/L.

If you live in an area with naturally high levels of antimony in soils and dust, the rainwater could be tested for antimony to check the levels are safe. Young children should not drink water containing detectable levels of antimony (ie 1 microgram/L). This includes water used to make children's drinks or baby formula.

Dust and soil:

You can reduce any health risk to you and your family by reducing the amount of dust and soil that you or your children swallow. Therefore:

- Prevent young children from swallowing soil
- Wash your hands before eating and drinking
- Wash young children's hands frequently
- Wash children's toys to remove dust or soil
- Mop dust frequently with a damp cloth.

Is there a medical test to check for antimony?

Urine testing can be useful to check if people are currently exposed to antimony. Speak to your doctor about testing. Your doctor may also consult with clinical toxicologists at the Austin Hospital to help interpret test results.

Hair testing is not recommended as it can be difficult to tell the difference between antimony on the outside of the hair (from dust or water) and antimony inside the hair (taken into the body by eating or drinking).

Where can I get more information?

Your doctor: for advice about your personal health.
Poisons Information Line 13 11 26
General information on antimony and health: Environmental Health, Department of Health 1300 761 874

Last updated: 30 May 2014.

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[1] One microgram =1 millionth of a gram

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