

Terramin Australia Limited
Angas Zinc Mine

Regional Rainwater Tank Annual Monitoring
2010 Data Processing, Charting and Statistical Analysis



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Data Processing, Charting and Statistical Analysis

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1 INTRODUCTION

Terramin Australia operates that Angas Zinc Mine three kilometres north of the South Australian town of Strathalbyn. The Environmental Management System developed by Angas Zinc Mine to address their commitments in the Mining and Rehabilitation Program (MARF) and to comply with the Mining Lease Conditions, include a regional rainwater tank monitoring program intended to demonstrate that mining activities do not adversely affect rainwater in tanks within a radius of 4.5 kilometres of the Mining Operations.

This report presents that results of the 2010 survey and compares the data to previous years data collected since between 2006.

2 2010 Data

Appendix A presents all of this years Regional Rainwater Tank data complete with descriptive statistics. It also compares data to EPA SA Schedule 2 potable water standards.

All data below the method limit of detection was converted to the detection limit for graphing individual Site concentrations for ease of visualisation and to demonstrate completion of data set. They were omitted from statistical analysis for conservative estimates.

Quality control duplicates were not included in statistical analysis or the graphs to reduce bias.

Some of the field information such as materials of roof and tank were assumed to be the same as previous years. The field notes record new contacts and sampling locations but not materials in contact with water. Summary statistics highlighted in light green at the end of Appendix A.

2.1 Quality control

The laboratory certified that all data is accurate and precise and within NATA standards. Field duplicates show poor relative percent difference (RPD) for turbidity, selenium, zinc, iron, nitrate/nitrite N and total N.

Most metal parameters were close to or below the method limit of detection. High coefficients of variation (>100%) for metals tends to indicate that there is significant variability between sites, this is probably indicative of the various materials that come into contact with rain water including roof, gutters, joints and rainwater tank.

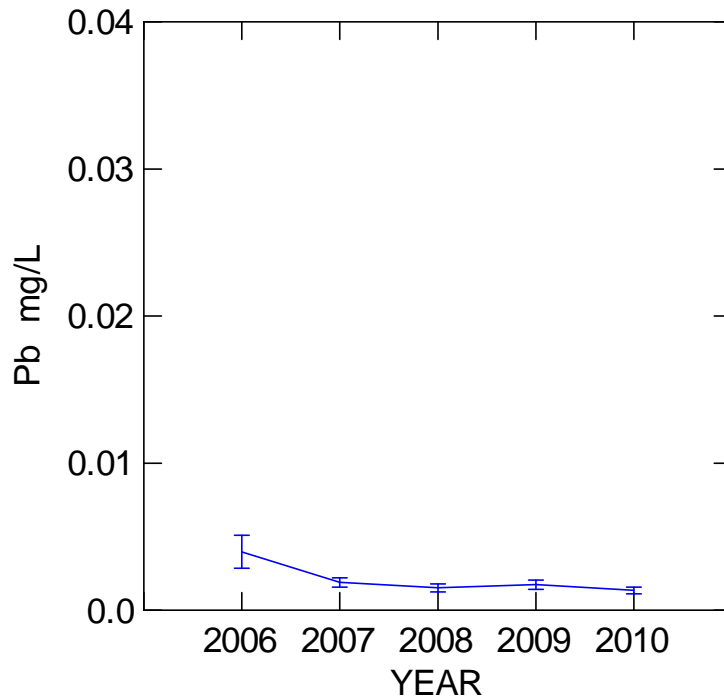
2.2 Results

The maximum value for each parameter is highlighted in tan and the values that exceed the 95 percentile are highlighted in yellow. Values that exceed potable water standards are shown in bold red text on a pink background. Only Site BL35 exceeded the potable standard for nickel by 8.2x. This site appears to have picked up some contamination probably not related to mining activity.

2.3 Graphs and description

It should be noted that many water quality values were less than 2 times the method detection limit and interpretation should take this into consideration.

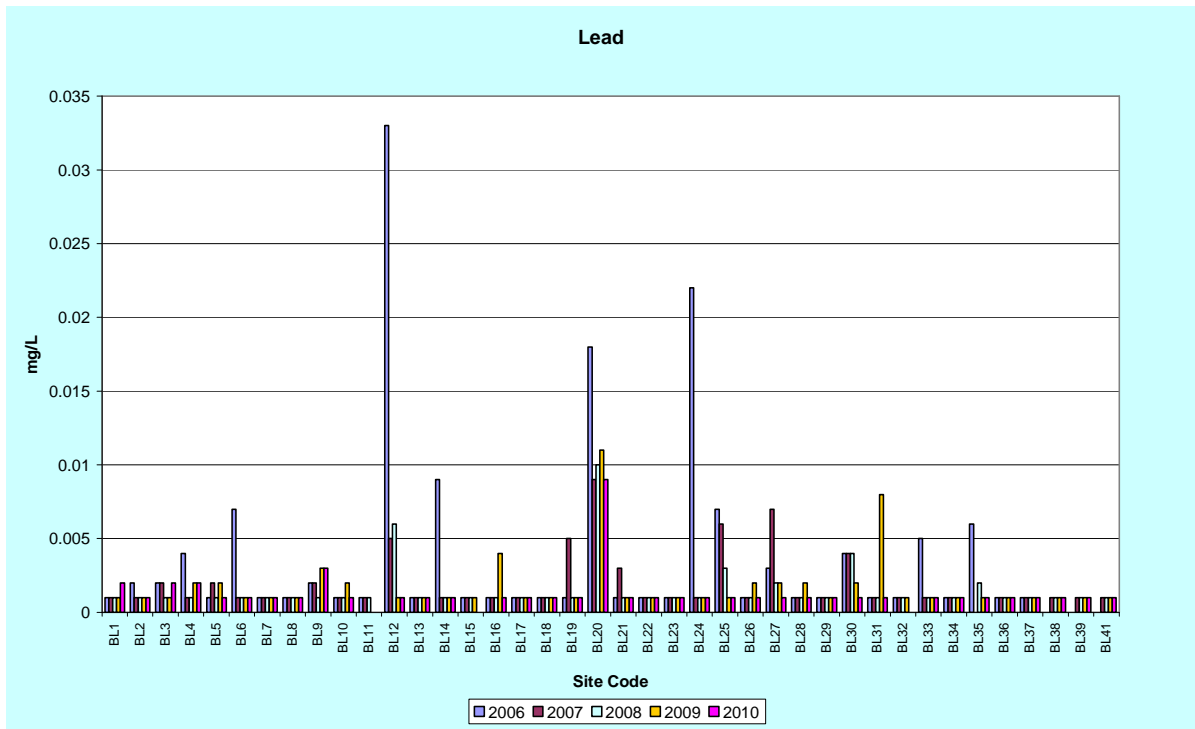
2.3.1 Lead



This graph shows the regional average for each year for lead, the higher apparent average values in 2006 and 2007 are just above the limit of detection (0.001). Analysis of Variance on values above detection level (46 samples out of 192) confirms that there is no statistically significant difference between annual regional average concentrations in rainwater tanks.

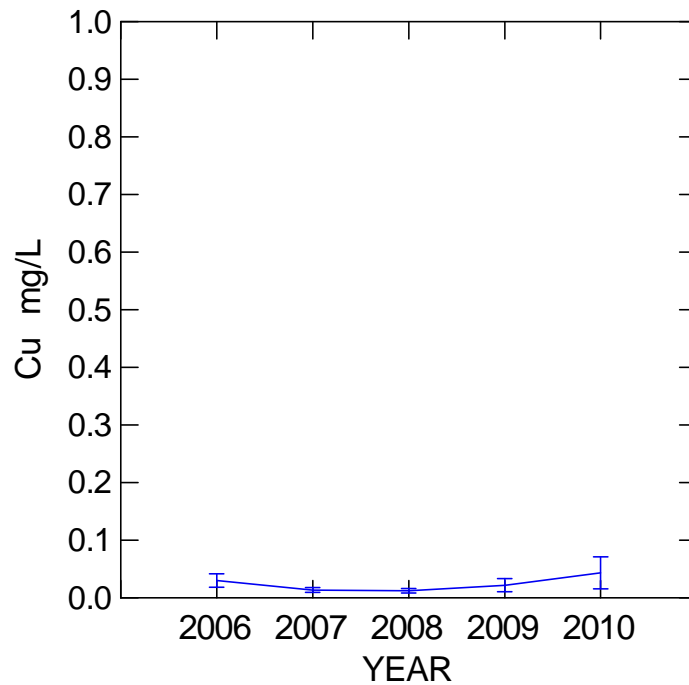
Dep Var: **Lead** N: 46 Multiple R: 0.385 Squared multiple R: 0.148

Source	Sum-of-Squares	df	Mean-Square	F-ratio	P
YEAR	0.000	4	0.000	1.787	0.150
Error	0.001	41	0.000		



Graph showing lead concentration at each site. Note BL12, BL20, BL24 initially had higher lead levels than other sites. Lead level at Site BL20 has remained around 0.01 mg/L, which is 10 times the method detection limit and is likely to be accurate.

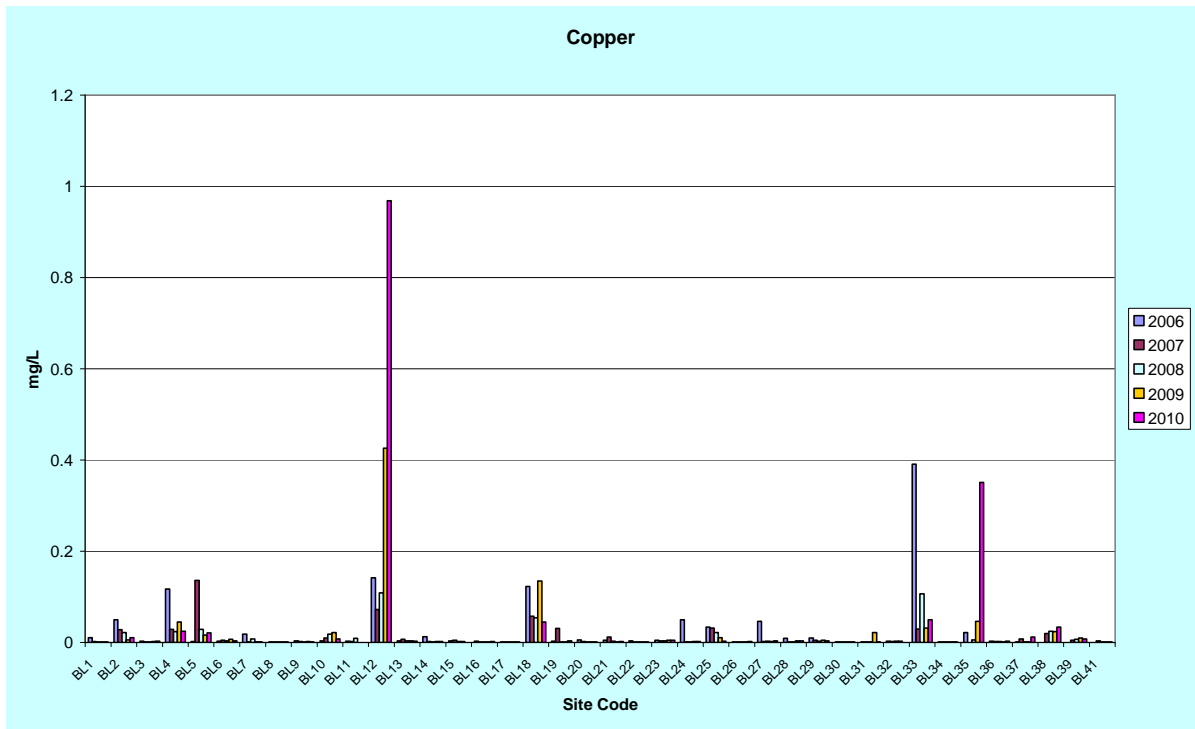
2.3.2 Copper



Copper values appear to be increasing but statistical analysis show that there is no statistically significant difference between years as show by the standard error bars and ANOVA on samples above detection limit, below. This is not an unusual result considering the range is from just under 0.02ppm to under 0.06 mg/L.

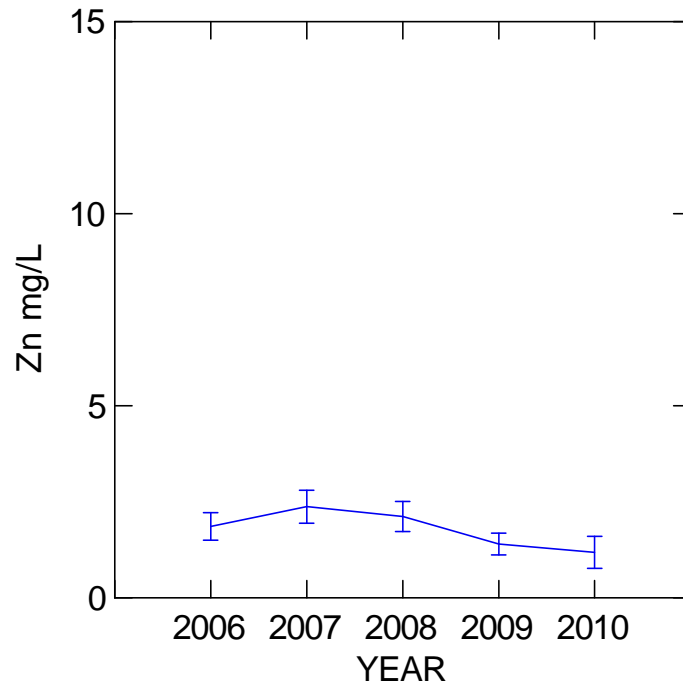
Dep Var: **Copper** N: 129 Multiple R: 0.142 Squared multiple R: 0.020

Source	Sum-of-Squares	df	Mean-Square	F-ratio	P
YEAR	0.028	4	0.007	0.642	0.633
Error	1.364	124	0.011		



Graph showing copper concentration at each site. Note BL12, BL18 and BL33 had higher copper levels than other sites; site BL12 shows increasing copper levels over time. BL35 had a spike in copper in 2010.

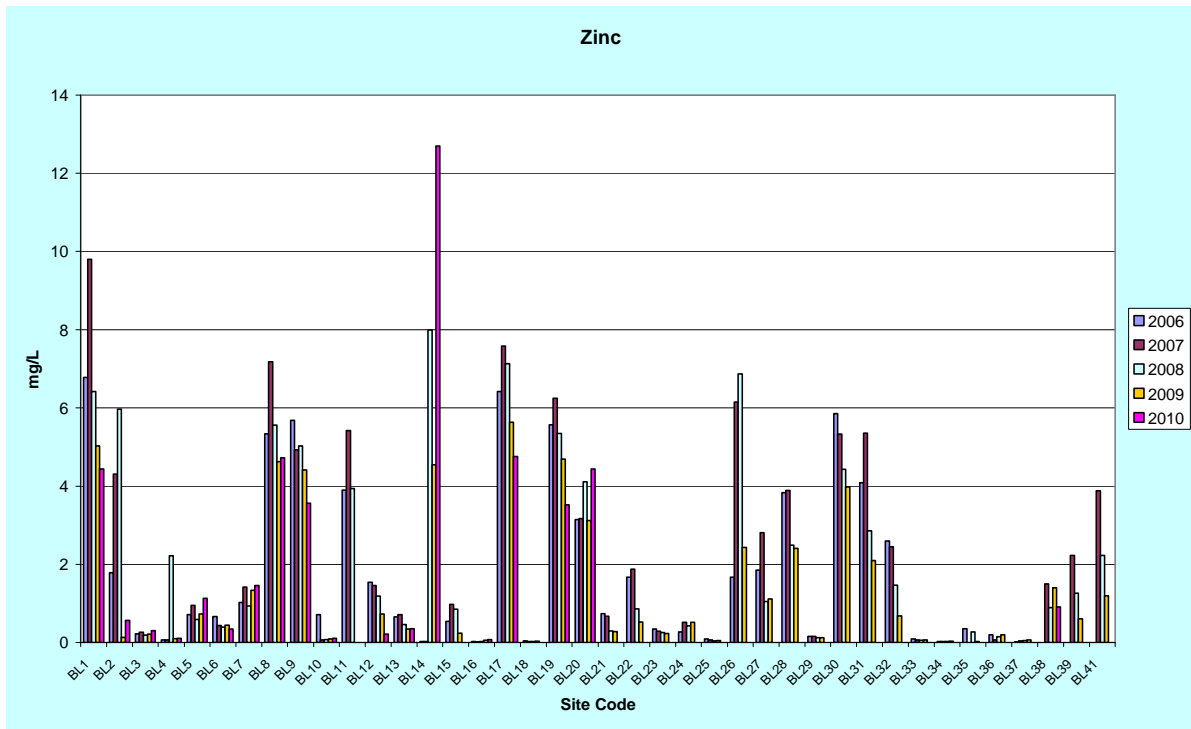
2.3.3 Zinc



This graph shows the annual regional average for zinc concentration in rainwater.

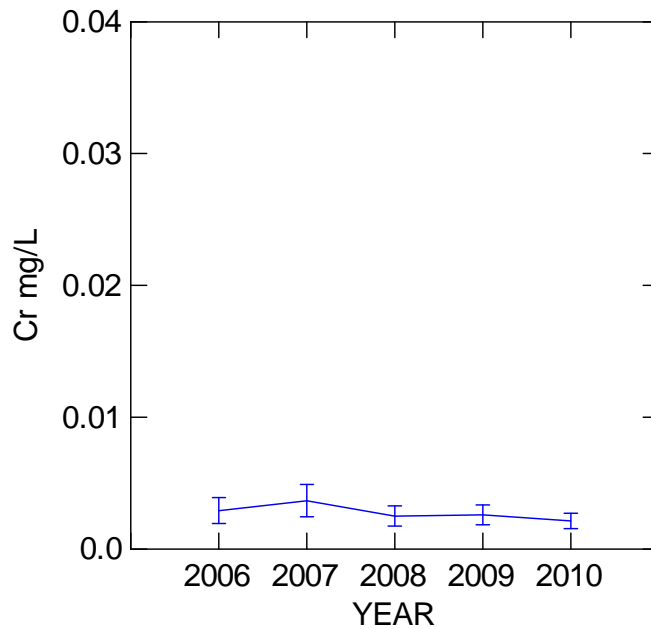
Dep Var: **Zinc** N: 173 Multiple R: 0.157 Squared multiple R: 0.025

Source	Sum-of-Squares	df	Mean-Square	F-ratio	P
YEAR	24.025	4	6.006	1.063	0.376
Error	948.955	168	5.649		

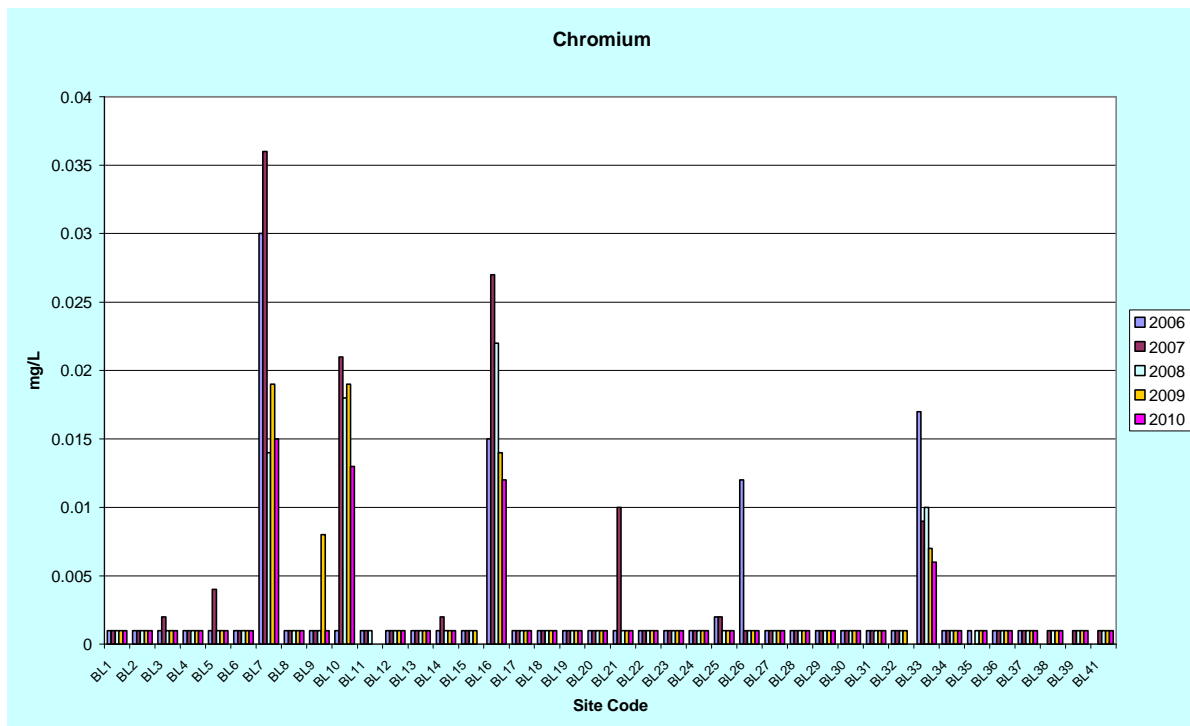


Graph showing zinc concentration at each site. While levels are low it is of interest to cross check roof and gutter materials to see if there is a correlation. We did not find a strong correlation between zinc and zinc / galvanised tanks and roofs. Site 14 had a small spike in zinc this year, this site has a concrete rainwater tank and a zinc galvanised roof.

2.3.4 Chromium

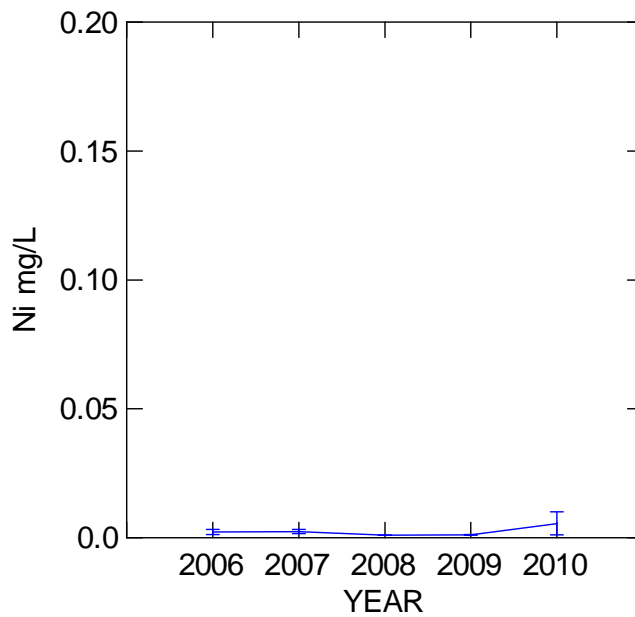


This graph shows the annual regional average for chromium.

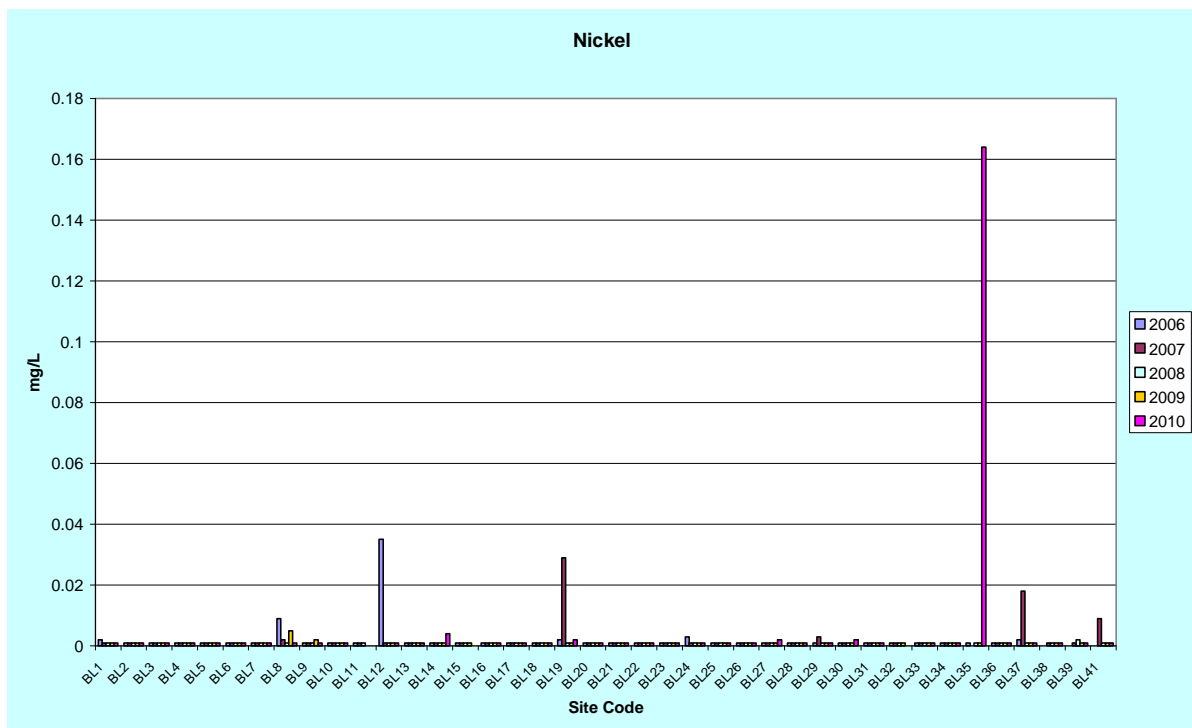


Site BL7, BL10, BL18 and BL33 have consistently returned higher chromium levels than other sites over the years.

2.3.5 Nickel



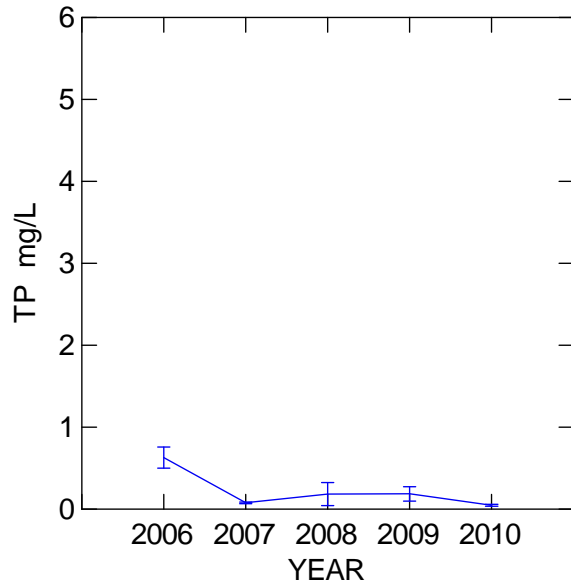
Annual regional average nickel content increased in 2010 due to a spike at site BL35.



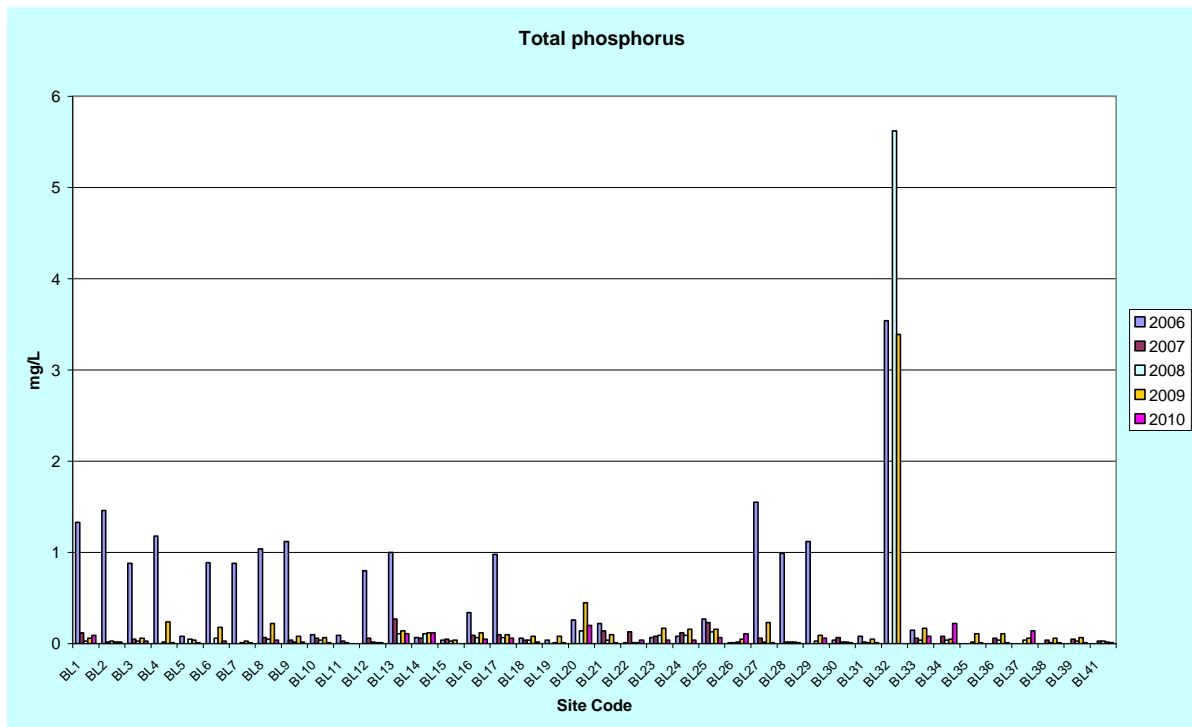
Individual nickel concentrations since 2006, a significant spike was recorded at site BL35 in 2010, this may be a one off error

Arsenic, selenium, silver and thallium are not graphed because data is generally below detection level.

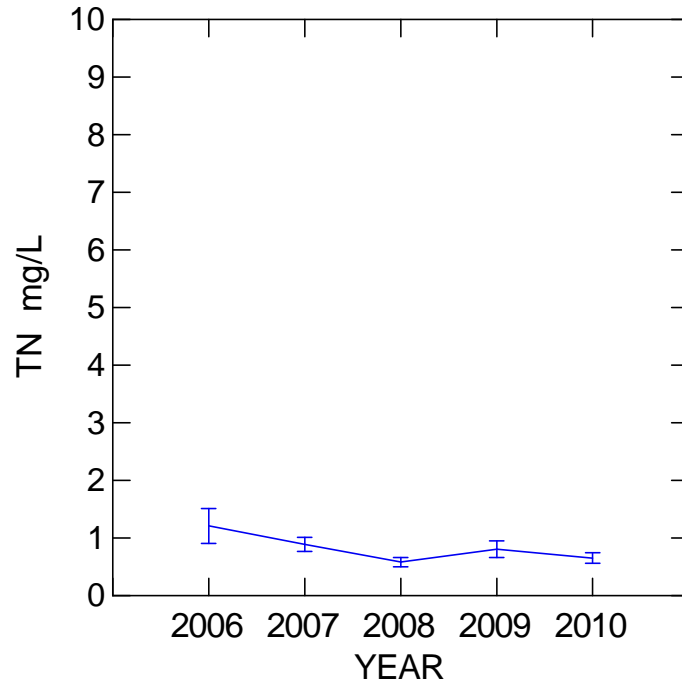
2.3.6 Other parameters of interest



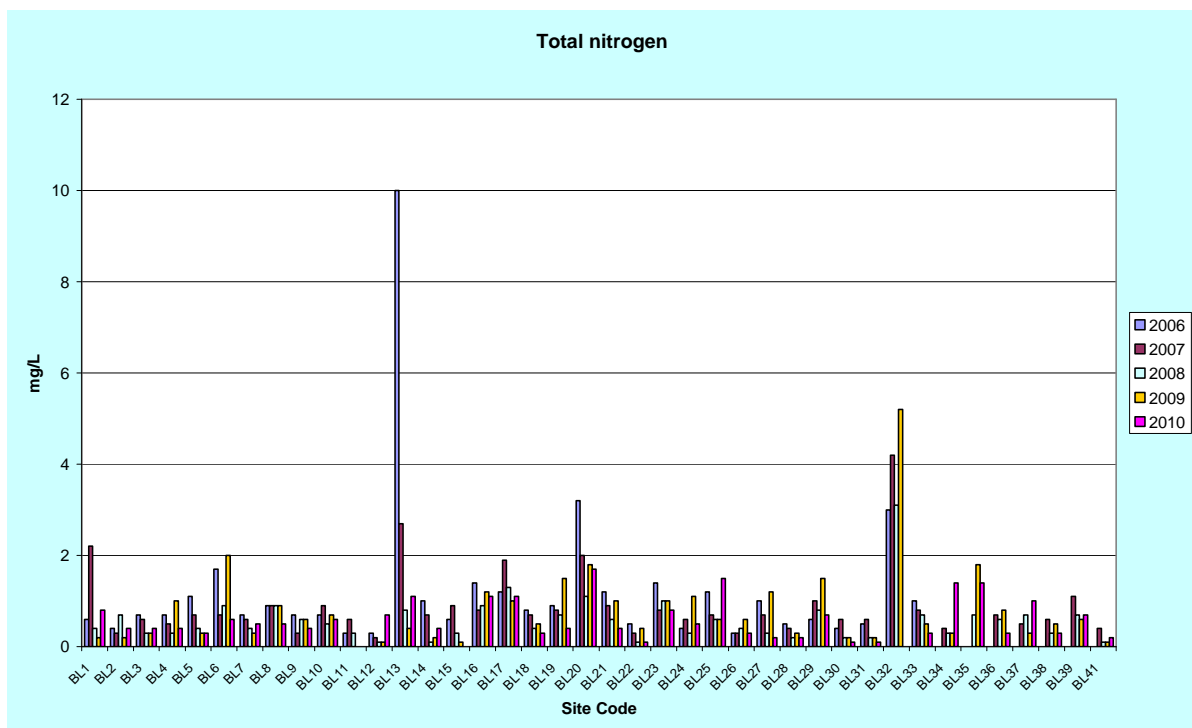
This graph shows the regional average Total Phosphorus Regional since 2006.



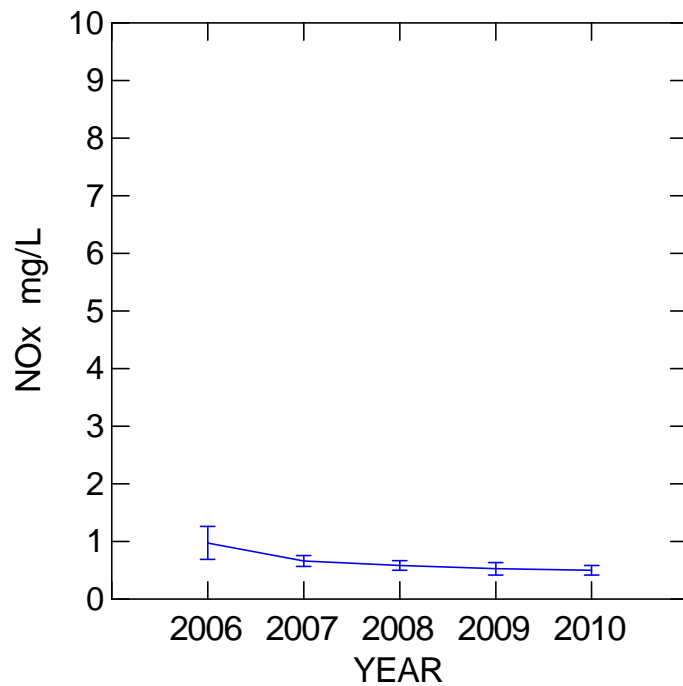
Graph showing total phosphorus concentration at each site. Site BL32 was higher than the other sites but was not measured in 2010.



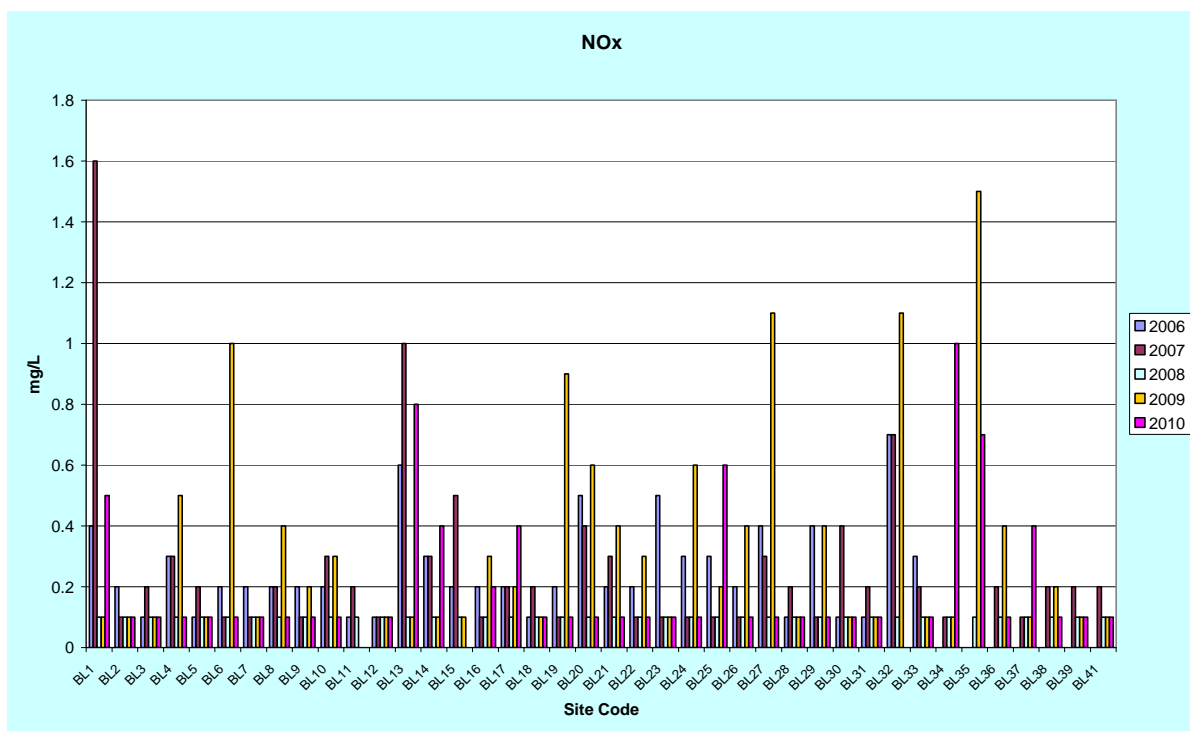
This graph shows the regional average for each year for Total Nitrogen. The error bars suggest that the difference between years is not statistically significant.



Graph showing total nitrogen concentration at each site between 2006 and 2010.



This graph shows the annual regional average nitrate and nitrite nitrogen.



Graph showing concentration of nitrite and nitrate at each site. Most sites were generally lower in 2010 than 2009 higher than previous years, site 34 had a small spike in NOx in 2010.

Appendix A: Process 2010 Regional Rainwater Tank Data

Rainwater tanks		pH	EC	TDS	Turbidity	SO4	Arsenic	Cadmium	Chromium	Copper	Lead	Nickel	Selenium	Silver	Thallium	Zinc	Iron	NOx as N	TKN as N	TN as N	TP as P
Date	Site	pH Unit	µS/cm	mg/L	NTU	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
	LOD	0.01	1	5	0.1	1	0.001	0.0001	0.001	0.001	0.001	0.001	0.01	0.001	0.001	0.005	0.05	0.01	0.1	0.1	0.01
7/09/2010	BL 1	6.32	44	36	0.6	<1	<0.001	<0.0001	<0.001	<0.001	0.002	<0.001	<0.01	<0.010	<0.001	4.44	<0.05	0.31	0.5	0.8	0.09
7/09/2010	BL 2	6.5	39	28	<0.1	1	<0.001	<0.0001	<0.001	0.011	<0.001	<0.001	<0.01	<0.010	<0.001	0.57	0.08	0.35	<0.1	0.4	0.02
7/09/2010	BL 3	6.48	42	27	0.4	<1	<0.001	0.0001	<0.001	0.003	0.002	<0.001	<0.01	<0.010	<0.001	0.3	<0.05	0.37	<0.1	0.4	0.03
7/09/2010	BL 4	7.04	128	86	<0.1	2	<0.001	<0.0001	<0.001	0.025	0.002	<0.001	<0.01	<0.010	<0.001	0.109	<0.05	0.33	<0.1	0.4	<0.01
7/09/2010	BL 5	6.75	48	36	<0.1	1	<0.001	<0.0001	<0.001	0.021	0.001	<0.001	<0.01	<0.010	<0.001	1.13	<0.05	0.33	<0.1	0.3	0.01
7/09/2010	BL 6	6.32	41	30	<0.1	1	<0.001	<0.0001	<0.001	0.004	<0.001	<0.001	<0.01	<0.010	<0.001	0.341	0.06	0.61	<0.1	0.6	0.03
7/09/2010	BL 7	6.64	62	43	0.2	2	<0.001	<0.0001	0.015	<0.001	0.001	<0.001	<0.01	<0.010	<0.001	1.46	<0.05	0.38	0.1	0.5	<0.01
7/09/2010	BL 8	6.65	55	43	0.2	1	<0.001	0.0001	<0.001	<0.001	<0.001	<0.001	<0.01	<0.010	<0.001	4.73	0.13	0.5	<0.1	0.5	0.04
7/09/2010	BL 9	6.76	73	50	<0.1	1	<0.001	0.0005	<0.001	<0.001	0.003	<0.001	<0.01	<0.010	<0.001	3.56	0.1	0.41	<0.1	0.4	0.02
7/09/2010	BL 10	6.73	68	50	0.2	1	<0.001	<0.0001	0.013	0.008	<0.001	<0.001	<0.01	<0.010	<0.001	0.11	0.08	0.51	0.1	0.6	<0.01
7/09/2010	BL 12	6.87	220	143	<0.1	18	<0.001	<0.0001	<0.001	0.968	<0.001	<0.001	<0.01	<0.010	<0.001	0.217	0.15	0.64	0.1	0.7	<0.01
7/09/2010	BL 13	6.5	29	20	0.9	<1	<0.001	<0.0001	<0.001	0.003	<0.001	<0.001	<0.01	<0.010	<0.001	0.351	<0.05	0.3	0.8	1.1	0.11
8/09/2010	BL 14	6.65	114	85	2.4	<1	0.004	<0.0001	<0.001	0.002	<0.001	0.004	<0.01	<0.010	<0.001	12.7	<0.05	<0.01	0.4	0.4	0.12
8/09/2010	BL 16	7.35	80	55	<0.1	3	<0.001	<0.0001	0.012	0.002	0.001	<0.001	<0.01	<0.010	<0.001	0.077	<0.05	0.86	0.2	1.1	0.05
8/09/2010	BL 17	7	62	46	<0.1	2	<0.001	<0.0001	<0.001	<0.001	<0.001	<0.001	<0.01	<0.010	<0.001	4.76	0.05	0.72	0.4	1.1	0.06
8/09/2010	BL 19	6.83	45	33	<0.1	2	<0.001	<0.0001	<0.001	0.004	<0.001	0.002	<0.01	<0.010	<0.001	3.52	<0.05	0.43	<0.1	0.4	<0.01
8/09/2010	BL 20	6.8	76	52	0.2	2	<0.001	0.0002	<0.001	0.001	0.009	<0.001	<0.01	<0.010	<0.001	4.44	<0.05	1.62	0.1	1.7	0.2
8/09/2010	BL 38	7.01	54	39	<0.1	2	<0.001	<0.0001	<0.001	0.034	<0.001	<0.001	<0.01	<0.010	<0.001	0.911	<0.05	0.32	<0.1	0.3	0.01
8/09/2010	BL21	6.26	37	25	<0.1	2	<0.001	0.0003	<0.001	0.002	<0.001	<0.001	0.276	<0.01	<0.010	<0.001	<0.05	0.36	<0.1	0.4	<0.01
8/09/2010	BL22	6.37	18	9	<0.1	<1	<0.001	<0.0001	<0.001	<0.001	<0.001	<0.001	0.577	<0.01	<0.010	<0.001	0.28	0.12	<0.1	0.1	0.04
8/09/2010	BL18	6.75	55	30	<0.1	2	<0.001	<0.0001	<0.001	0.045	<0.001	<0.001	0.024	<0.01	<0.010	<0.001	<0.05	0.3	<0.1	0.3	0.02
8/09/2010	BL36	6.49	39	27	<0.1	1	<0.001	<0.0001	<0.001	0.003	<0.001	<0.001	0.276	<0.01	<0.010	<0.001	<0.05	0.27	<0.1	0.3	<0.01
9/09/2010	BL23	7.18	62	38	<0.1	2	<0.001	<0.0001	<0.001	0.005	<0.001	<0.001	0.246	<0.01	<0.010	<0.001	<0.05	0.65	0.1	0.8	0.04
9/09/2010	BL24	6.91	65	38	<0.1	2	<0.001	0.0011	<0.001	0.002	<0.001	<0.001	0.725	<0.01	<0.010	<0.001	0.08	0.48	<0.1	0.5	0.04
9/09/2010	BL25	7.13	100	58	<0.1	3	<0.001	<0.0001	<0.001	0.003	<0.001	<0.001	0.012	<0.01	<0.010	<0.001	<0.05	0.89	0.6	1.5	0.07
9/09/2010	BL26	6.78	54	30	<0.1	1	<0.001	<0.0001	<0.001	0.002	<0.001	<0.001	5.87	<0.01	<0.010	<0.001	0.09	0.33	<0.1	0.3	0.11
9/09/2010	BL27	6.82	51	30	<0.1	1	<0.001	0.0001	<0.001	0.004	<0.001	0.002	1.32	<0.01	<0.010	<0.001	0.16	0.19	<0.1	0.2	<0.01
9/09/2010	BL28	5.74	19	9	<0.1	<1	<0.001	0.0001	<0.001	0.004	<0.001	<0.001	1.51	<0.01	<0.010	<0.001	0.13	0.16	<0.1	0.2	<0.01
9/09/2010	BL29	6.83	110	64	<0.1	3	<0.001	<0.0001	<0.001	0.004	<0.001	<0.001	0.145	<0.01	<0.010	<0.001	<0.05	0.68	<0.1	0.7	0.06
9/09/2010	BL30	6.72	49	30	<0.1	<1	<0.001	<0.0001	<0.001	<0.001	<0.001	0.002	2.28	<0.01	<0.010	<0.001	0.45	0.1	<0.1	0.1	<0.01
9/09/2010	BL31	6.66	45	33	<0.1	1	<0.001	<0.0001	<0.001	<0.001	<0.001	<0.001	1.34	<0.01	<0.010	<0.001	<0.05	0.1	<0.1	0.1	<0.01
9/09/2010	BL33	6.86	86	59	<0.1	2	<0.001	<0.0001	0.006	0.05	<0.001	<0.001	0.065	<0.01	<0.010	<0.001	<0.05	0.33	<0.1	0.3	0.08
9/09/2010	BL34	6.64	39	25	<0.1	2	<0.001	<0.0001	<0.001	<0.001	<0.001	<0.001	0.046	<0.01	<0.010	<0.001	<0.05	0.4	1	1.4	0.22
9/09/2010	BL35	6.7	106	65	<0.1	3	<0.001	0.0004	<0.001	0.351	<0.001	0.164	7.16	<0.01	<0.010	<0.001	0.06	0.66	0.7	1.4	<0.01
9/09/2010	BL37	6.72	46	30	<0.1	2	<0.001	<0.0001	<0.001	0.012	<0.001	<0.001	0.063	<0.01	<0.010	<0.001	0.09	0.58	0.4	1	0.14
9/09/2010	BL39	6.9	55	31	<0.1	1	<0.001	<0.0001	<0.001	0.008	0.001	<0.001	2.21	<0.01	<0.010	<0.001	<0.05	0.74	<0.1	0.7	<0.01
9/09/2010	BL43	6.7	79	52	<0.1	1	<0.001	<0.0001	<0.001	<0.001	<0.001	<0.001	1.03	<0.01	<0.010	<0.001	<0.05	0.08	0.1	0.2	<0.01
count	37	37	37	37	8	30	1	9	4	27	9	5	19	0	0	18	15	36	16	37	23
<DL		0	0	0	29	7	36	28	33	10	28	32	18	37	37	19	22	1	21	0	14
min		5.74	18	9	0.2	1	0.004	0.0001	0.006	0.001	0.001	0.002	0.012	0	0	0.077	0.05	0.08	0.1	0.1	0.01
5%		6.308	27	17.8	0.2	1	0.004	0.0001	0.0069	0.002	0.001	0.002	0.0228			0.1042	0.057	0.1	0.1	0.1	0.011
median		6.73	55	36	0.3	2	0.004	0.0002	0.0125	0.004	0.002	0.002	0.577			1.0205	0.09	0.375	0.3	0.4	0.05
95%		7.14	116.8	85.2	1.875	3	0.004	0.00086	0.0147	0.2607	0.0066	0.132	5.999			5.951	0.331	0.8675	0.85	1.42	0.194
Max		7.35	220	143	2.4	18	0.004	0.0011	0.015	0.968	0.009	0.164	7.16	0	0	12.7	0.45	1.62	1	1.7	0.22
Average		6.71	64.73	42.84	0.64	2.27	0.00	0.00	0.01	0.06	0.00	0.03	1.33			2.43	0.13	0.46	0.36	0.60	0.07
Std Dev		0.29	36.83	24.26	0.76	3.05		0.00	0.00	0.19	0.00	0.07	1.98			3.16	0.10	0.29	0.29	0.42	0.06
CoV		4%	57%	57%	119%	135%		101%	34%	331%	105%	208%	149%			130%	79%	64%	83%	70%	82%
Schedule 2 *							0.007	0.002	0.05	2	0.01	0.02									

*Schedule 2 - Water quality criteria EPA - SA Potable, Std Dev = Standard Deviation, CoV = Coefficient of variation. EC=Electrical Conductivity, TDS= Total Dissolved Solids @180°C @ 25°C. NOx= Nitrite + Nitrate, TKN= Total Kjeldahl Nitrogen, TN=Total Nitrogen, TP= Total Phosphorus.

Appendix B: Raw data graphs

The following graphs present the complete data set for each parameter shown. Many values are at or very close to the method detection limit.

