



ANGAS ZINC MINE

Soil Monitoring Program

Annual Regional Topsoil Monitoring, 2008



Prepared by



EXECUTIVE SUMMARY

In June 2006 Terramin sampled rainwater and topsoil from 36 sites within a 4.5 kilometre radius of the mine to establish a pre-mining baseline for selected metals content in regional topsoil (MARP Appendix D) and rainwater (MARP Appendix AE). Soil sampling sites were selected from exposed surfaces near rainwater tanks, to combine the rainwater and soil sampling programs for logistical and comparative purposes.

Three soil samples were collected from each site using a treated pine post or galvanised fence post as a reference point (along with GPS coordinates) for long term studies. The three samples were collected in a line down slope from the marker post and around 5 metres apart. Soil samples were tested for pH, electrical conductivity (EC), moisture content (MC), Arsenic (As), Chromium (Cr), Copper (Cu), Lead (Pb), Nickel (Ni) and Zinc (Zn).

The soil sampling procedure used in 2008 was exactly the same as the baseline. Sampling location changes include the discontinuation of Site BL3 due to the construction of a new housing complex over the site as well as sites BL34, BL35, BL36. Additional sites include BL38, BL39, BL40, BL41, BL42, BL43, and duplicate sites BL50 (duplicate of BL25) and BL51 (duplicate of BL18).

Data from 2006, 2007 and 2008 were statistically compared. No significant differences were found between mean metal content in 2008 and 2007 or 2006 (baseline). Moisture, pH and electrical conductivity showed a significant difference between years but followed the same trends with moisture and pH increasing over time and electrical conductivity decreasing overtime. This was attributed to the increase in rainfall from 2006 to 2007 with similar high levels again in 2008 (www.weatherzone.com.au and BOM).

The results presented in this report demonstrate that the Angas Zinc Mine has not had any impact on the metal content in topsoil within 4.5 km of the property during 2008 and in particular that the process of bringing ore to the surface in the three months prior to the survey has had no significant effect on soil metal levels.

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INTRODUCTION

The construction phase of the Angas Zinc mine is now all but complete with ore being stockpiled on the ROM (Run of Mine) pad in the 3 months period preceding the current soil monitoring in anticipation of the mill start up. The mill start up occurred at the end of July, at the same time as this survey; therefore ore processing it is not likely to have influenced the soil metal content in the region.

In June 2006, as part of their MARP monitoring criteria, Terramin Australia Pty Ltd established a regional topsoil quality baseline within a 4.5km radius of the Angas Zinc Mine. Both agricultural and residential properties were included in the survey. The purpose of this baseline was to enable Terramin to track changes in topsoil within 4.5 kilometres of the mine using the content of selected metals, moisture, electrical conductivity and pH as indicators. In July 2008 the third soil survey was conducted at the 36 baseline sites and used the same methods as in the baseline survey. A housing complex has been developed on Site BL3; therefore this site was discontinued from the program. Sites BL34, BL35 and BL36 were not included in this year's survey and have been replaced with BL37, 38, BL39, BL40, BL41, BL42 and BL43. Blind duplicate samples were made to test laboratory precision for quality control purposes. Sample BL50 is a duplicate of BL25 and sample BL51 is a duplicate of BL18.

METHODS

In July 2008 the top 20mm of topsoil was sampled from 36 baseline sites. The sites were selected near the Rainwater Tank Survey sites for logistical purposes. Fence posts or other prominent markers were selected for ease of relocating the sites. Treated fence posts were selected when available near the rainwater tank, to see whether arsenic or chromium had leached into the soil from the treated posts, providing an effect gradient which can be tested for localised variations as well as potential changes that may be attributable to mining activities. Three samples were collected in a straight line transect over a distance of around 11 metres. The transect direction always travelled downhill from the initial locating post. Samples were taken at 1 metre from the post, 6 metres and 11 metres from the locating post. Each sample was a composite made from 5 sub-samples of equal volume from the top 20mm of topsoil, collected using a hard plastic scoop, which was cleaned between sites and rinsed with distilled water. Plastic powderless gloves were used to avoid contamination between sites.

The GPS locations and field observations for each site were recorded and the samples placed in labelled glass jars and sent to ASL Laboratories (NATA certified) for analysis. ASL laboratories tested the soil samples in both years for heavy metals, electrical conductivity, moisture and pH.

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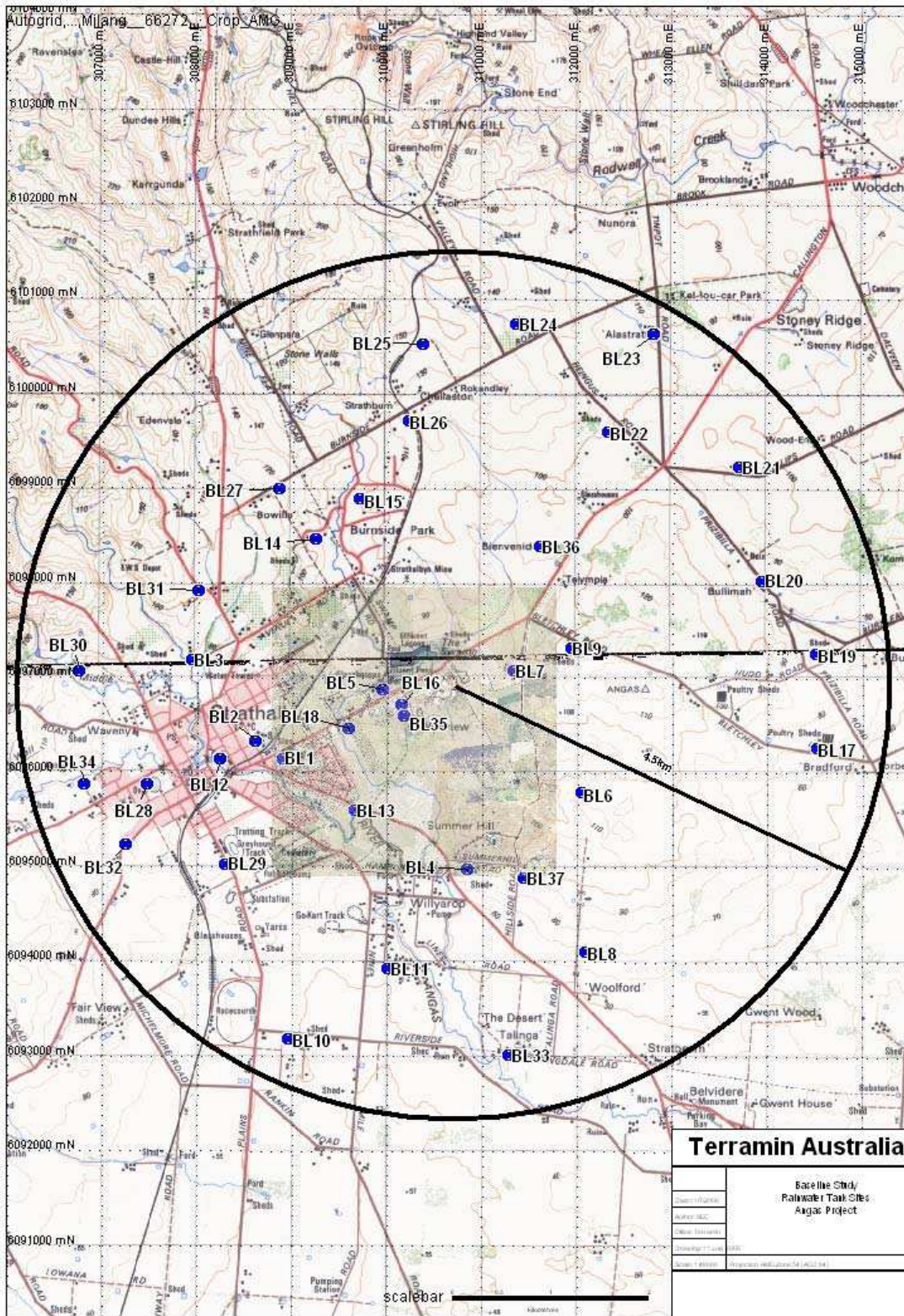


Figure 1: Baseline soil sampling locations

RESULTS

The data for each variable tested was analysed statistically to investigate trends over the three years of monitoring. There were no significant differences in any of the metals levels detected in 2008 and the 2006 (baseline) and 2007 surveys. The decrease in soil salinity (EC) and increase in soil moisture and soil pH over time were statistically significant ($P \leq 0.05$).

The observed changes in electrical conductivity, pH, soil moisture could be related to higher rainfall between years in the months prior to the survey (late April, to July) from 113mm recorded in 2006 to 222mm in 2007 and another high rainfall in the same period in 2008 with 215mm from April to July by the Bureau of Meteorology in Strathalbyn (www.weatherzone.com.au). At this stage in there is insufficient evidence to draw any conclusions and changes may also be due to natural variation.

With increased rainfall one would intuitively expect higher soil moisture and lower salinity due to dilution and leaching of salts from the topsoil. Soil pH may be influenced by rainfall and/ or temperature changes, but it is difficult to assign contributing factors to this change (Burns 1974, Eney & Petzold 1988).

CONCLUSIONS

The 2008 regional soil survey has shown that metal concentrations in topsoil have not changed significantly between 2006 (baseline) and 2007 surveys. Based on these findings it is concluded that Angas Zinc mine has had no detectable effect on soil metal levels in the region.

Soil moisture content and pH increased over the three years while salinity (EC) decreased over the same period. Rainfall data for the 2 months prior to sampling helps explain the higher soil moisture content in 2007 and 2008 and by inference to the lower salinity, none of these changes could be attributed to mining activities.

REFERENCES

I. G. Burns (1974) "A Model For Predicting The Redistribution Of Salts Applied To Fallow Soils After Excess Rainfall or Evaporation." European Journal of Soil Science, 25:2 165

A. B. Eney and D. E. Petzold (1988) "The Spatial Variability of Rainfall pH in the Washington, D.C Metropolitan Area." The Professional Geographer. 40:3 315.

Graeme Noll, 22/08/2007, rainfall data www.weatherzone.com.au

BOM (Bureau of Meteorology) 23/10/2008, rainfall data
www.bom.gov.au/climate/averages/tables/cw_023747.shtml

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ATTACHMENTS
Statistical Probability of Differences between the Monitoring Years

Factorial Analysis*	pH	EC	MC	As	Cr	Cu	Pb	Ni	Zn
2006/2007	0	0.004	0.011	0.537	0.035	0.176	0.809	0.309	0.328
2007/2008	0	0	0	0.801	0.976	0.402	0.605	0.847	0.975
2006/2008	0	0	0	0.800	0.134	0.227	0.605	0.419	0.329

* Unit less probability values. There is a significant difference when $p \leq 0.05$, these are shown in bold text. Only sites that were sampled in both years were used for the statistical analysis of probability of difference between years.

Descriptive Statistics for Regional Soil Surveys

Statistics	As	As	As	Cr	Cr	Cr	Cu	Cu	Cu
Min	5	5	5	2	3	2	5	5	5
10%	5	5	5	9	9.8	10	5	5	5
Median	6	6	5.5	19.5	21	20	10.5	12	12
90%	17	18.9	21	26	33	34.2	26	27.9	41.1
Max	82	112	108	46	45	44	81	110	149
Average	10.3	11.5	11	19	21.3	21.4	13.9	16.7	19.3
STDEV	12.4	16.2	14.6	7.6	8.7	9.1	13.3	17.8	26.3
CoV	120%	141%	132%	40%	41%	43%	95%	107%	137%
Year	2006	2007	2008	2006	2007	2008	2006	2007	2008
Statistics	Ni	Ni	Ni	Pb	Pb	Pb	Zn	Zn	Zn
Min	2	2	2	5	5	5	5	6	5
10%	2	2	3	6	6.4	5	12.7	13.4	11.8
Median	8	7.5	7	12	12.5	11	31	37.5	34
90%	12	14	14.1	36.2	26.9	57.4	80.3	84.9	93.1
Max	18	19	20	261	662	222	199	329	326
Average	7.6	8.1	8.2	21.5	25.4	21.7	43.1	46.2	47.1
STDEV	3.8	4.1	4.3	34.4	68.6	29.3	37.5	42.4	45.4
CoV	51%	50%	52%	160%	270%	135%	87%	90%	96%
Year	2006	2007	2008	2006	2007	2008	2006	2007	2008
Statistics	EC	EC	EC	MC%	MC%	MC%	pH	pH	pH
Min	66	50	20	1.5	2.4	1.6	5.4	6	6.2
10%	129	114	60.8	3.37	4.34	9.5	5.97	6.84	7.2
Median	307	264	135	7.65	9.65	16	7.1	7.3	8.1
90%	621	409	264	14.7	17.3	24.9	7.9	7.9	8.6
Max	1980	1080	1160	34.4	23	35.4	8.4	8.3	8.9
Average	374	273	171	8.6	10.4	16.7	7	7.3	7.9
STDEV	312	151	164	5.1	5.1	6	0.7	0.4	0.6
CoV	83%	55%	96%	59%	49%	36%	10%	6%	8%

Note: 10% of sites in 2007 and 2008 are different to those in 2006, see text for details.

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Relative Percent Difference (RPD) between Field Duplicates

	Site 1	Rep S1	RPD	Site 2	Rep S2	RPD	Site 3	Rep S3	RPD
pH	7.3	7.4	-1.4	7.5	7.5	0.0	7.6	7.5	1.3
EC	107	93	14.0	165	151	8.9	236	263	-10.8
MC	10	10.9	-8.6	24.4	26.8	-9.4	31.3	25.4	20.8
As	5	5	<3x	5	5	<3x	5	5	<3x
Cr	17	17	0.0	16	16	0.0	17	19	-11.1
Cu	8	8	0.0	9	9	0.0	11	10	9.5
Pb	10	10	0.0	9	9	0.0	9	10	-10.5
Ni	6	6	0.0	5	6	-18.2	6	7	-15.4
Zn	18	19	-5.4	22	25	-12.8	30	21	35.3
	Site 4	Rep S4	RPD	Site 5	Rep 5	RPD	Site 6	Rep 6	RPD
pH	7.9	8.1	-2.5	8.6	8.6	0.0	8.6	8.6	0.0
EC	159	149	6.5	162	158	2.5	162	161	0.6
MC	16.1	16.8	-4.3	21.8	21.9	-0.5	21.1	19.9	5.9
As	5	5	<3x	5	5	<3x	5	5	<3x
Cr	24	23	4.3	41	41	0.0	34	38	-11.1
Cu	48	52	-8.0	140	136	2.9	77	86	-11.0
Pb	10	10	0.0	13	13	0.0	10	11	-9.5
Ni	8	8	0.0	18	17	5.7	14	16	-13.3
Zn	64	66	-3.1	54	53	1.9	50	56	-11.3

Values highlighted in blue were below the detection limit and have been assigned the value of the detection limit, this is a conservative approach. Quality control criteria are set at 30-50% RPD or <3x the detection limit, all the results meet this criteria.