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OPERATION/CONSTRUCTION MANAGERS

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Engineering Company, P.A.

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Fac/Perm/Co ID #	Date	Doc ID#
67	05/13/09	DIN

February 2, 2000

Mr. Larry Rose
Solid Waste Section
Division of Waste Management
North Carolina Department of Environment and Natural Resources
401 Oberlin Road, Suite 150
Raleigh, NC 27605

FEB 2000
Received
Solid Waste
Section

Re: Groundwater Sampling and Statistical Analysis
Alexander County Closed Sanitary Landfill
MESCO Project No. G01002.0

Dear Mr. Rose:

Municipal Engineering Services Company, P.A. (MESCO) completed the statistical analyses for the Alexander County Closed Sanitary Landfill located near Taylorsville, North Carolina. The purpose of these analyses is to determine, in comparison to background levels, statistical significance of constituents detected during the May-2000 sampling event.

Statistical Analysis Methodology

Metals

An inter-well statistical analysis was conducted upon metals detected during the May 17, 2000 sampling event. Monitoring wells MW-1 and MW-1A were defined as the background wells, and an upper tolerance limit (UTL) with a 95% coverage was computed for each detected constituent from the background data at a 95% confidence level. For each tested constituent, an appropriate statistical analysis method was selected based on the percentages of non-detects (%ND) in the historical background data. The following table (Table 1) summarizes the methods used for four different %ND ranges.

Table 1. Statistical Analysis Methods for Various %ND Ranges

%ND	Analysis Method	ND Substitution
%ND<15%	Parametric tolerance limit	1/2 ND
15%<%ND<50%	Parametric tolerance limit	Cohen or 1/2 ND
50%<%ND<90%	Non-parametric tolerance limit	1/2 ND
90%<%ND	Poisson tolerance limit	-

NOTE: For parametric tolerance interval, normality of the background data was checked by the Shapiro-Wilks normality test, as the method requires that the data be normally distributed.

A preliminary data screening was conducted upon the metals detected in all monitoring locations. Detected metals with concentrations found below that of the background well MW-1 were eliminated and a statistical analysis was not conducted upon these wells. A total of eleven metals were tested for statistical significance. For chromium and zinc, the parametric tolerance limit with an appropriate ND adjustment was used on the log of the original data as its %ND was less than 50% and the data was "log-normally" distributed. The Poisson tolerance limit was used for

arsenic and silver because their %ND was greater than 90%. For all the other metals, the non-parametric tolerance interval method was used.

VOCs

All historical VOC detections in the background wells (MW-1 and MW-1A) were pooled in order to determine the total number of detections, from which the expected number of detections in a single down gradient monitoring point (y^*) was derived by utilizing the Poisson prediction interval. The parameter y^* is defined by the following equation:

$$y^* = cy + \frac{t^2 c}{2} + tc\sqrt{y\left(1+\frac{1}{c}\right)+\frac{t^2}{4}}$$

where

$c = 1/n$ (n =number of background samples)
t = one-sided value of students t-Statistic at 95% confidence [a]
y = number of events observed in n previous samples
y^* = expected number of events in a single future sample

[a] Gibbons, R.D., 1994, Statistical methods for groundwater monitoring: John Wiley & Sons, Inc., p.12.

For each monitoring location showing any VOC detections, the number of detected VOCs was counted with each detection being considered a "hit". The number was then compared with the expected number of detections derived from the background VOC data. The value of Student's t-Statistic was derived from tabulated values included in Gibbons (1994).

Results

Interwell analysis was performed on 11 metals detected during the May 2000 sampling event. Historical data compiled for monitoring wells MW-1 and MW-1A were used as the baseline. Data distribution and potential outliers were reviewed using time series and box and whiskers plots (enclosed charts). No tested metal parameters, including those which concentrations exceeded the NC groundwater Standard, depicted statistically significant increases over their background levels during this sampling event. Therefore, further intrawell analysis was not conducted for this sampling event.

The Poisson prediction interval analysis conducted for VOCs shows no evidence of groundwater contamination at 95% confidence level. However, all of the sampled monitoring wells with the exception of MW-8 showed one or more VOC detections during the May-2000 sampling event. Monitoring well MW-3 located very close to the northwest waste boundary continues to exhibit detectable concentrations of the same VOCs found since the implementation of the monitoring plan.

Carbon disulfide was detected at six sampling locations. However, MW-1 is located upgradient of the waste and carbon disulfide was also detected within the sampling equipment blank (EB). Furthermore, the VOC concentrations were found to be outliers by the Dixon's test for Outliers at a 95% confidence level (enclosed results). This evidence suggests carbon disulfide's presence apparently is caused by another source other than the landfill.

Conclusion

The statistical analysis results on metals and VOCs depict no direct evidence of landfill impact on groundwater quality. However, other evidence suggests that one of the background wells has been impacted by the landfill. Background monitoring well MW-1, located hydraulically upgradient and to the northeast of the scale house, has historically shown consistent detections of both VOCs and metals. This has resulted in considerably increasing the expected number of VOC detections in the compliance wells, thereby making it difficult to statistically detect true contamination due to the increase of false negatives (type II errors). In an effort to more reliably assess the

groundwater conditions surrounding the closed landfill seven additional monitoring wells were installed further hydraulically downgradient of the existing wells. MESCO supervised the installation of these wells by Graham & Currie Well Drilling Co., of West End NC. during October–2000. The baler that was lodged in background well MW-1A was also removed at this time. Due to the historically consistent trends of detected parameters found within the background well MW-1, coupled with suitable background data available for MW-1A, we have proposed a modification to the statistical approach for future sampling event analyses. We propose utilizing MW-1A, located 79 feet NE of MW-1, as the lone upgradient well and transform the status of MW-1 to a compliance well. This adjustment is expected to provide a more reliable and accurate set of historical baseline data in which to compare constituents detected in compliance sampling points. Therefore, future Interwell statistical analyses will likely be able to better determine the presence of contamination originating from the landfill.

The well construction records, boring logs and a location plan for the newly installed monitoring wells will be submitted to the Section as soon as all relevant documents are compiled. If you have any questions or comments regarding this report, please contact me at (919) 772-5393.

Sincerely,
MUNICIPAL ENGINEERING SERVICES CO., P.A.

Jonathan Pfohl
Environmental Technician

Enclosures
cc: Mr. Rick French
Alexander County

Exceedance Scan
Alexander County Closed Sanitary Landfill

Well ID	Parameter Name [1]	Sample Date	Result	Unit	PQL [2]	MCL [3]	Exceedance
EB	Carbon disulfide	5/17/2000	6.2	ug/l	5	-	
MW-1	Antimony, total	5/17/2000	0.0087	mg/l	0.005	-	
MW-1	Antimony, total	5/17/2000	0.0087	mg/l	0.005	-	
MW-1	Barium, total	5/17/2000	0.038	mg/l	0.005	2	
MW-1	Barium, total	5/17/2000	0.038	mg/l	0.005	2	
MW-1	Chromium, total	5/17/2000	0.0063	mg/l	0.002	0.05	
MW-1	Chromium, total	5/17/2000	0.0063	mg/l	0.002	0.05	
MW-1	Cobalt, total	5/17/2000	0.017	mg/l	0.005	-	
MW-1	Cobalt, total	5/17/2000	0.017	mg/l	0.005	-	
MW-1	Nickel, total	5/17/2000	0.019	mg/l	0.005	0.1	
MW-1	Nickel, total	5/17/2000	0.019	mg/l	0.005	0.1	
MW-1	Zinc, total	5/17/2000	0.046	mg/l	0.01	2.1	
MW-1	Zinc, total	5/17/2000	0.046	mg/l	0.01	2.1	
MW-1	1,1-Dichloroethane	5/17/2000	17	ug/l	5	700	
MW-1	1,1-Dichloroethane	5/17/2000	17	ug/l	5	700	
MW-1	Carbon disulfide	5/17/2000	18	ug/l	5	-	
MW-1	Carbon disulfide	5/17/2000	18	ug/l	5	-	
MW-1	cis-1,2-Dichloroethene	5/17/2000	7.8	ug/l	5	70	
MW-1	cis-1,2-Dichloroethene	5/17/2000	7.8	ug/l	5	70	
MW-3	Barium, total	5/17/2000	0.068	mg/l	0.005	2	
MW-3	Chromium, total	5/17/2000	0.0082	mg/l	0.002	0.05	
MW-3	Cobalt, total	5/17/2000	0.0075	mg/l	0.005	-	
MW-3	Nickel, total	5/17/2000	0.063	mg/l	0.005	0.1	
MW-3	Zinc, total	5/17/2000	0.038	mg/l	0.01	2.1	
MW-3	1,4-Dichlorobenzene	5/17/2000	7.6	ug/l	5	75	
MW-3	**Benzene**	**5/17/2000**	**9.5**	**ug/l**	**5**	**1**	**8.5**
MW-3	Carbon disulfide	5/17/2000	22	ug/l	5	-	
MW-3	cis-1,2-Dichloroethene	5/17/2000	20	ug/l	5	70	
MW-4R	Antimony, total	5/17/2000	0.0075	mg/l	0.005	-	
MW-4R	Barium, total	5/17/2000	0.11	mg/l	0.005	2	
MW-4R	Chromium, total	5/17/2000	0.0043	mg/l	0.002	0.05	
MW-4R	Cobalt, total	5/17/2000	0.2	mg/l	0.005	-	
MW-4R	Copper, total	5/17/2000	0.0044	mg/l	0.002	1	
MW-4R	Nickel, total	5/17/2000	0.017	mg/l	0.005	0.1	
MW-4R	Silver, total	5/17/2000	0.0025	mg/l	0.002	0.018	
MW-4R	Zinc, total	5/17/2000	0.077	mg/l	0.01	2.1	
MW-4R	1,1-Dichloroethane	5/17/2000	12	ug/l	5	700	
MW-4R	Carbon disulfide	5/17/2000	30	ug/l	5	-	
MW-4R	cis-1,2-Dichloroethene	5/17/2000	14	ug/l	5	70	
MW-5	Arsenic, total	5/17/2000	0.0078	mg/l	0.005	0.05	
MW-5	Barium, total	5/17/2000	0.38	mg/l	0.005	2	
MW-5	Beryllium, total	5/17/2000	0.0066	mg/l	0.001	-	
MW-5	**Chromium, total**	**5/17/2000**	**0.23**	**mg/l**	**0.002**	**0.05**	**0.18**
MW-5	Cobalt, total	5/17/2000	0.064	mg/l	0.005	-	
MW-5	Copper, total	5/17/2000	0.12	mg/l	0.002	1	
MW-5	**Lead, total**	**5/17/2000**	**0.018**	**mg/l**	**0.005**	**0.015**	**0.003**
MW-5	**Nickel, total**	**5/17/2000**	**0.13**	**mg/l**	**0.005**	**0.1**	**0.03**
MW-5	Vanadium	5/17/2000	0.19	mg/l	0.005	-	
MW-5	Zinc, total	5/17/2000	0.35	mg/l	0.01	2.1	

Well ID	Parameter Name [1]	Sample Date	Result	Unit	PQL [2]	MCL [3]	Exceedance
MW-5	1,1-Dichloroethane	5/17/2000	10	ug/l	5	700	
MW-5	Carbon disulfide	5/17/2000	17	ug/l	5	-	
MW-6	Barium, total	5/17/2000	0.21	mg/l	0.005	2	
MW-6	Chromium, total	5/17/2000	0.029	mg/l	0.002	0.05	
MW-6	Cobalt, total	5/17/2000	0.031	mg/l	0.005	-	
MW-6	Copper, total	5/17/2000	0.02	mg/l	0.002	1	
MW-6	Nickel, total	5/17/2000	0.022	mg/l	0.005	0.1	
MW-6	Vanadium	5/17/2000	0.015	mg/l	0.005	-	
MW-6	Zinc, total	5/17/2000	0.047	mg/l	0.01	2.1	
MW-6	Carbon disulfide	5/17/2000	18	ug/l	5	-	
MW-7	Antimony, total	5/17/2000	0.0068	mg/l	0.005	-	
MW-7	Barium, total	5/17/2000	0.018	mg/l	0.005	2	
MW-7	Chromium, total	5/17/2000	0.0081	mg/l	0.002	0.05	
MW-7	Nickel, total	5/17/2000	0.005	mg/l	0.005	0.1	
MW-7	Zinc, total	5/17/2000	0.03	mg/l	0.01	2.1	
MW-7	1,1-Dichloroethane	5/17/2000	15	ug/l	5	700	
MW-7	Carbon disulfide	5/17/2000	5.4	ug/l	5	-	
MW-7	cis-1,2-Dichloroethene	5/17/2000	5.7	ug/l	5	70	
MW-8	Antimony, total	5/17/2000	0.0054	mg/l	0.005	-	
MW-8	Barium, total	5/17/2000	0.12	mg/l	0.005	2	
MW-8	Chromium, total	5/17/2000	0.008	mg/l	0.002	0.05	
MW-8	Cobalt, total	5/17/2000	0.0079	mg/l	0.005	-	
MW-8	Copper, total	5/17/2000	0.0056	mg/l	0.002	1	
MW-8	Nickel, total	5/17/2000	0.0095	mg/l	0.005	0.1	
MW-8	Vanadium	5/17/2000	0.008	mg/l	0.005	-	
MW-8	Zinc, total	5/17/2000	0.048	mg/l	0.01	2.1	
SW-3	Barium, total	5/17/2000	0.032	mg/l	0.005	2	
SW-3	Cobalt, total	5/17/2000	0.011	mg/l	0.005	-	
SW-5	Barium, total	5/17/2000	0.056	mg/l	0.005	2	
SW-5	Cobalt, total	5/17/2000	0.0084	mg/l	0.005	-	

[1] Table only contains detected constituents.

[2] PQL = Practical Quantitation Limit

[3] MCL = Maximam Contaminant Level (North Carolina Groundwater Standard)

Statistical Analyses Summary

Inter-Well Analyses Summary
Alexander County Landfill

Background Well(s): MW-1, MW-1A

Arsenic, total

%ND	Normality	Method	ND Adj.	Upper Limit (α = 95%)	Unit
96.30	-	Poisson tolerance interval	ND	14	ug/l

Well	Result	Significance
MW-5	7.8	no

Barium, total

%ND	Normality	Method	ND Adj.	Upper Limit (α = 95%)	Unit
33.33	no	Non-parametric tolerance interval	1/2 ND	1000	ug/l

Well	Result	Significance
MW-3	68	no
MW-4R	110	no
MW-5	380	no
MW-6	210	no
MW-8	120	no
SW-5	56	no

Beryllium, total

%ND	Normality	Method	ND Adj.	Upper Limit (α = 95%)	Unit
81.48	-	Non-parametric tolerance interval	½ ND	12.5	ug/l

Well	Result	Significance
MW-5	6.6	no

Chromium, total

%ND	Normality	Method	ND Adj.	Upper Limit (α = 95%)	Unit
22.22	log-normal	Parametric tolerance interval	½ ND	5.84241	log[ug/l]

Well	Result	Significance
MW-3	2.10413	no
MW-5	5.43808	no
MW-6	3.36730	no
MW-7	2.09186	no
MW-8	2.02815	no

Cobalt, total

%ND	Normality	Method	ND Adj.	Upper Limit (α = 95%)	Unit
22.22	no	Non-parametric tolerance interval	½ ND	770	ug/l

Well	Result	Significance
MW-4R	200	no
MW-5	64	no
MW-6	31	no

Copper, total

%ND	Normality	Method	ND Adj.	Upper Limit (α = 95%)	Unit
66.67	-	Non-parametric tolerance interval	½ ND	260	ug/l

Well	Result	Significance
MW-4R	4.4	no
MW-5	120	no
MW-6	20	no
MW-8	5.6	no

Lead, total

%ND	Normality	Method	ND Adj.	Upper Limit (α = 95%)	Unit
62.96	-	Non-parametric tolerance interval	½ ND	75	ug/l

Well	Result	Significance
MW-5	18	no

Nickel, total

%ND	Normality	Method	ND Adj.	Upper Limit (α = 95%)	Unit
59.26	-	Non-parametric tolerance interval	½ ND	260	ug/l

Well	Result	Significance
MW-3	63	no
MW-5	130	no
MW-6	22	no

Silver, total

%ND	Normality	Method	ND Adj.	Upper Limit (α = 95%)	Unit
100	-	Poisson tolerance interval	ND	11	ug/l

Well	Result	Significance
MW-4R	2.5	no

Vanadium

%ND	Normality	Method	ND Adj.	Upper Limit (α = 95%)	Unit
55.56	-	Non-parametric tolerance interval	½ ND	330	ug/l

Well	Result	Significance
MW-5	190	no
MW-6	15	no
MW-8	8	no

Zinc, total

%ND	Normality	Method	ND Adj.	Upper Limit (α = 95%)	Unit
18.52	log-normal	Parametric tolerance interval	½ ND	5.97437	log[ug/l]

Well	Result	Significance
MW-4R	4.34381	no
MW-5	5.85793	no
MW-6	3.85015	no
MW-8	3.87120	no

NOTE: Bold-faced monitoring points indicate detected levels exceed North Carolina Groundwater Standard.

Summary of Pooled VOCs in Background Wells (MW-1 & MW-1A)
Alexander County Closed Landfill

Constituent	Samples	NDs	% NDs
1,1,1,2-Tetrachloroethane	27	27	100.00
1,1,1-Trichloroethane	27	27	100.00
1,1,2,2-Tetrachloroethane	27	27	100.00
1,1,2-Trichloroethane	27	27	100.00
1,1-Dichloroethane	27	11	40.74
1,1-Dichloroethene	27	27	100.00
1,2,3-Trichloropropane	27	27	100.00
1,2-Dibromo-3-chloropropane	27	27	100.00
1,2-Dibromoethane	27	27	100.00
1,2-Dichlorobenzene	27	27	100.00
1,2-Dichloroethane	27	27	100.00
1,2-Dichloropropane	27	27	100.00
1,4-Dichlorobenzene	27	27	100.00
2-Butanone	27	27	100.00
2-Hexanone	27	27	100.00
4-Methyl-2-Pentanone	27	27	100.00
Acetone	27	27	100.00
Acrylonitrile	27	27	100.00
Benzene	27	24	88.89
Bromochloromethane	27	26	96.30
Bromodichloromethane	27	27	100.00
Bromoform	27	27	100.00
Bromomethane	27	27	100.00
Carbon disulfide	27	24	88.89
Carbon tetrachloride	27	27	100.00
Chlorobenzene	27	27	100.00
Chloroethane	27	25	92.59
Chloroform	27	27	100.00
Chloromethane	27	27	100.00
cis-1,2-Dichloroethene	27	22	81.48
cis-1,3-Dichloropropene	27	27	100.00
Chlorodibromomethane	27	27	100.00
Dibromomethane	27	27	100.00
Ethylbenzene	27	27	100.00
Iodomethane	27	27	100.00
Dichloromethane	27	27	100.00
Styrene	27	27	100.00
Tetrachloroethylene	27	27	100.00
Toluene	27	27	100.00
trans-1,2-Dichloroethene	27	27	100.00
trans-1,3-Dichloropropene	27	27	100.00
trans-1,4-Dichloro-2-butene	25	25	100.00
Trichloroethylene	27	27	100.00
Trichlorofluoromethane	27	27	100.00
Vinyl acetate	25	25	100.00
Vinyl chloride	27	27	100.00
Xylene	27	25	92.59
Total	**1265**	**1233**	**97.47**

Poisson Prediction Interval Based upon Pooled Background VOCs
Alexander County Closed Landfill

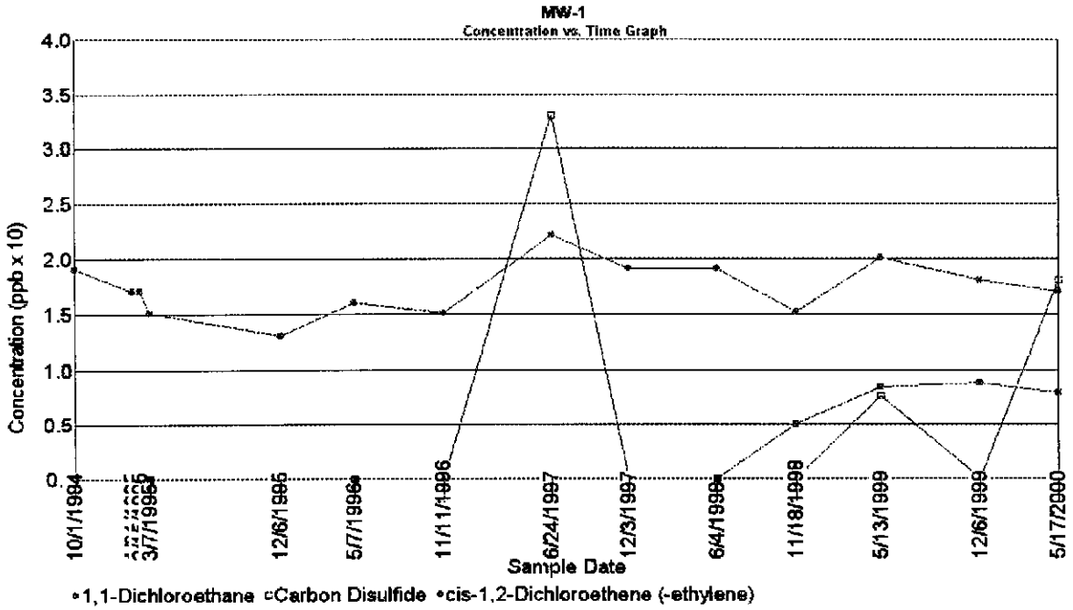
All detected VOCs (Background Wells: MW-1 & MW-1A)

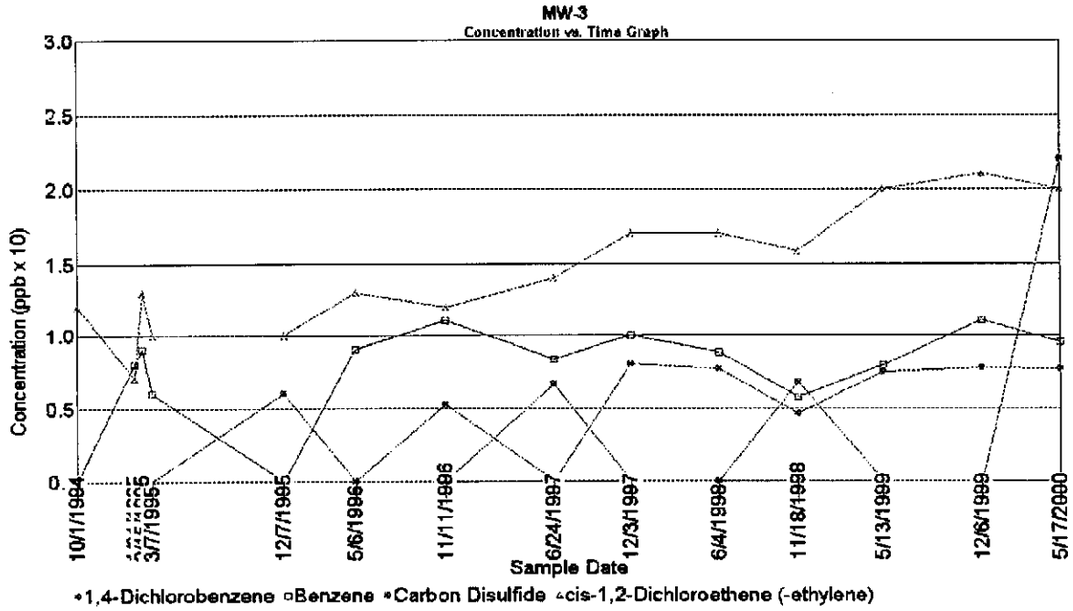
Constituent	MW-1	MW-3	MW-4R	MW-5	MW-6	MW-7
1,1-Dichloroethane	x		x	x		x
1,4-Dichlorobenzene		x				
Benzene		x				
Carbon disulfide	x	x	x	x	x	x
cis-1,2-Dichloroethene	x	x	x			x
Detection(s) per Scan	-	4.00	3.00	2.00	1.00	3.00

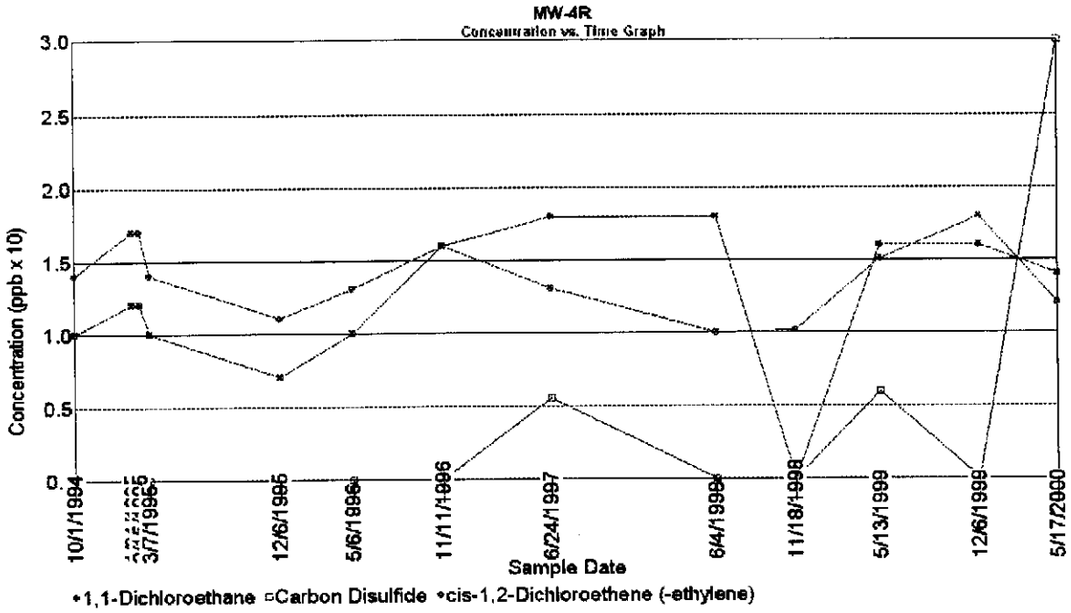
Total number of sampling events [n] = 26.91489362
Total number of detections in background wells [y] = 32
Number of comparisons (downgradient wells) [k] = 8
One-sided value of Student's t-statistic (95% confidence) [t] = 2.66
Expected number of detections in a single future sample [y*] = **4.28**

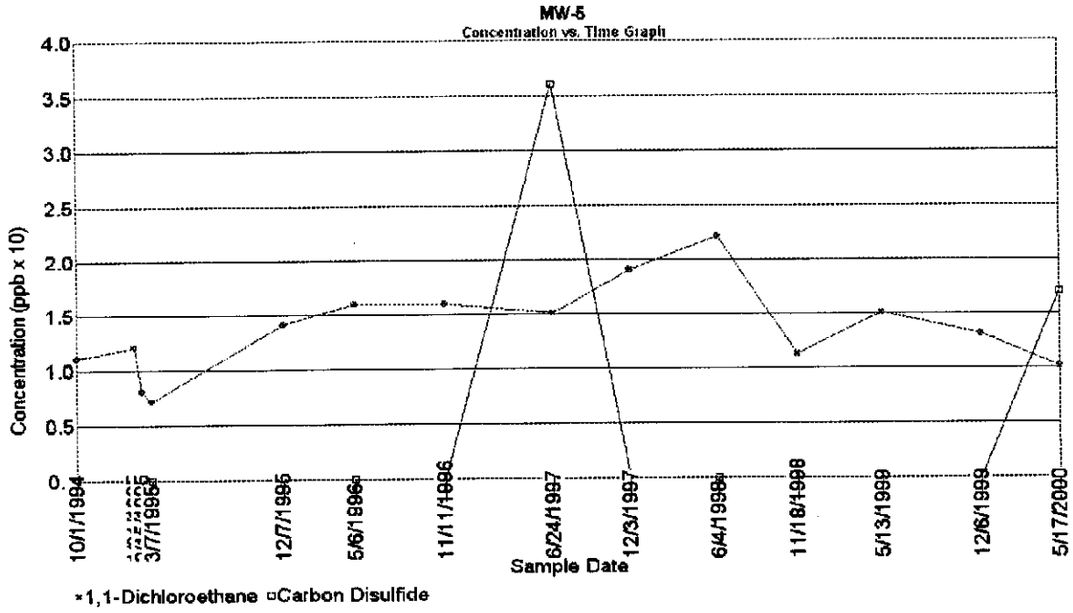
No statistically significant VOC detections at 95% confidence level

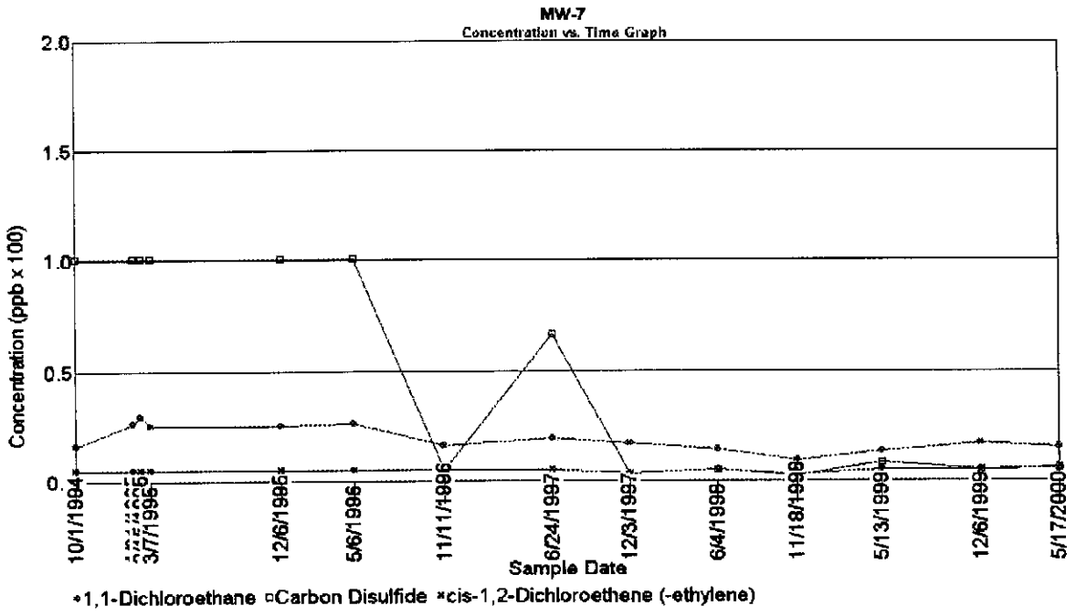
Box Plots for Select Constituents (VOC)
Alexander County Closed Landfill

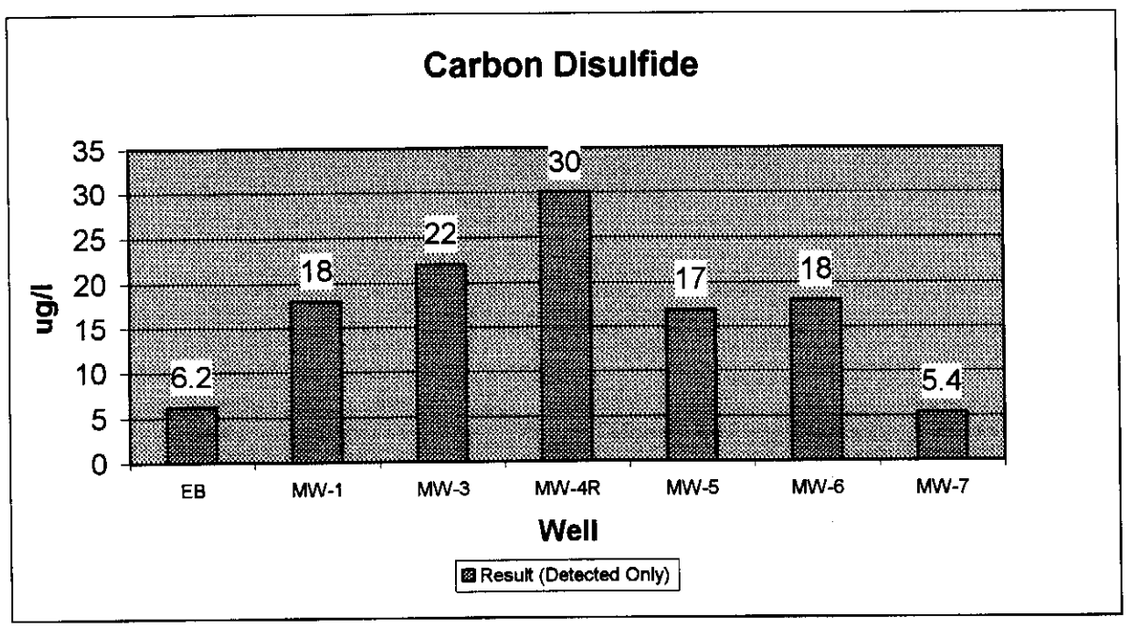




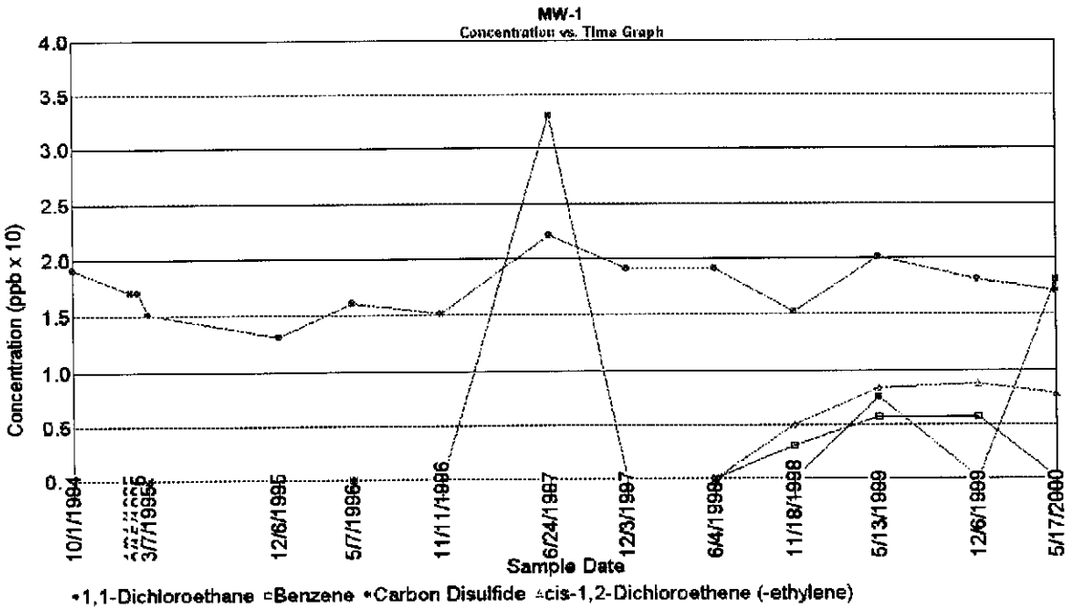

MW-4R
Concentration vs. Time Graph
Concentration (ppb x 10)
3.0
2.5
2.0
1.5
1.0
0.5
0.
10/1/1994
3/7/1995
12/6/1995
5/6/1996
11/11/1996
6/24/1997
6/4/1998
11/18/1998
5/13/1999
12/6/1999
5/17/2000
Sample Date
1,1-Dichloroethane
Carbon Disulfide
cis-1,2-Dichloroethene (-ethylene)

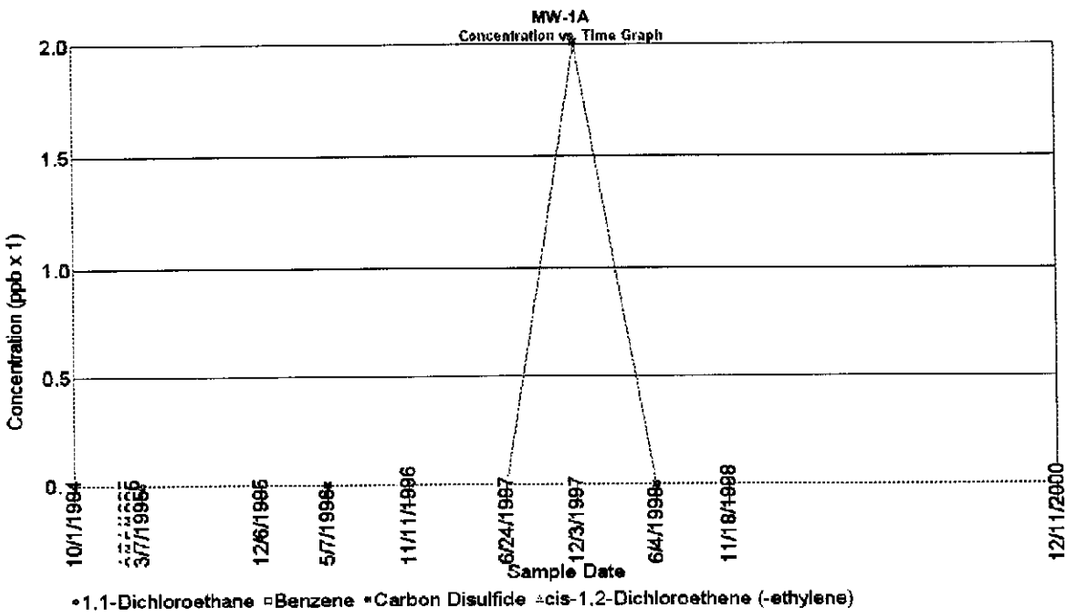

MW-5
Concentration vs. Time Graph
Concentration (ppb x 10)
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.
10/1/1994
3/7/1995
12/7/1995
5/6/1996
11/11/1996
6/24/1997
12/3/1997
6/4/1998
11/18/1998
5/13/1999
12/6/1999
5/17/2000
Sample Date
1,1-Dichloroethane
Carbon Disulfide


MW-7
Concentration vs. Time Graph
Concentration (ppb x 100)
2.0
1.5
1.0
0.5
0.
10/1/1994
3/7/1996
12/6/1995
5/6/1996
11/11/1996
6/24/1997
12/3/1997
6/4/1998
11/18/1998
5/13/1999
12/6/1999
5/17/2000
Sample Date
1,1-Dichloroethane
Carbon Disulfide
cis-1,2-Dichloroethene (-ethylene)

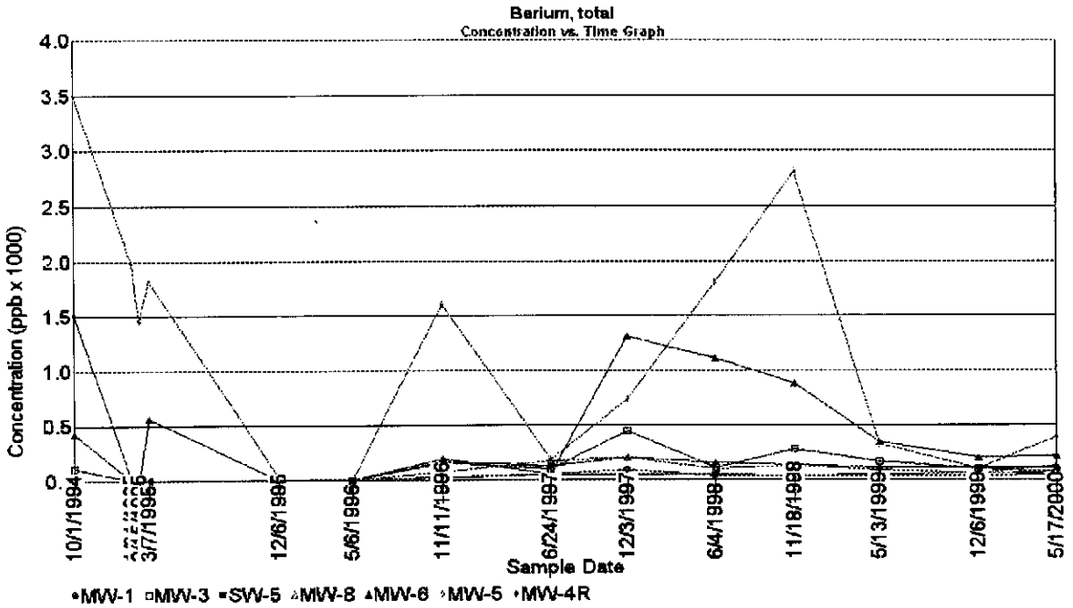

Carbon Disulfide
ug/l
35
30
25
20
15
10
5
0
6.2
18
22
30
17
18
5.4
EB
MW-1
MW-3
MW-4R
MW-5
MW-6
MW-7
Well
Result (Detected Only)

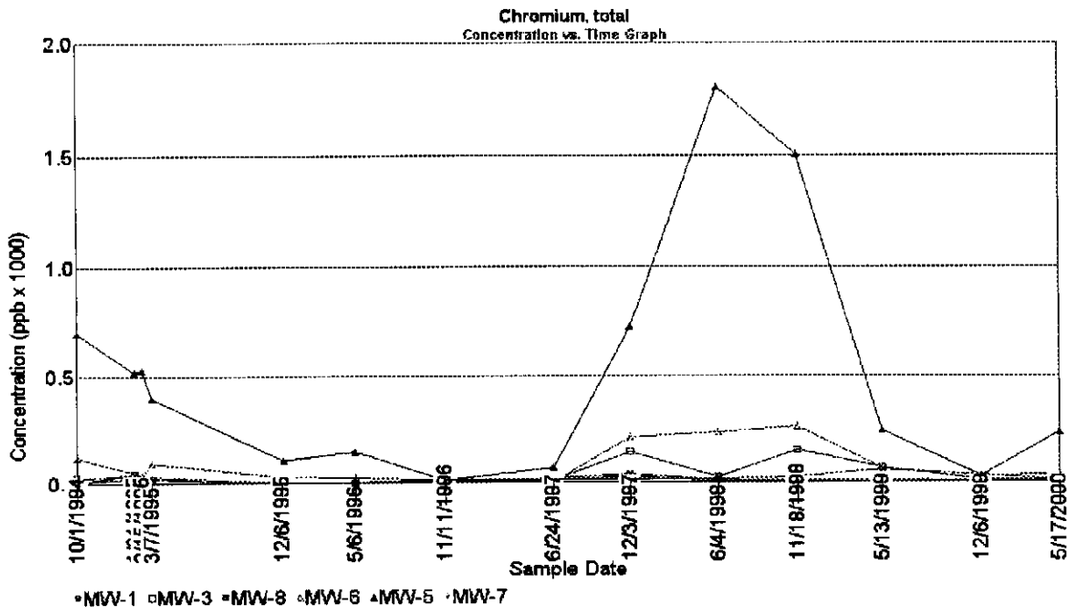
Box Plots for Select Constituents (VOC)
Background Wells
Alexander County Closed Landfill

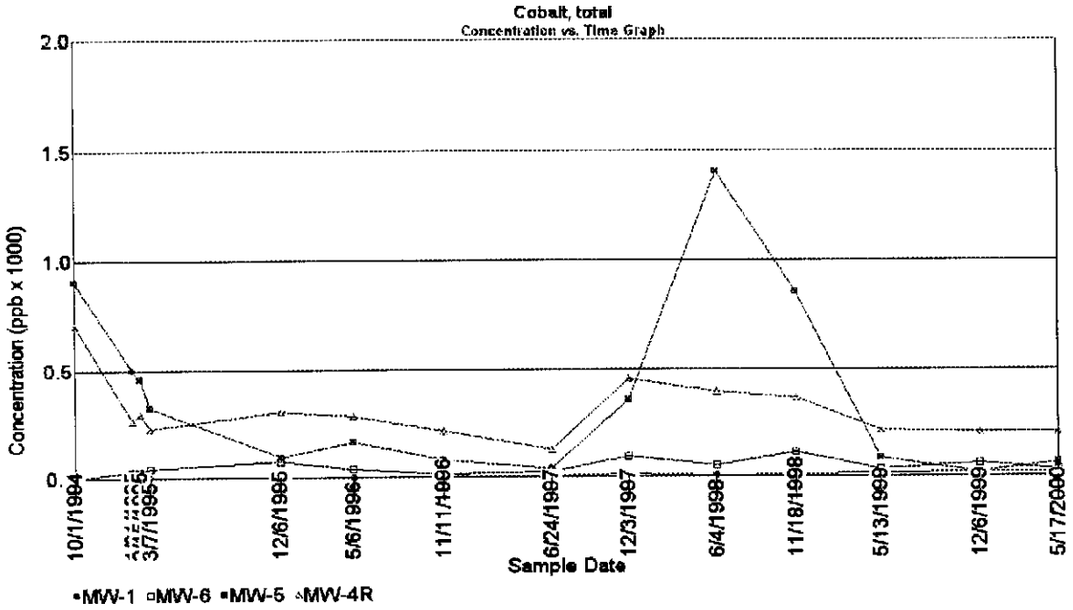


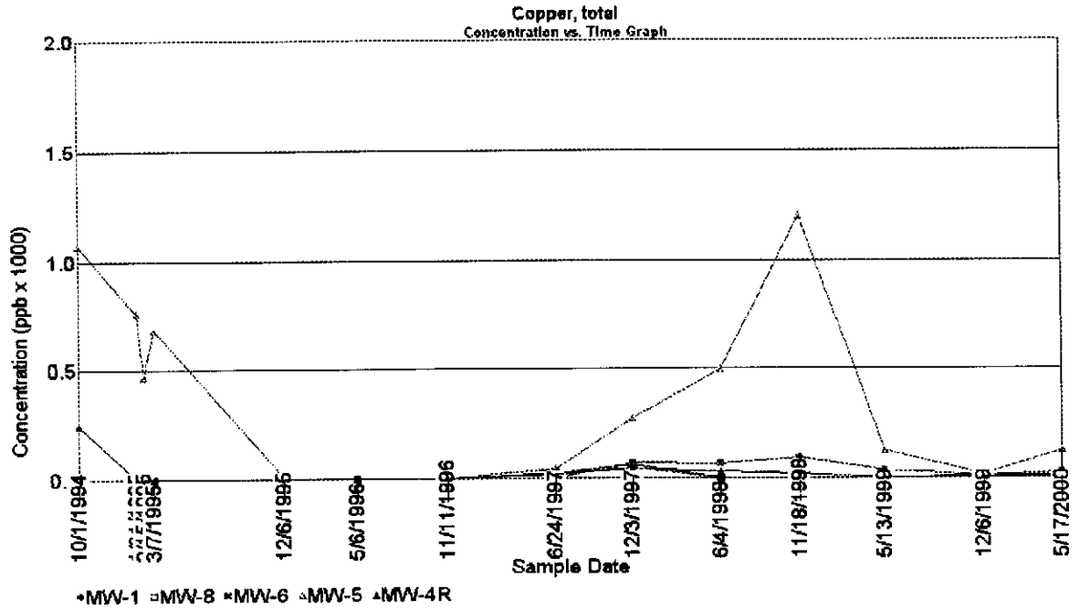


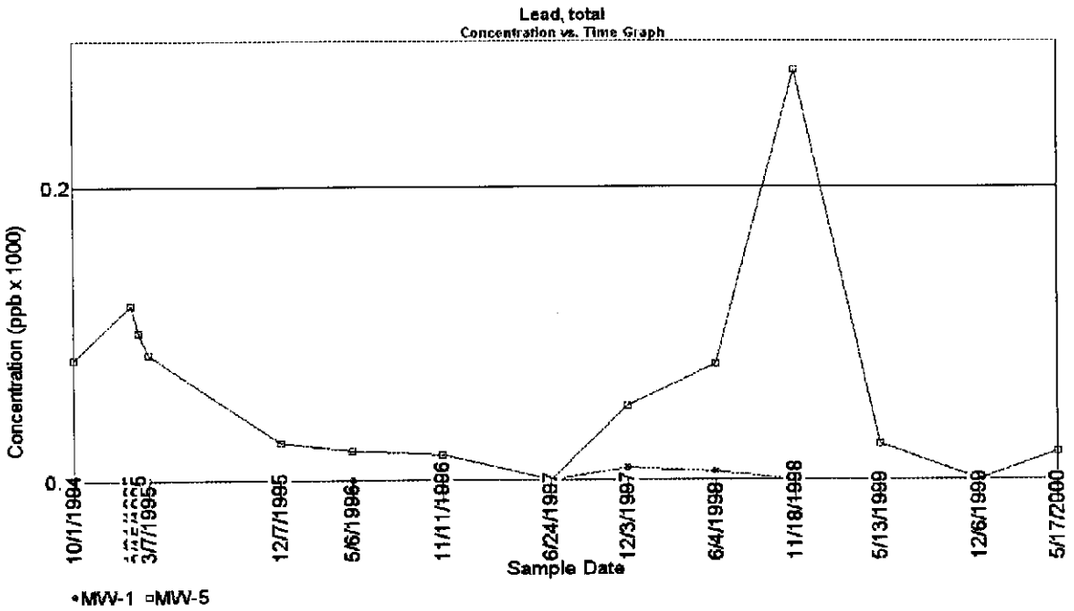
Box Plots for Select Constituents (Metals)
Alexander County Closed Landfill

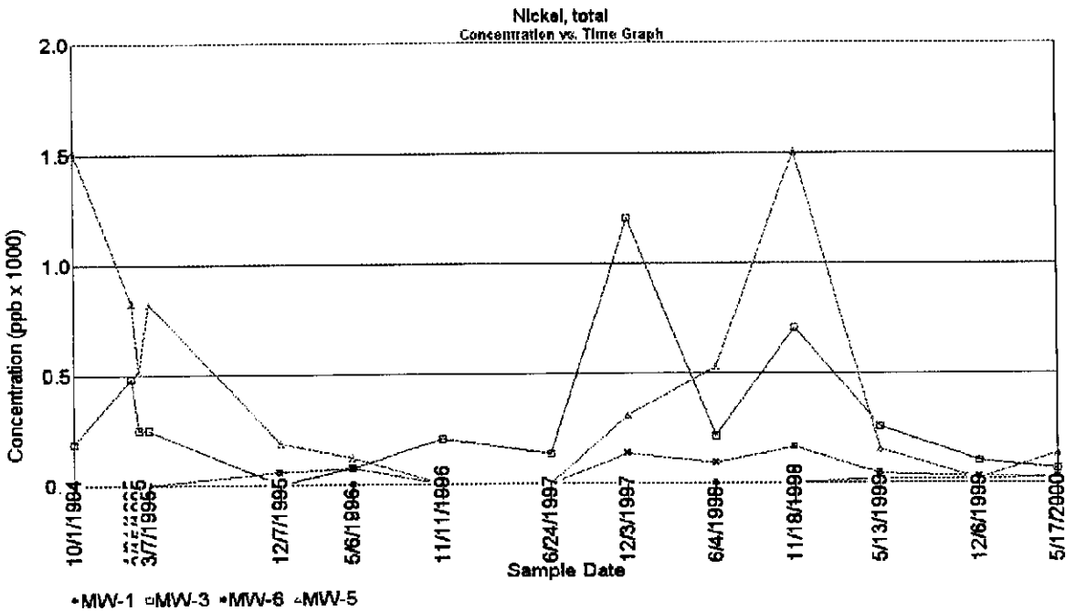


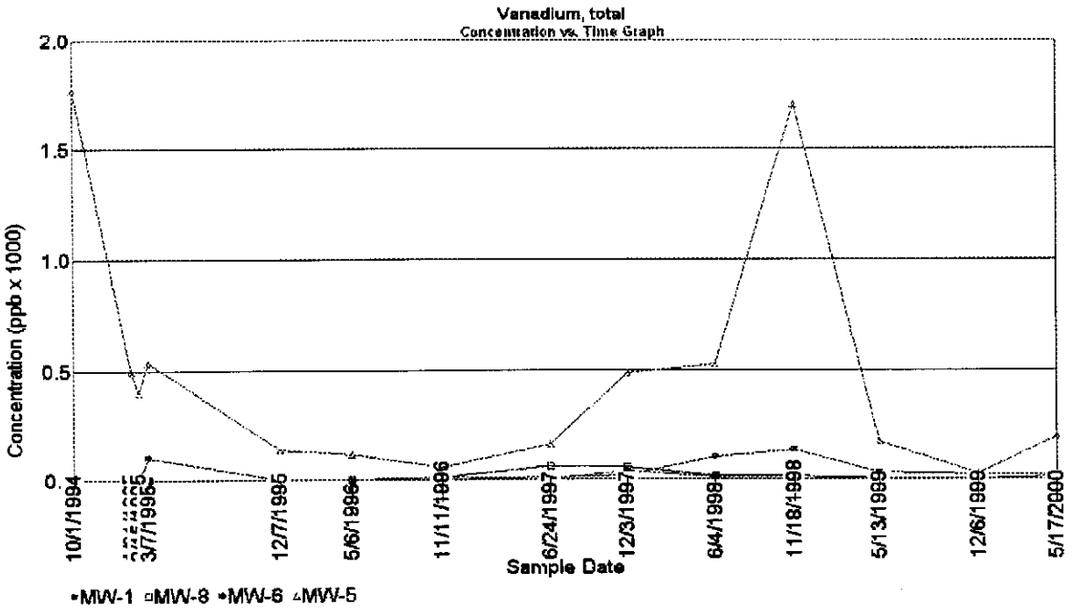


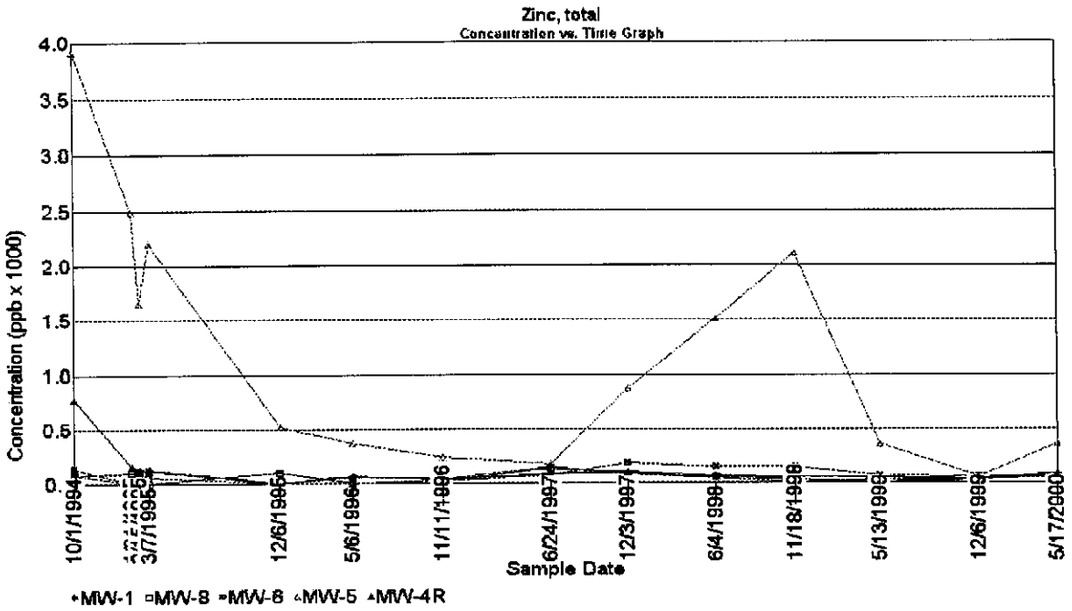

Cobalt, total
Concentration vs. Time Graph
Concentration (ppb x 1000)
2.0
1.5
1.0
0.5
0.
10/1/1994
3/7/1995
12/6/1995
5/6/1996
11/11/1996
6/24/1997
12/3/1997
6/4/1998
11/18/1998
5/13/1999
12/6/1999
5/17/2000
Sample Date
MW-1 MW-6 MW-5 MW-4R

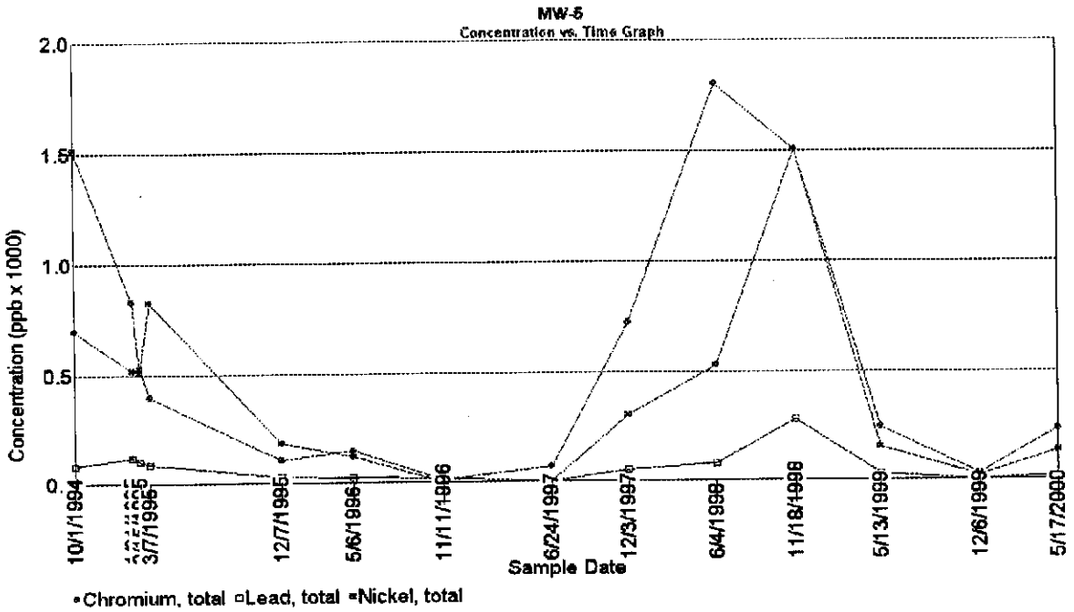

Copper, total
Concentration vs. Time Graph
Concentration (ppb x 1000)
2.0
1.5
1.0
0.5
0.
10/1/1994
3/7/1995
12/6/1995
5/6/1996
11/11/1996
6/24/1997
12/3/1997
6/4/1998
11/18/1998
5/13/1999
12/6/1999
5/17/2000
Sample Date
MW-1 MW-8 MW-6 MW-5 MW-4R

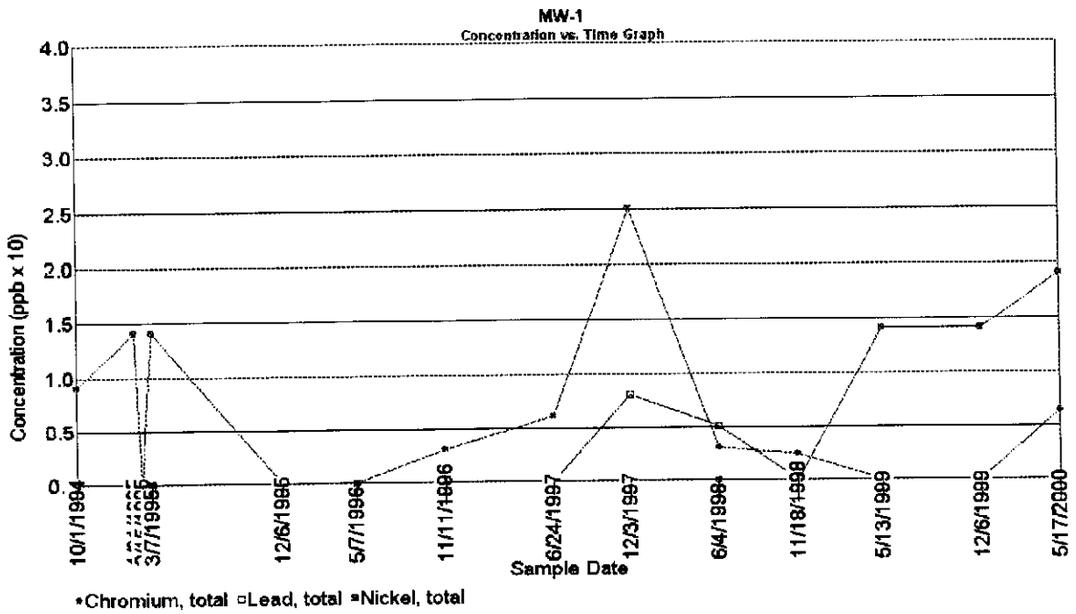

Lead, total
Concentration vs. Time Graph
Concentration (ppb x 1000)
0.2
0.
10/1/1994
3/7/1995
12/7/1995
5/6/1996
11/11/1996
6/24/1997
12/3/1997
6/4/1998
11/18/1998
5/13/1999
12/6/1999
5/17/2000
Sample Date
MW-1 MW-5


Nickel, total
Concentration vs. Time Graph
Concentration (ppb x 1000)
2.0
1.5
1.0
0.5
0.
10/1/1994
3/7/1995
12/7/1995
5/6/1996
11/11/1996
6/24/1997
12/3/1997
6/4/1998
11/18/1998
5/13/1999
12/6/1999
5/17/2000
Sample Date
MW-1 MW-3 MW-6 MW-5

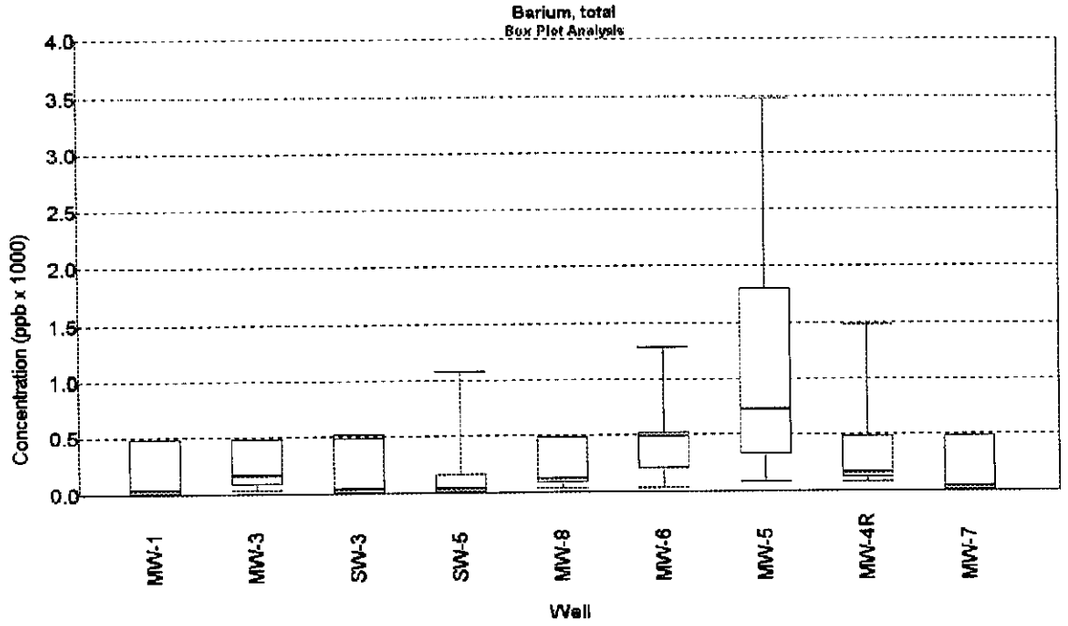

Vanadium, total
Concentration vs. Time Graph
Concentration (ppb x 1000)
2.0
1.5
1.0
0.5
0.
10/1/1994
3/7/1995
12/7/1995
5/6/1996
11/11/1996
6/24/1997
12/3/1997
6/4/1998
11/18/1998
5/13/1999
12/6/1999
5/17/2000
Sample Date
MW-1 MW-8 MW-6 MW-5

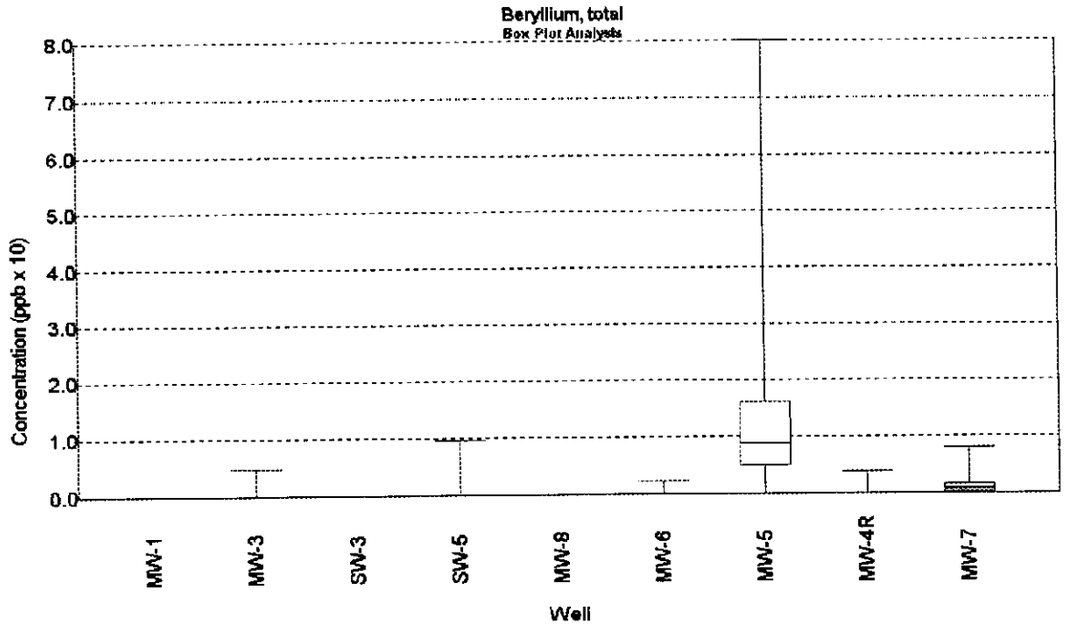

Zinc, total
Concentration vs. Time Graph
Concentration (ppb x 1000)
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.
10/1/1994
3/7/1995
12/6/1995
5/6/1996
11/11/1996
6/24/1997
12/3/1997
6/4/1998
11/18/1998
5/13/1999
12/6/1999
5/17/2000
Sample Date
MW-1 MW-8 MW-6 MW-5 MW-4R

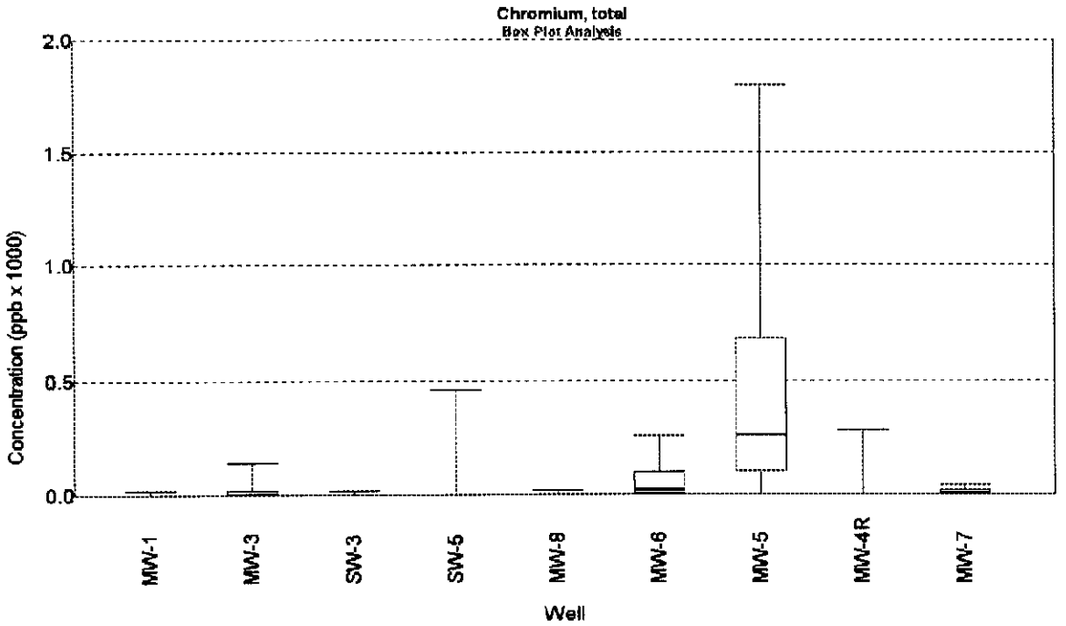

MW-5
Concentration vs. Time Graph
Concentration (ppb x 1000)
2.0
1.5
1.0
0.5
0.
10/1/1994
3/7/1996
12/7/1995
5/6/1996
11/11/1996
6/24/1997
12/3/1997
6/4/1998
11/18/1998
5/13/1999
12/6/1999
5/17/2000
Sample Date
•Chromium, total ▫Lead, total ▪Nickel, total

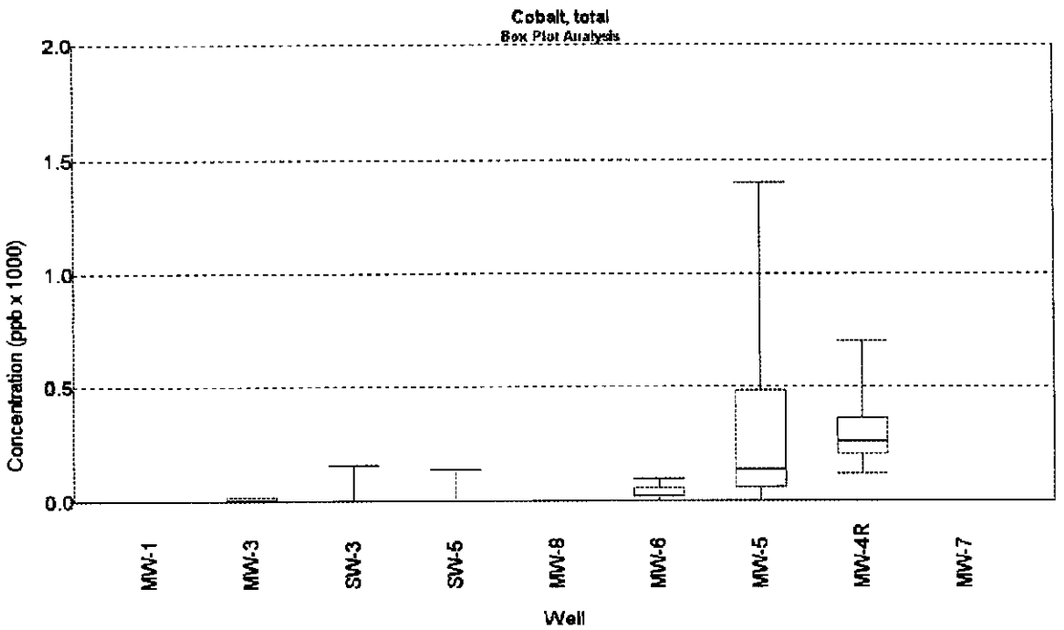

MW-1
Concentration vs. Time Graph
Concentration (ppb x 10)
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.
10/1/1994
3/7/1996
12/6/1995
5/7/1996
11/11/1996
6/24/1997
12/3/1997
6/4/1998
11/18/1998
5/13/1999
12/6/1999
5/17/2000
Sample Date
•Chromium, total ▫Lead, total ▪Nickel, total

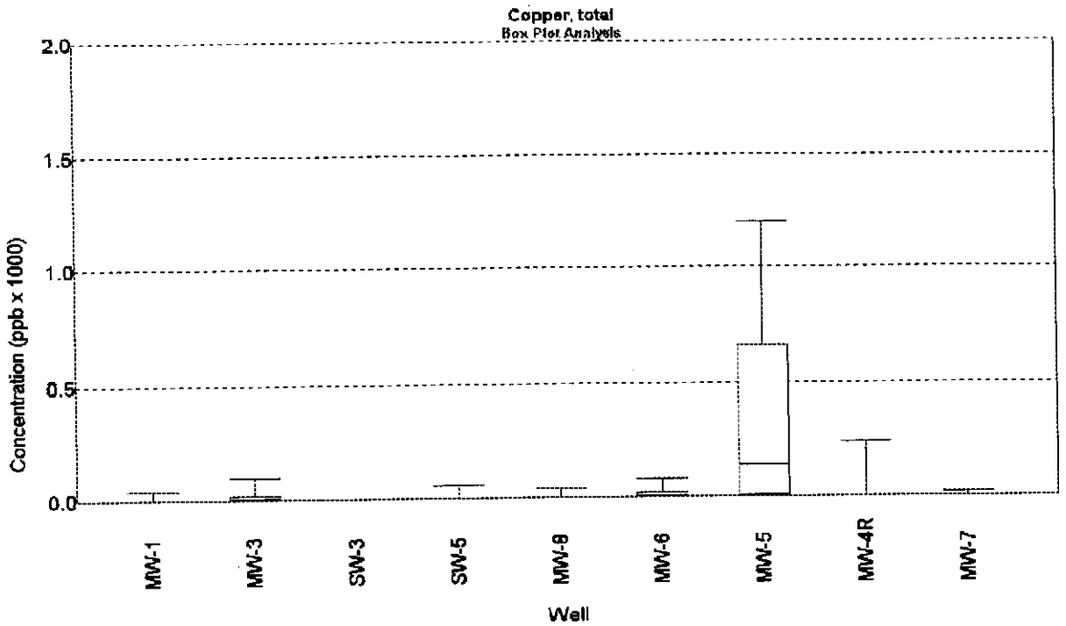
Box Plots for Select Constituents (Metals)
Alexander County Closed Landfill

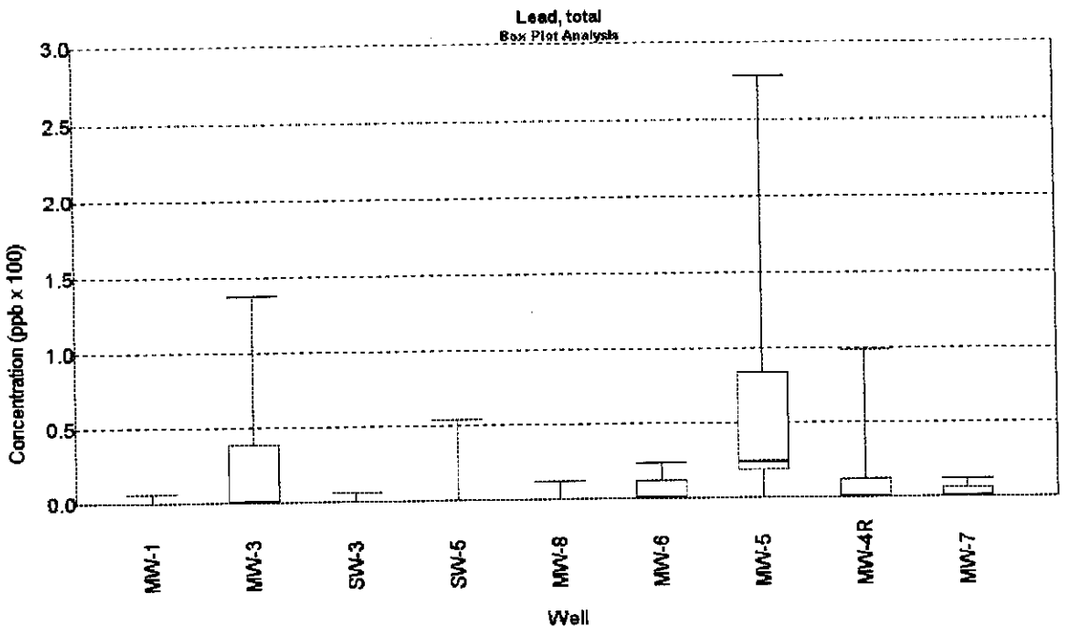


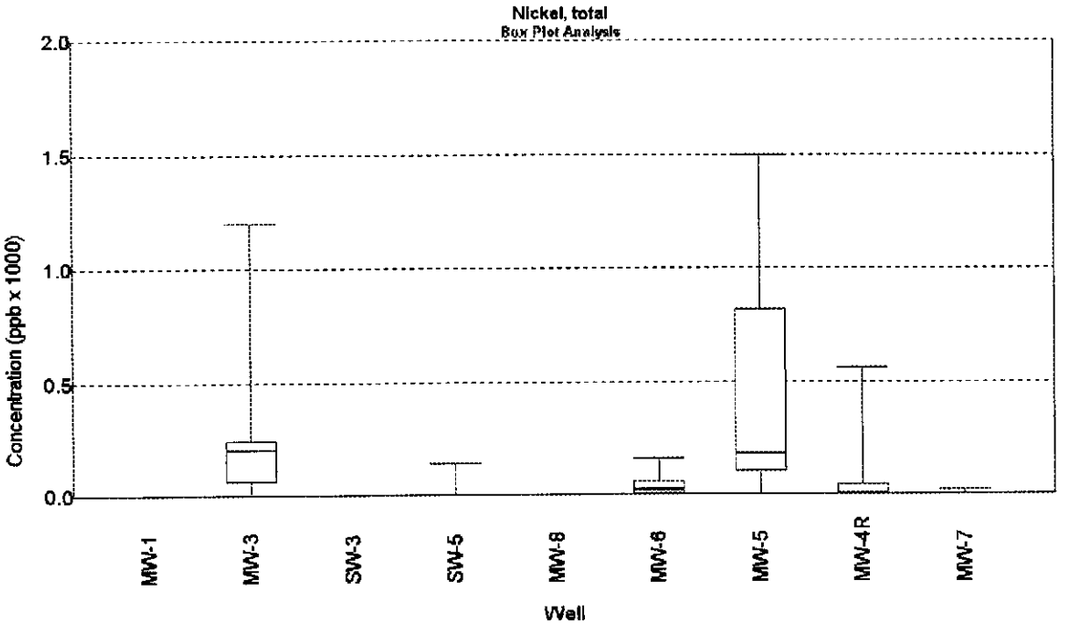


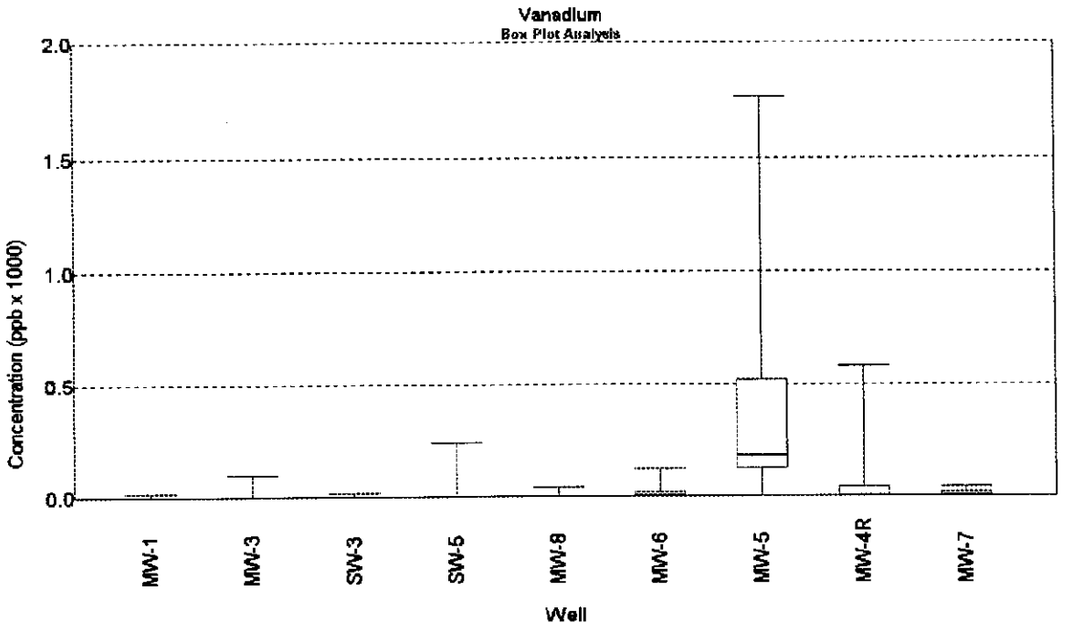

Chromium, total
Box Plot Analysis
2.0
1.5
1.0
0.5
0.0
Concentration (ppb x 1000)
MW-1
MW-3
SW-3
SW-5
MW-8
MW-6
MW-5
MW-4R
MW-7
Well

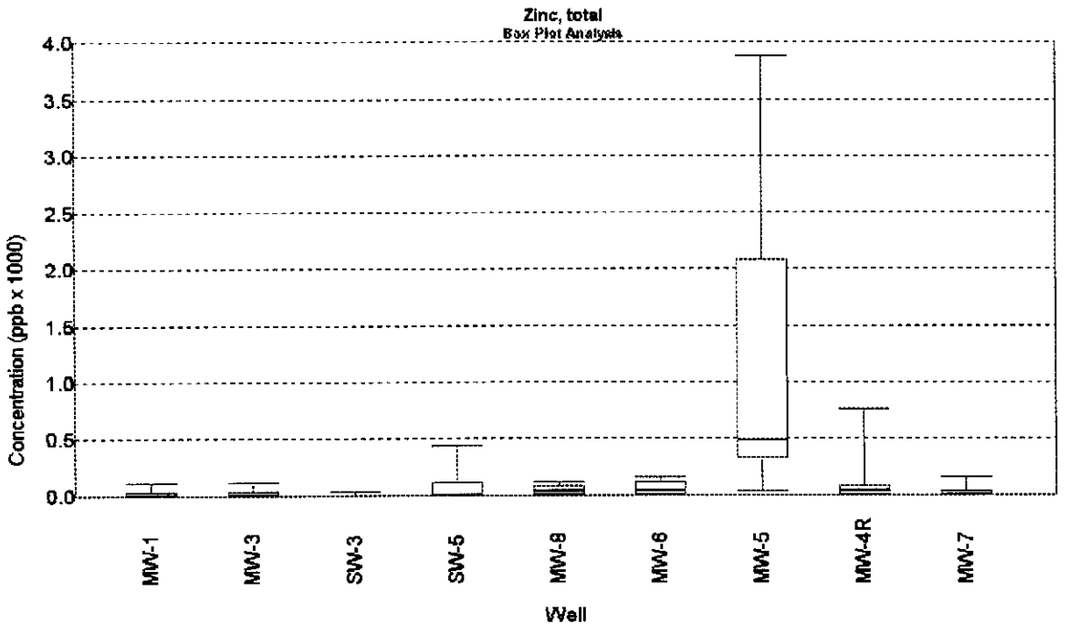

Cobalt, total
Box Plot Analysis
2.0
1.5
1.0
0.5
0.0
Concentration (ppb x 1000)
MW-1
MW-3
SW-3
SW-5
MW-8
MW-6
MW-5
MW-4R
MW-7
Well


Copper, total
Box Plot Analysis
Concentration (ppb x 1000)
2.0
1.5
1.0
0.5
0.0
MW-1
MW-3
SW-3
SW-5
MW-8
MW-6
MW-5
MW-4R
MW-7
Well

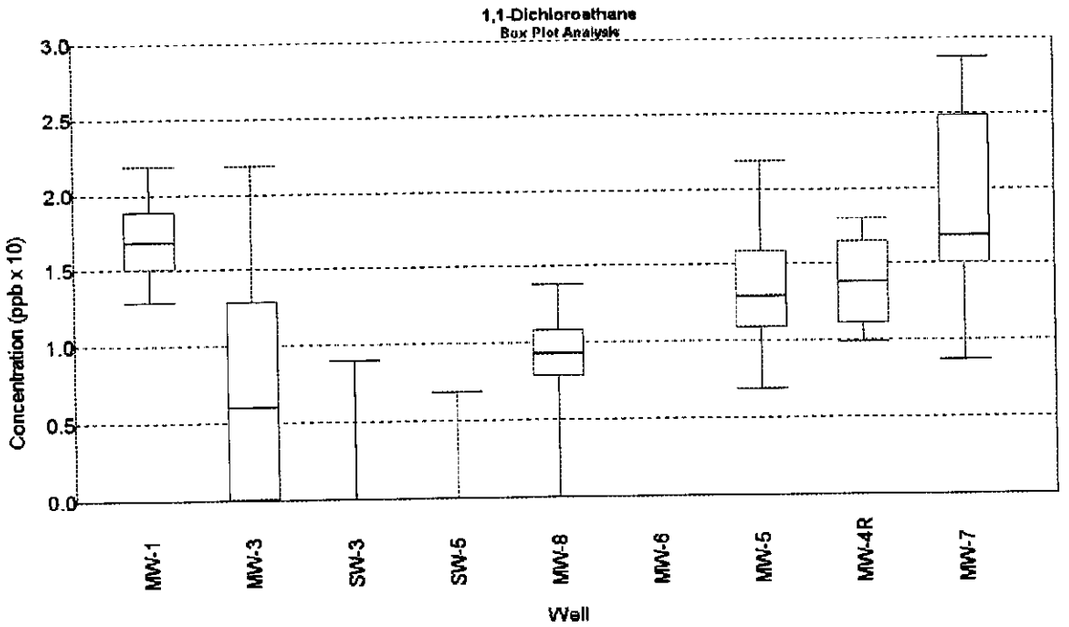

Lead, total
Box Plot Analysis
Concentration (ppb x 100)
3.0
2.5
2.0
1.5
1.0
0.5
0.0
MW-1
MW-3
SW-3
SW-5
MW-8
MW-6
MW-5
MW-4R
MW-7
Well

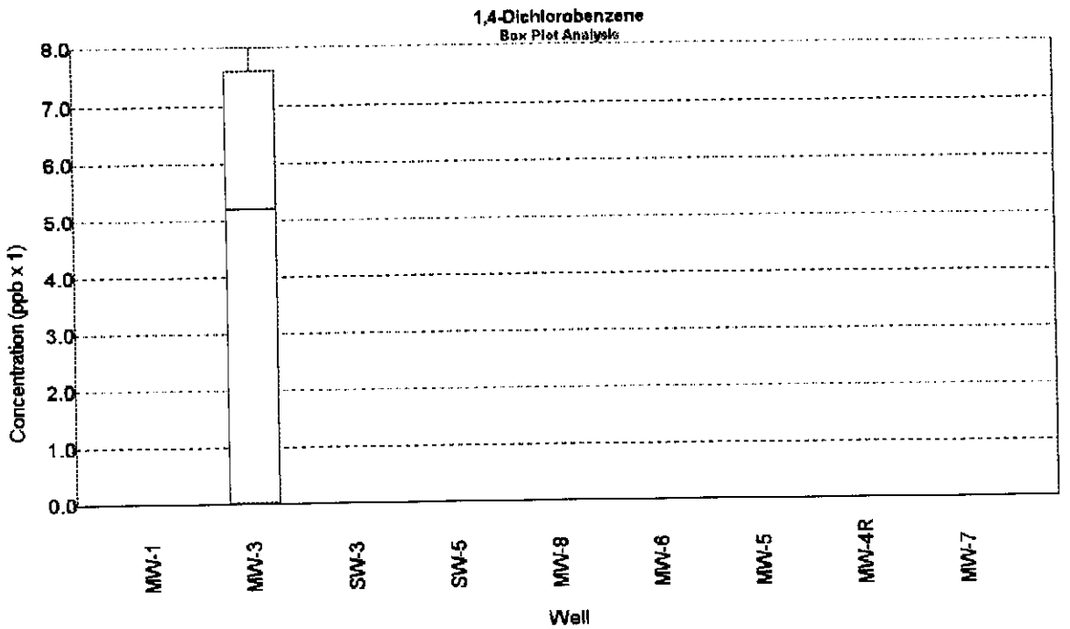

Nickel, total
Box Plot Analysis
2.0
1.5
1.0
0.5
0.0
Concentration (ppb x 1000)
MW-1
MW-3
SW-3
SW-5
MW-8
MW-6
MW-5
MW-4R
MW-7
Well

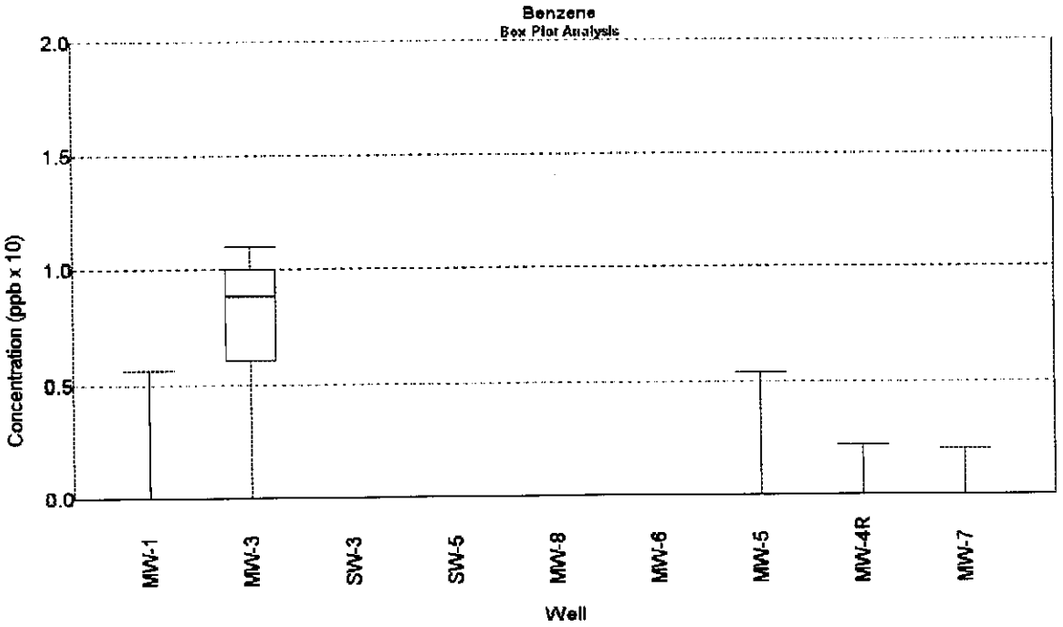

Vanadium
Box Plot Analysis
2.0
1.5
1.0
0.5
0.0
Concentration (ppb x 1000)
MW-1
MW-3
SW-3
SW-5
MW-8
MW-6
MW-5
MW-4R
MW-7
Well

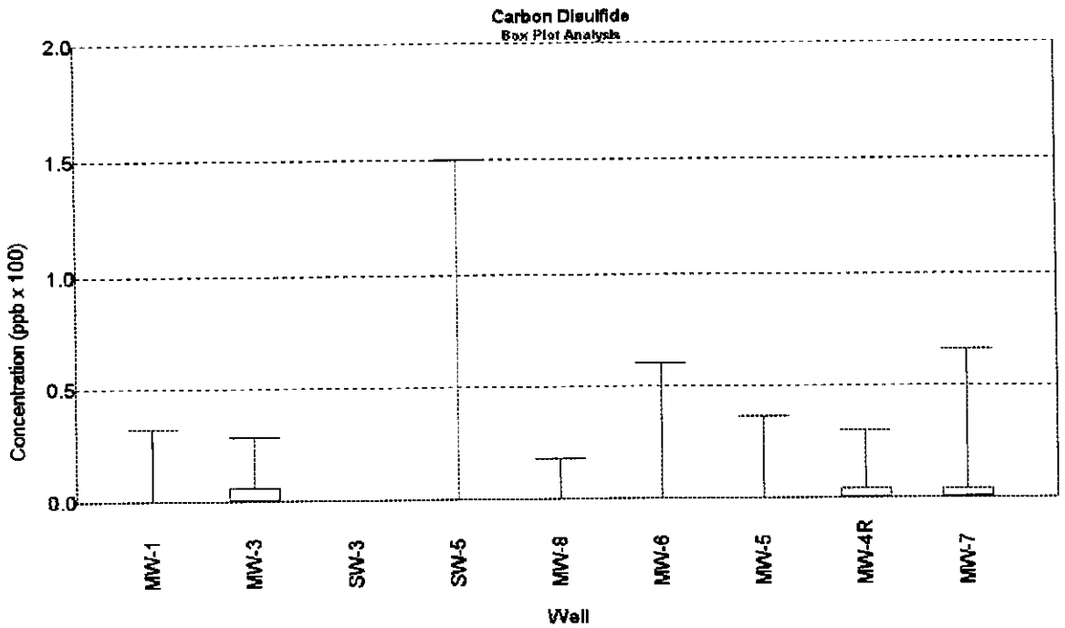

Zinc, total
Box Plot Analysis
Concentration (ppb x 1000)
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
MW-1
MW-3
SW-3
SW-5
MW-8
MW-6
MW-5
MW-4R
MW-7
Well

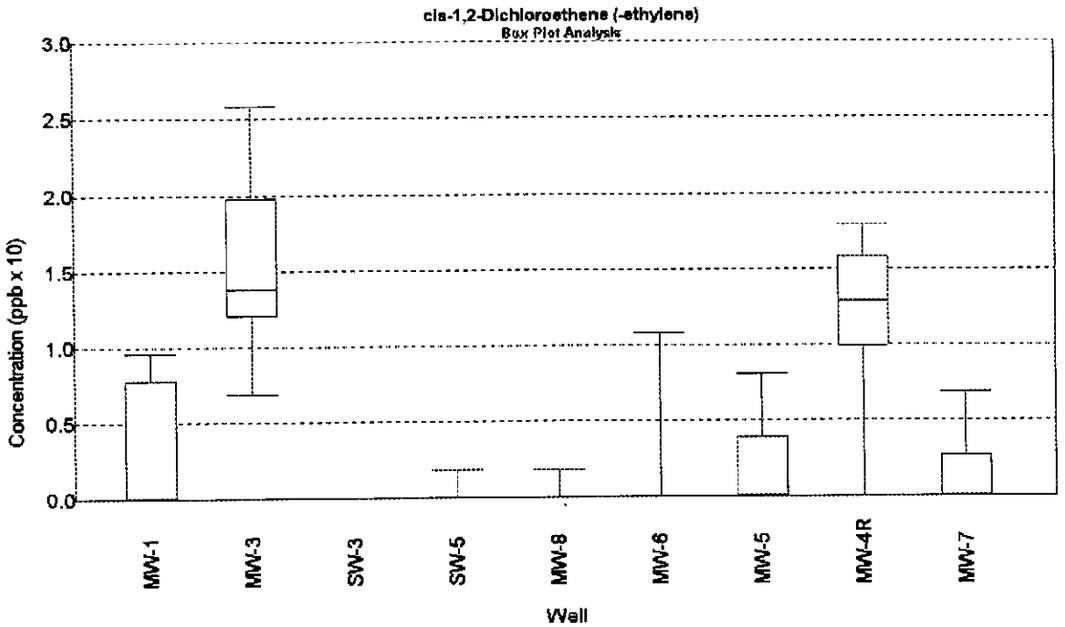
Box Plots for Select Constituents (VOC)
Alexander County Closed Landfill






Benzene
Box Plot Analysis
2.0
1.5
1.0
0.5
0.0
Concentration (ppb x 10)
MW-1
MW-3
SW-3
SW-5
MW-8
MW-6
MW-5
MW-4R
MW-7
Well


Carbon Disulfide
Box Plot Analysis
2.0
1.5
1.0
0.5
0.0
Concentration (ppb x 100)
MW-1
MW-3
SW-3
SW-5
MW-8
MW-6
MW-5
MW-4R
MW-7
Well


cis-1,2-Dichloroethene (-ethylene)
Box Plot Analysis
Concentration (ppb x 10)
3.0
2.5
2.0
1.5
1.0
0.5
0.0
MW-1
MW-3
SW-3
SW-5
MW-8
MW-6
MW-5
MW-4R
MW-7
Well

Basic Statistics

Basic Statistics
Parameter: Arsenic, total

Total Observations	159
Total Non-Detects	149
Pooled Mean	7.7283
Pooled Std Dev	3.7385
Background Mean	8.18519
Background Std Dev	3.78293

Background Wells
There are 2 background wells

Well	Samples	Non-Detects	% ND	Total
MW-1	15	15	100	105
MW-1A	12	11	91.6667	116

Well	Mean	Std Dev	Std Err	Rank Sum	Rank Mean
MW-1	7	2.53546	0	1125	75
MW-1A	9.66667	4.6188	0	982	81.8333

Compliance Wells
There are 20 compliance wells

Well	Samples	Non-Detects	% ND	Total
MW-2	7	7	100	65
MW-3	15	15	100	105
MW-4	1	1	100	10
MW-4R	15	15	100	105
MW-5	15	9	60	137.2
MW-6	15	15	100	120
MW-7	15	15	100	105
MW-8	15	15	100	105
SW-2	2	2	100	20
SW-3	15	15	100	105
SW-4	1	1	100	10
SW-5	8	7	87.5	71
SW-1	1	1	100	5
MW-10	1	1	100	5
MW-11	1	0	0	10
MW-12	1	0	0	9.6
MW-13	1	1	100	5
MW-15	1	1	100	5
MW-9	1	1	100	5
MW-14	1	1	100	5

Well	Mean	Std Dev	Dif From Bkg	Std Err	Rank Sum	Rank Mean
MW-2	9.28571	1.88982	1.10053	1.61352	525	75
MW-3	7	2.53546	-1.18519	1.22508	1125	75
MW-4	10	0	1.81481	3.87404	75	75
MW-4R	7	2.53546	-1.18519	1.22508	1125	75
MW-5	9.14667	5.11103	0.961481	1.22508	1593	106.2
MW-6	8	4.14039	-0.185185	1.22508	1125	75
MW-7	7	2.53546	-1.18519	1.22508	1125	75
MW-8	7	2.53546	-1.18519	1.22508	1125	75
SW-2	10	0	1.81481	2.78785	150	75
SW-3	7	2.53546	-1.18519	1.22508	1125	75

SW-4	10	0	1.81481	3.87404	75	75
SW-5	8.875	9.10945	0.689815	1.53135	684	85.5
SW-1	5	0	-3.18519	3.87404	75	75
MW-10	5	0	-3.18519	3.87404	75	75
MW-11	10	0	1.81481	3.87404	156	156
MW-12	9.6	0	1.41481	3.87404	155	155
MW-13	5	0	-3.18519	3.87404	75	75
MW-15	5	0	-3.18519	3.87404	75	75
MW-9	5	0	-3.18519	3.87404	75	75
MW-14	5	0	-3.18519	3.87404	75	75

Analysis of Variance Statistics

SS Wells	225.575
SS Total	2208.26

Kruskal-Wallis Statistics

Non-Detect Rank	75
Background Rank Sum	2107
Background Rank Mean	78.037
H Statistic	11.6597
H Adjusted for Ties	65.8497

Basic Statistics
Parameter: Barium, total

Total Observations	159
Total Non-Detects	50
Pooled Mean	423.855
Pooled Std Dev	624.326
Background Mean	371.63
Background Std Dev	321.998

Background Wells
There are 2 background wells

Well	Samples	Non-Detects	% ND	Total
MW-1	15	6	40	2950
MW-1A	12	3	25	7084

Well	Mean	Std Dev	Std Err	Rank Sum	Rank Mean
MW-1	196.667	223.102	0	758	50.5333
MW-1A	590.333	296.303	0	1245.5	103.792

Compliance Wells
There are 20 compliance wells

Well	Samples	Non-Detects	% ND	Total
MW-2	7	5	71.4286	3030
MW-3	15	5	33.3333	4053
MW-4	1	0	0	100
MW-4R	15	5	33.3333	5210
MW-5	15	2	13.3333	17944
MW-6	15	4	26.6667	7333
MW-7	15	5	33.3333	2941
MW-8	15	6	40	3629
SW-2	2	2	100	600
SW-3	15	5	33.3333	3397
SW-4	1	1	100	500
SW-5	8	1	12.5	1852
SW-1	1	0	0	100
MW-10	1	0	0	30
MW-11	1	0	0	830
MW-12	1	0	0	5300
MW-13	1	0	0	110
MW-15	1	0	0	110
MW-9	1	0	0	180
MW-14	1	0	0	110

Well	Mean	Std Dev	Dif From Bkg	Std Err	Rank Sum	Rank Mean
MW-2	432.857	132.503	61.2275	178.152	374.5	53.5
MW-3	270.2	192.728	-101.43	135.263	1179.5	78.6333
MW-4	100	0	-271.63	427.739	95	95
MW-4R	347.333	364.544	-24.2963	135.263	1277.5	85.1667
MW-5	1196.27	1038.27	824.637	135.263	1883	125.533
MW-6	488.867	358.923	117.237	135.263	1499	99.9333
MW-7	196.067	223.451	-175.563	135.263	839.5	55.9667
MW-8	241.933	192.171	-129.696	135.263	1083	72.2
SW-2	300	282.843	-71.6296	307.811	51	25.5
SW-3	226.467	237.256	-145.163	135.263	889.5	59.3

SW-4	500	0	128.37	427.739	25.5	25.5
SW-5	231.5	385.847	-140.13	169.079	617.5	77.1875
SW-1	100	0	-271.63	427.739	99	99
MW-10	30	0	-341.63	427.739	58	58
MW-11	830	0	458.37	427.739	144	144
MW-12	5300	0	4928.37	427.739	159	159
MW-13	110	0	-261.63	427.739	106	106
MW-15	110	0	-261.63	427.739	107	107
MW-9	180	0	-191.63	427.739	121	121
MW-14	110	0	-261.63	427.739	108	108

Analysis of Variance Statistics

SS Wells	3.74153e+007
SS Total	6.15857e+007

Kruskal-Wallis Statistics

Non-Detect Rank	25.5
Background Rank Sum	2003.5
Background Rank Mean	74.2037
H Statistic	39.4178
H Adjusted for Ties	40.6824

Basic Statistics
Parameter: Beryllium, total

Total Observations	159
Total Non-Detects	121
Pooled Mean	5.26289
Pooled Std Dev	11.0436
Background Mean	3.67407
Background Std Dev	6.30516

Background Wells
There are 2 background wells

Well	Samples	Non-Detects	% ND	Total
MW-1	15	15	100	44
MW-1A	12	7	58.3333	55.2

Well	Mean	Std Dev	Std Err	Rank Sum	Rank Mean
MW-1	2.93333	6.12334	0	915	61
MW-1A	4.6	6.67546	0	1111	92.5833

Compliance Wells
There are 20 compliance wells

Well	Samples	Non-Detects	% ND	Total
MW-2	7	7	100	36
MW-3	15	13	86.6667	49.6
MW-4	1	1	100	25
MW-4R	15	12	80	47
MW-5	15	1	6.66667	279.2
MW-6	15	12	80	49.5
MW-7	15	7	46.6667	54.3
MW-8	15	15	100	44
SW-2	2	2	100	27
SW-3	15	15	100	44
SW-4	1	1	100	2
SW-5	8	7	87.5	18
SW-1	1	1	100	1
MW-10	1	1	100	1
MW-11	1	0	0	11
MW-12	1	0	0	45
MW-13	1	1	100	1
MW-15	1	1	100	1
MW-9	1	1	100	1
MW-14	1	1	100	1

Well	Mean	Std Dev	Dif From Bkg	Std Err	Rank Sum	Rank Mean
MW-2	5.14286	8.7641	1.46878	4.25582	427	61
MW-3	3.30667	6.09302	-0.367407	3.23126	1069	71.2667
MW-4	25	0	21.3259	10.2181	61	61
MW-4R	3.13333	6.10464	-0.540741	3.23126	1125	75
MW-5	18.6133	25.1417	14.9393	3.23126	2144	142.933
MW-6	3.3	6.04684	-0.374074	3.23126	1137	75.8
MW-7	3.62	6.15678	-0.0540741	3.23126	1467	97.8
MW-8	2.93333	6.12334	-0.740741	3.23126	915	61
SW-2	13.5	16.2635	9.82593	7.35321	122	61
SW-3	2.93333	6.12334	-0.740741	3.23126	915	61

SW-4	2	0	-1.67407	10.2181	61	61
SW-5	2.25	3.15096	-1.42407	4.03908	577	72.125
SW-1	1	0	-2.67407	10.2181	61	61
MW-10	1	0	-2.67407	10.2181	61	61
MW-11	11	0	7.32593	10.2181	151	151
MW-12	45	0	41.3259	10.2181	157	157
MW-13	1	0	-2.67407	10.2181	61	61
MW-15	1	0	-2.67407	10.2181	61	61
MW-9	1	0	-2.67407	10.2181	61	61
MW-14	1	0	-2.67407	10.2181	61	61

Analysis of Variance Statistics

SS Wells	5476.31
SS Total	19269.7

Kruskal-Wallis Statistics

Non-Detect Rank	61
Background Rank Sum	2026
Background Rank Mean	75.037
H Statistic	44.8318
H Adjusted for Ties	80.1584

Basic Statistics
Parameter: Chromium, total

Total Observations	159
Total Non-Detects	45
Pooled Mean	89.389
Pooled Std Dev	233.772
Background Mean	67.1963
Background Std Dev	121.721

Background Wells
There are 2 background wells

Well	Samples	Non-Detects	% ND	Total
MW-1	15	5	33.3333	122.3
MW-1A	12	1	8.33333	1692

Well	Mean	Std Dev	Std Err	Rank Sum	Rank Mean
MW-1	8.15333	6.21241	0	792	52.8
MW-1A	141	155.803	0	1381	115.083

Compliance Wells
There are 20 compliance wells

Well	Samples	Non-Detects	% ND	Total
MW-2	7	3	42.8571	130.9
MW-3	15	3	20	501.5
MW-4	1	0	0	15
MW-4R	15	4	26.6667	506.8
MW-5	15	0	0	7211
MW-6	15	1	6.66667	1153
MW-7	15	2	13.3333	287.1
MW-8	15	3	20	186.4
SW-2	2	2	100	15
SW-3	15	13	86.6667	101.18
SW-4	1	1	100	10
SW-5	8	7	87.5	490.67
SW-1	1	0	0	9.1
MW-10	1	0	0	8.9
MW-11	1	0	0	660
MW-12	1	0	0	1000
MW-13	1	0	0	40
MW-15	1	0	0	21
MW-9	1	0	0	32
MW-14	1	0	0	19

Well	Mean	Std Dev	Dif From Bkg	Std Err	Rank Sum	Rank Mean
MW-2	18.7	20.4287	-48.4963	77.683	429	61.2857
MW-3	33.4333	48.343	-33.763	58.9813	1169	77.9333
MW-4	15	0	-52.1963	186.515	89	89
MW-4R	33.7867	71.5236	-33.4096	58.9813	1065	71
MW-5	480.733	529.185	413.537	58.9813	2079	138.6
MW-6	76.8667	86.9391	9.67037	58.9813	1648	109.867
MW-7	19.14	13.0754	-48.0563	58.9813	1270	84.6667
MW-8	12.4267	9.32182	-54.7696	58.9813	1033	68.8667
SW-2	7.5	3.53553	-59.6963	134.221	46	23
SW-3	6.74533	5.74792	-60.451	58.9813	487	32.4667

SW-4	10	0	-57.1963	186.515	23	23
SW-5	61.3338	165.152	-5.86255	73.7267	312	39
SW-1	9.1	0	-58.0963	186.515	74	74
MW-10	8.9	0	-58.2963	186.515	72	72
MW-11	660	0	592.804	186.515	154	154
MW-12	1000	0	932.804	186.515	157	157
MW-13	40	0	-27.1963	186.515	122	122
MW-15	21	0	-46.1963	186.515	103	103
MW-9	32	0	-35.1963	186.515	117	117
MW-14	19	0	-48.1963	186.515	98	98

Analysis of Variance Statistics

SS Wells	4.03884e+006
SS Total	8.63459e+006

Kruskal-Wallis Statistics

Non-Detect Rank	23
Background Rank Sum	2173
Background Rank Mean	80.4815
H Statistic	67.6749
H Adjusted for Ties	69.2439

Basic Statistics
Parameter: Cobalt, total

Total Observations	159
Total Non-Detects	31
Pooled Mean	105.752
Pooled Std Dev	189.489
Background Mean	68.1407
Background Std Dev	151.255

Background Wells
There are 2 background wells

Well	Samples	Non-Detects	% ND	Total
MW-1	15	6	40	236.8
MW-1A	12	0	0	1603

Well	Mean	Std Dev	Std Err	Rank Sum	Rank Mean
MW-1	15.7867	23.657	0	598	39.8667
MW-1A	133.583	212.022	0	1207	100.583

Compliance Wells
There are 20 compliance wells

Well	Samples	Non-Detects	% ND	Total
MW-2	7	0	0	1444
MW-3	15	1	6.66667	339.4
MW-4	1	0	0	320
MW-4R	15	0	0	4397
MW-5	15	0	0	5359
MW-6	15	1	6.66667	759
MW-7	15	5	33.3333	228.4
MW-8	15	6	40	227.4
SW-2	2	2	100	110
SW-3	15	7	46.6667	393.7
SW-4	1	1	100	10
SW-5	8	1	12.5	227.9
SW-1	1	0	0	140
MW-10	1	1	100	5
MW-11	1	0	0	340
MW-12	1	0	0	370
MW-13	1	0	0	180
MW-15	1	0	0	65
MW-9	1	0	0	28
MW-14	1	0	0	31

Well	Mean	Std Dev	Dif From Bkg	Std Err	Rank Sum	Rank Mean
MW-2	206.286	96.7673	138.145	65.2583	918	131.143
MW-3	22.6267	23.5197	-45.5141	49.5478	1030	68.6667
MW-4	320	0	251.859	156.684	144	144
MW-4R	293.133	141.353	224.993	49.5478	2091	139.4
MW-5	357.267	406.233	289.126	49.5478	1932	128.8
MW-6	50.6	30.5913	-17.5407	49.5478	1397	93.1333
MW-7	15.2267	23.7463	-52.9141	49.5478	666	44.4
MW-8	15.16	23.9929	-52.9807	49.5478	647	43.1333
SW-2	55	63.6396	-13.1407	112.753	32	16
SW-3	26.2467	51.0889	-41.8941	49.5478	681	45.4

SW-4	10	0	-58.1407	156.684	16	16
SW-5	28.4875	49.5981	-39.6532	61.9347	500	62.5
SW-1	140	0	71.8593	156.684	122	122
MW-10	5	0	-63.1407	156.684	16	16
MW-11	340	0	271.859	156.684	146	146
MW-12	370	0	301.859	156.684	149	149
MW-13	180	0	111.859	156.684	130	130
MW-15	65	0	-3.14074	156.684	107	107
MW-9	28	0	-40.1407	156.684	94	94
MW-14	31	0	-37.1407	156.684	97	97

Analysis of Variance Statistics

SS Wells	2.42995e+006
SS Total	5.67315e+006

Kruskal-Wallis Statistics

Non-Detect Rank	16
Background Rank Sum	1805
Background Rank Mean	66.8519
H Statistic	99.5367
H Adjusted for Ties	100.279

Basic Statistics
Parameter: Copper, total

Total Observations	159
Total Non-Detects	97
Pooled Mean	122.777
Pooled Std Dev	167.112
Background Mean	117.459
Background Std Dev	97.9644

Background Wells
There are 2 background wells

Well	Samples	Non-Detects	% ND	Total
MW-1	15	12	80	1192.4
MW-1A	12	6	50	1979

Well	Mean	Std Dev	Std Err	Rank Sum	Rank Mean
MW-1	79.4933	91.6125	0	929	61.9333
MW-1A	164.917	87.0605	0	1136	94.6667

Compliance Wells
There are 20 compliance wells

Well	Samples	Non-Detects	% ND	Total
MW-2	7	5	71.4286	1266
MW-3	15	9	60	1339.1
MW-4	1	1	100	100
MW-4R	15	9	60	1351.4
MW-5	15	3	20	5765
MW-6	15	8	53.3333	1400.3
MW-7	15	9	60	1227
MW-8	15	10	66.6667	1226.2
SW-2	2	2	100	300
SW-3	15	14	93.3333	1166
SW-4	1	1	100	200
SW-5	8	7	87.5	320
SW-1	1	1	100	2
MW-10	1	0	0	3
MW-11	1	0	0	190
MW-12	1	0	0	350
MW-13	1	0	0	63
MW-15	1	0	0	42
MW-9	1	0	0	7.1
MW-14	1	0	0	32

Well	Mean	Std Dev	Dif From Bkg	Std Err	Rank Sum	Rank Mean
MW-2	180.857	59.9317	63.3979	62.8355	525	75
MW-3	89.2733	87.2155	-28.1859	47.7083	1169	77.9333
MW-4	100	0	-17.4593	150.867	49	49
MW-4R	90.0933	99.4184	-27.3659	47.7083	1176	78.4
MW-5	384.333	383.367	266.874	47.7083	1905	127
MW-6	93.3533	83.4092	-24.1059	47.7083	1254	83.6
MW-7	81.8	89.498	-35.6593	47.7083	1149	76.6
MW-8	81.7467	90.2743	-35.7126	47.7083	1057	70.4667
SW-2	150	70.7107	32.5407	108.567	98	49
SW-3	77.7333	92.5723	-39.7259	47.7083	796	53.0667

SW-4	200	0	82.5407	150.867	49	49
SW-5	40	69.059	-77.4593	59.6354	482	60.25
SW-1	2	0	-115.459	150.867	49	49
MW-10	3	0	-114.459	150.867	101	101
MW-11	190	0	72.5407	150.867	146	146
MW-12	350	0	232.541	150.867	153	153
MW-13	63	0	-54.4593	150.867	134	134
MW-15	42	0	-75.4593	150.867	130	130
MW-9	7.1	0	-110.359	150.867	106	106
MW-14	32	0	-85.4593	150.867	127	127

Analysis of Variance Statistics

SS Wells	1.4055e+006
SS Total	4.41237e+006

Kruskal-Wallis Statistics

Non-Detect Rank	49
Background Rank Sum	2065
Background Rank Mean	76.4815
H Statistic	34.2978
H Adjusted for Ties	44.3718

Basic Statistics
Parameter: Lead, total

Total Observations	159
Total Non-Detects	100
Pooled Mean	19.4324
Pooled Std Dev	32.6452
Background Mean	19.4815
Background Std Dev	22.4008

Background Wells
There are 2 background wells

Well	Samples	Non-Detects	% ND	Total
MW-1	15	13	86.6667	108
MW-1A	12	4	33.3333	418

Well	Mean	Std Dev	Std Err	Rank Sum	Rank Mean
MW-1	7.2	2.48424	0	867.5	57.8333
MW-1A	34.8333	26.7474	0	1315	109.583

Compliance Wells
There are 20 compliance wells

Well	Samples	Non-Detects	% ND	Total
MW-2	7	5	71.4286	88
MW-3	15	8	53.3333	500
MW-4	1	1	100	10
MW-4R	15	8	53.3333	244.5
MW-5	15	2	13.3333	929
MW-6	15	8	53.3333	163.2
MW-7	15	10	66.6667	122.4
MW-8	15	13	86.6667	114
SW-2	2	2	100	20
SW-3	15	13	86.6667	106.2
SW-4	1	1	100	10
SW-5	8	6	75	97.45
SW-1	1	1	100	5
MW-10	1	1	100	5
MW-11	1	0	0	34
MW-12	1	0	0	95
MW-13	1	1	100	5
MW-15	1	1	100	5
MW-9	1	1	100	5
MW-14	1	1	100	5

Well	Mean	Std Dev	Dif From Bkg	Std Err	Rank Sum	Rank Mean
MW-2	12.5714	5.25538	-6.91005	12.4202	507.5	72.5
MW-3	33.3333	44.6473	13.8519	9.43014	1380	92
MW-4	10	0	-9.48148	29.8207	50.5	50.5
MW-4R	16.3	24.2726	-3.18148	9.43014	1265	84.3333
MW-5	61.9333	70.7455	42.4519	9.43014	1949	129.933
MW-6	10.88	6.45769	-8.60148	9.43014	1265	84.3333
MW-7	8.16	2.38711	-11.3215	9.43014	1064	70.9333
MW-8	7.6	2.84856	-11.8815	9.43014	882.5	58.8333
SW-2	10	0	-9.48148	21.4597	101	50.5
SW-3	7.08	2.48055	-12.4015	9.43014	864.5	57.6333

SW-4	10	0	-9.48148	29.8207	50.5	50.5
SW-5	12.1813	18.0085	-7.30023	11.7877	564	70.5
SW-1	5	0	-14.4815	29.8207	50.5	50.5
MW-10	5	0	-14.4815	29.8207	50.5	50.5
MW-11	34	0	14.5185	29.8207	139	139
MW-12	95	0	75.5185	29.8207	152	152
MW-13	5	0	-14.4815	29.8207	50.5	50.5
MW-15	5	0	-14.4815	29.8207	50.5	50.5
MW-9	5	0	-14.4815	29.8207	50.5	50.5
MW-14	5	0	-14.4815	29.8207	50.5	50.5

Analysis of Variance Statistics

SS Wells	50901.8
SS Total	168382

Kruskal-Wallis Statistics

Non-Detect Rank	50.5
Background Rank Sum	2182.5
Background Rank Mean	80.8333
H Statistic	34.9448
H Adjusted for Ties	46.5162

Basic Statistics
Parameter: Nickel, total

Total Observations	159
Total Non-Detects	83
Pooled Mean	122.46
Pooled Std Dev	231.024
Background Mean	71.4444
Background Std Dev	58.527

Background Wells
There are 2 background wells

Well	Samples	Non-Detects	% ND	Total
MW-1	15	11	73.3333	662
MW-1A	12	5	41.6667	1267

Well	Mean	Std Dev	Std Err	Rank Sum	Rank Mean
MW-1	44.1333	21.9768	0	848	56.5333
MW-1A	105.583	72.0637	0	1128	94

Compliance Wells
There are 20 compliance wells

Well	Samples	Non-Detects	% ND	Total
MW-2	7	6	85.7143	359.4
MW-3	15	1	6.66667	4126
MW-4	1	1	100	100
MW-4R	15	5	33.3333	1208
MW-5	15	2	13.3333	6827
MW-6	15	6	40	951
MW-7	15	12	80	670
MW-8	15	12	80	633
SW-2	2	2	100	150
SW-3	15	13	86.6667	627.4
SW-4	1	0	0	67
SW-5	8	7	87.5	400
SW-1	1	0	0	9
MW-10	1	0	0	7.4
MW-11	1	0	0	380
MW-12	1	0	0	840
MW-13	1	0	0	52
MW-15	1	0	0	21
MW-9	1	0	0	84
MW-14	1	0	0	30

Well	Mean	Std Dev	Dif From Bkg	Std Err	Rank Sum	Rank Mean
MW-2	51.3429	26.2543	-20.1016	82.9987	342	48.8571
MW-3	275.067	310.968	203.622	63.0173	1945	129.667
MW-4	100	0	28.5556	199.278	42	42
MW-4R	80.5333	134.714	9.08889	63.0173	1344	89.6
MW-5	455.133	500.678	383.689	63.0173	1922	128.133
MW-6	63.4	40.3835	-8.04444	63.0173	1297	86.4667
MW-7	44.6667	22.4425	-26.7778	63.0173	803	53.5333
MW-8	42.2	24.7486	-29.2444	63.0173	774	51.6
SW-2	75	35.3553	3.55556	143.405	84	42
SW-3	41.8267	25.298	-29.6178	63.0173	721	48.0667

SW-4	67	0	-4.44444	199.278	119	119
SW-5	50	41.6619	-21.4444	78.7717	427	53.375
SW-1	9	0	-62.4444	199.278	88	88
MW-10	7.4	0	-64.0444	199.278	85	85
MW-11	380	0	308.556	199.278	148	148
MW-12	840	0	768.556	199.278	156	156
MW-13	52	0	-19.4444	199.278	113	113
MW-15	21	0	-50.4444	199.278	104	104
MW-9	84	0	12.5556	199.278	122	122
MW-14	30	0	-41.4444	199.278	108	108

Analysis of Variance Statistics

SS Wells	3.18655e+006
SS Total	8.43277e+006

Kruskal-Wallis Statistics

Non-Detect Rank	42
Background Rank Sum	1976
Background Rank Mean	73.1852
H Statistic	68.837
H Adjusted for Ties	80.2513

Basic Statistics
Parameter: Silver, total

Total Observations	159
Total Non-Detects	156
Pooled Mean	5.63333
Pooled Std Dev	3.7588
Background Mean	6
Background Std Dev	3.78255

Background Wells
There are 2 background wells

Well	Samples	Non-Detects	% ND	Total
MW-1	15	15	100	84
MW-1A	12	12	100	78

Well	Mean	Std Dev	Std Err	Rank Sum	Rank Mean
MW-1	5.6	3.85079	0	1177.5	78.5
MW-1A	6.5	3.80191	0	942	78.5

Compliance Wells
There are 20 compliance wells

Well	Samples	Non-Detects	% ND	Total
MW-2	7	7	100	62
MW-3	15	15	100	84
MW-4	1	1	100	10
MW-4R	15	14	93.3333	84.5
MW-5	15	14	93.3333	84
MW-6	15	14	93.3333	84.2
MW-7	15	15	100	84
MW-8	15	15	100	84
SW-2	2	2	100	20
SW-3	15	15	100	84
SW-4	1	1	100	10
SW-5	8	8	100	27
SW-1	1	1	100	2
MW-10	1	1	100	2
MW-11	1	1	100	2
MW-12	1	1	100	2
MW-13	1	1	100	2
MW-15	1	1	100	2
MW-9	1	1	100	2
MW-14	1	1	100	2

Well	Mean	Std Dev	Dif From Bkg	Std Err	Rank Sum	Rank Mean
MW-2	8.85714	3.02372	2.85714	1.59102	549.5	78.5
MW-3	5.6	3.85079	-0.4	1.20799	1177.5	78.5
MW-4	10	0	4	3.82	78.5	78.5
MW-4R	5.63333	3.81944	-0.366667	1.20799	1257	83.8
MW-5	5.6	3.85079	-0.4	1.20799	1258	83.8667
MW-6	5.61333	3.83776	-0.386667	1.20799	1256	83.7333
MW-7	5.6	3.85079	-0.4	1.20799	1177.5	78.5
MW-8	5.6	3.85079	-0.4	1.20799	1177.5	78.5
SW-2	10	0	4	2.74896	157	78.5
SW-3	5.6	3.85079	-0.4	1.20799	1177.5	78.5

SW-4	10	0	4	3.82	78.5	78.5
SW-5	3.375	2.87539	-2.625	1.50999	628	78.5
SW-1	2	0	-4	3.82	78.5	78.5
MW-10	2	0	-4	3.82	78.5	78.5
MW-11	2	0	-4	3.82	78.5	78.5
MW-12	2	0	-4	3.82	78.5	78.5
MW-13	2	0	-4	3.82	78.5	78.5
MW-15	2	0	-4	3.82	78.5	78.5
MW-9	2	0	-4	3.82	78.5	78.5
MW-14	2	0	-4	3.82	78.5	78.5

Analysis of Variance Statistics

SS Wells	304.551
SS Total	2232.31

Kruskal-Wallis Statistics

Non-Detect Rank	78.5
Background Rank Sum	2119.5
Background Rank Mean	78.5
H Statistic	0.427563
H Adjusted for Ties	7.69774

Basic Statistics
Parameter: Vanadium

Total Observations	159
Total Non-Detects	80
Pooled Mean	90.0101
Pooled Std Dev	222.994
Background Mean	71.9074
Background Std Dev	97.6532

Background Wells
There are 2 background wells

Well	Samples	Non-Detects	% ND	Total
MW-1	15	11	73.3333	330.5
MW-1A	12	4	33.3333	1611

Well	Mean	Std Dev	Std Err	Rank Sum	Rank Mean
MW-1	22.0333	18.235	0	818.5	54.5667
MW-1A	134.25	120.353	0	1239	103.25

Compliance Wells
There are 20 compliance wells

Well	Samples	Non-Detects	% ND	Total
MW-2	7	5	71.4286	349.1
MW-3	15	9	60	501
MW-4	1	1	100	50
MW-4R	15	6	40	1009
MW-5	15	0	0	6904
MW-6	15	5	33.3333	636.8
MW-7	15	7	46.6667	448
MW-8	15	8	53.3333	414
SW-2	2	2	100	90
SW-3	15	13	86.6667	321
SW-4	1	1	100	40
SW-5	8	7	87.5	320
SW-1	1	0	0	9.2
MW-10	1	1	100	5
MW-11	1	0	0	340
MW-12	1	0	0	830
MW-13	1	0	0	33
MW-15	1	0	0	37
MW-9	1	0	0	15
MW-14	1	0	0	18

Well	Mean	Std Dev	Dif From Bkg	Std Err	Rank Sum	Rank Mean
MW-2	49.8714	41.3777	-22.036	79.0126	432.5	61.7857
MW-3	33.4	27.9867	-38.5074	59.9908	1040.5	69.3667
MW-4	50	0	-21.9074	189.708	40.5	40.5
MW-4R	67.2667	147.158	-4.64074	59.9908	1306	87.0667
MW-5	460.267	546.435	388.359	59.9908	2158	143.867
MW-6	42.4533	38.1673	-29.4541	59.9908	1289.5	85.9667
MW-7	29.8667	15.8829	-42.0407	59.9908	1197.5	79.8333
MW-8	27.6	20.3096	-44.3074	59.9908	1021	68.0667
SW-2	45	7.07107	-26.9074	136.518	81	40.5
SW-3	21.4	17.9794	-50.5074	59.9908	738.5	49.2333

SW-4	40	0	-31.9074	189.708	40.5	40.5
SW-5	40	85.7321	-31.9074	74.9885	429.5	53.6875
SW-1	9.2	0	-62.7074	189.708	92	92
MW-10	5	0	-66.9074	189.708	40.5	40.5
MW-11	340	0	268.093	189.708	150	150
MW-12	830	0	758.093	189.708	157	157
MW-13	33	0	-38.9074	189.708	117	117
MW-15	37	0	-34.9074	189.708	120	120
MW-9	15	0	-56.9074	189.708	103	103
MW-14	18	0	-53.9074	189.708	108	108

Analysis of Variance Statistics

SS Wells	3.10234e+006
SS Total	7.85675e+006

Kruskal-Wallis Statistics

Non-Detect Rank	40.5
Background Rank Sum	2057.5
Background Rank Mean	76.2037
H Statistic	52.7383
H Adjusted for Ties	60.4352

Basic Statistics
Parameter: Zinc, total

Total Observations	159
Total Non-Detects	40
Pooled Mean	191.063
Pooled Std Dev	475.26
Background Mean	104.333
Background Std Dev	103.443

Background Wells
There are 2 background wells

Well	Samples	Non-Detects	% ND	Total
MW-1	15	4	26.6667	766
MW-1A	12	1	8.33333	2051

Well	Mean	Std Dev	Std Err	Rank Sum	Rank Mean
MW-1	51.0667	31.306	0	964	64.2667
MW-1A	170.917	123.851	0	1274.5	106.208

Compliance Wells
There are 20 compliance wells

Well	Samples	Non-Detects	% ND	Total
MW-2	7	3	42.8571	833
MW-3	15	6	40	886
MW-4	1	1	100	50
MW-4R	15	1	6.66667	1777
MW-5	15	0	0	17106
MW-6	15	4	26.6667	1164
MW-7	15	2	13.3333	1021
MW-8	15	3	20	869
SW-2	2	2	100	100
SW-3	15	8	53.3333	454
SW-4	1	1	100	50
SW-5	8	4	50	1060
SW-1	1	0	0	33
MW-10	1	0	0	24
MW-11	1	0	0	560
MW-12	1	0	0	1300
MW-13	1	0	0	74
MW-15	1	0	0	54
MW-9	1	0	0	27
MW-14	1	0	0	120

Well	Mean	Std Dev	Dif From Bkg	Std Err	Rank Sum	Rank Mean
MW-2	119	113.286	14.6667	157.242	529.5	75.6429
MW-3	59.0667	36.1356	-45.2667	119.387	920	61.3333
MW-4	50	0	-54.3333	377.535	20.5	20.5
MW-4R	118.467	184.141	14.1333	119.387	1390.5	92.7
MW-5	1140.4	1125.12	1036.07	119.387	2168	144.533
MW-6	77.6	50.3868	-26.7333	119.387	1152	76.8
MW-7	68.0667	39.409	-36.2667	119.387	1233	82.2
MW-8	57.9333	37.2299	-46.4	119.387	1104.5	73.6333
SW-2	50	0	-54.3333	271.683	41	20.5
SW-3	30.2667	20.0516	-74.0667	119.387	598	39.8667

SW-4	50	0	-54.3333	377.535	20.5	20.5
SW-5	132.5	197.206	28.1667	149.234	520	65
SW-1	33	0	-71.3333	377.535	64	64
MW-10	24	0	-80.3333	377.535	54	54
MW-11	560	0	455.667	377.535	150	150
MW-12	1300	0	1195.67	377.535	153	153
MW-13	74	0	-30.3333	377.535	102	102
MW-15	54	0	-50.3333	377.535	85	85
MW-9	27	0	-77.3333	377.535	55	55
MW-14	120	0	15.6667	377.535	121	121

Analysis of Variance Statistics

SS Wells	1.68582e+007
SS Total	3.56878e+007

Kruskal-Wallis Statistics

Non-Detect Rank	20.5
Background Rank Sum	2238.5
Background Rank Mean	82.9074
H Statistic	59.1542
H Adjusted for Ties	60.1107

Dixon's Test for Outliers

Parameter: Carbon Disulfide

Well: MW-3

For 15 Samples

5% Level of Significance

Iteration	Highest	Lowest	Critical	Outlier
1	0.768966	0	0.525	29
2	0.7	0	0.546	22
3	1	0	0.521	6.7

A Divide-By-Zero error occurred in the calculations.

Additional Outliers May Exist.

Well	Date	Conc.	Outlier
MW-3	10/1/1994	ND<0	FALSE
	1/31/1995	ND<0	FALSE
	2/15/1995	ND<0	FALSE
	3/7/1995	ND<0	FALSE
	12/7/1995	ND<0	FALSE
	5/6/1996	ND<0	FALSE
	11/11/1996	ND<0	FALSE
	6/24/1997	6.6	FALSE
	12/3/1997	ND<0	FALSE
	6/4/1998	ND<0	FALSE
	11/18/1998	6.7	TRUE
	5/13/1999	ND<0	FALSE
	12/6/1999	ND<0	FALSE
	5/17/2000	22	TRUE
	12/11/2000	29	TRUE

Dixon's Test for Outliers

Parameter: Carbon Disulfide

Well: MW-4R

For 14 Samples

5% Level of Significance

Iteration	Highest	Lowest	Critical	Outlier
1	0.816667	0	0.546	30
2	1	0	0.521	5.9

A Divide-By-Zero error occurred in the calculations.

Additional Outliers May Exist.

Well	Date	Conc.	Outlier
MW-4R	10/1/1994	ND<0	FALSE
	1/31/1995	ND<0	FALSE
	2/15/1995	ND<0	FALSE
	3/7/1995	ND<0	FALSE
	12/6/1995	ND<0	FALSE
	5/6/1996	ND<0	FALSE
	11/11/1996	ND<0	FALSE
	6/24/1997	5.5	FALSE
	6/4/1998	ND<0	FALSE
	11/18/1998	ND<0	FALSE
	5/13/1999	5.9	TRUE
	12/6/1999	ND<0	FALSE
	5/17/2000	30	TRUE
	12/11/2000	ND<0	FALSE

Dixon's Test for Outliers

Parameter: Carbon Disulfide

Well: MW-7

For 15 Samples

5% Level of Significance

Iteration	Highest	Lowest	Critical	Outlier
1	0.878788	0	0.525	66
2	0.584615	0	0.546	13
3	0.625	0	0.521	8
4	1	0	0.546	5.4

A Divide-By-Zero error occurred in the calculations.

Additional Outliers May Exist.

Well	Date	Conc.	Outlier
MW-7	10/1/1994	ND<0	FALSE
	1/31/1995	ND<0	FALSE
	2/15/1995	ND<0	FALSE
	3/7/1995	ND<0	FALSE
	12/6/1995	ND<0	FALSE
	5/6/1996	ND<0	FALSE
	11/11/1996	ND<0	FALSE
	6/24/1997	66	TRUE
	12/3/1997	3	FALSE
	6/4/1998	ND<0	FALSE
	11/18/1998	ND<0	FALSE
	5/13/1999	8	TRUE
	12/6/1999	ND<0	FALSE
	5/17/2000	5.4	TRUE
	12/12/2000	13	TRUE

Interwell Analyses for Metals

Poisson Tolerance Limit
Parameter: Arsenic, total

Poisson Count of 27 background Samples = 221
Degrees of Freedom = 444

95% Confidence Values
Chi-Squared Value (95% Confidence) = 494.126
Lambda (from Zack's formula) = 9.15048
Smallest Degrees of Freedom = 30
Upper Tolerance Limit (95%) = 14

99% Confidence Values
Chi-Squared Value (99% Confidence) = 516.25
Lambda (from Zack's formula) = 9.56018
Smallest Degrees of Freedom = 36
Upper Tolerance Limit (99%) = 17

	Date	Result	Impacted 95%	Impacted 99%
MW-5	10/1/1994	ND<10	FALSE	FALSE
	1/31/1995	ND<10	FALSE	FALSE
	2/15/1995	ND<10	FALSE	FALSE
	3/7/1995	ND<10	FALSE	FALSE
	12/7/1995	ND<10	FALSE	FALSE
	5/6/1996	ND<10	FALSE	FALSE
	11/11/1996	ND<5	FALSE	FALSE
	6/24/1997	ND<5	FALSE	FALSE
	12/3/1997	6	FALSE	FALSE
	6/4/1998	8	FALSE	FALSE
	11/18/1998	26	TRUE	TRUE
	5/13/1999	5.6	FALSE	FALSE
	12/6/1999	ND<5	FALSE	FALSE
	5/17/2000	7.8	FALSE	FALSE
	12/11/2000	8.8	FALSE	FALSE

Non-Parametric Tolerance Interval

Parameter: Barium, total

Total Percent Non-Detects = 29.0909%
Background Samples (n) = 27
Maximum Background Concentration = 1000
Minimum Coverage = 89.5%
Average Coverage = 96.4286%

Well	Sample	Result	Impacted
MW-5	10/1/1994	3490	TRUE
MW-5	1/31/1995	1980	TRUE
MW-5	2/15/1995	1450	TRUE
MW-5	3/7/1995	1820	TRUE
MW-5	12/7/1995	ND<250	FALSE
MW-5	5/6/1996	ND<250	FALSE
MW-5	11/11/1996	1600	TRUE
MW-5	6/24/1997	180	FALSE
MW-5	12/3/1997	720	FALSE
MW-5	6/4/1998	1800	TRUE
MW-5	11/18/1998	2800	TRUE
MW-5	5/13/1999	320	FALSE
MW-5	12/6/1999	94	FALSE
MW-5	5/17/2000	380	FALSE
MW-5	12/11/2000	310	FALSE
MW-3	10/1/1994	110	FALSE
MW-3	1/31/1995	ND<250	FALSE
MW-3	2/15/1995	ND<250	FALSE
MW-3	3/7/1995	ND<250	FALSE
MW-3	12/7/1995	ND<250	FALSE
MW-3	5/6/1996	ND<250	FALSE
MW-3	11/11/1996	150	FALSE
MW-3	6/24/1997	97	FALSE
MW-3	12/3/1997	440	FALSE
MW-3	6/4/1998	110	FALSE
MW-3	11/18/1998	270	FALSE
MW-3	5/13/1999	160	FALSE
MW-3	12/6/1999	100	FALSE
MW-3	5/17/2000	68	FALSE
MW-3	12/11/2000	48	FALSE
MW-4R	10/1/1994	1500	TRUE
MW-4R	1/31/1995	ND<250	FALSE
MW-4R	2/15/1995	ND<250	FALSE
MW-4R	3/7/1995	ND<250	FALSE
MW-4R	12/6/1995	ND<250	FALSE
MW-4R	5/6/1996	ND<250	FALSE
MW-4R	11/11/1996	160	FALSE
MW-4R	6/24/1997	120	FALSE
MW-4R	12/3/1997	200	FALSE
MW-4R	6/4/1998	150	FALSE
MW-4R	11/18/1998	130	FALSE
MW-4R	5/13/1999	110	FALSE

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MW-4R	12/6/1999	110	FALSE
MW-4R	5/17/2000	110	FALSE
MW-4R	12/11/2000	120	FALSE
MW-6	10/1/1994	420	FALSE
MW-6	1/31/1995	ND<250	FALSE
MW-6	2/15/1995	ND<250	FALSE
MW-6	3/7/1995	554	FALSE
MW-6	12/6/1995	ND<250	FALSE
MW-6	5/6/1996	ND<250	FALSE
MW-6	11/11/1996	190	FALSE
MW-6	6/24/1997	49	TRUE
MW-6	12/3/1997	1300	TRUE
MW-6	6/4/1998	1100	FALSE
MW-6	11/18/1998	870	FALSE
MW-6	5/13/1999	340	FALSE
MW-6	12/6/1999	200	FALSE
MW-6	5/17/2000	210	FALSE
MW-6	12/11/2000	100	FALSE
MW-8	10/1/1994	ND<50	FALSE
MW-8	1/31/1995	ND<250	FALSE
MW-8	2/15/1995	ND<250	FALSE
MW-8	3/7/1995	ND<250	FALSE
MW-8	12/6/1995	ND<250	FALSE
MW-8	5/6/1996	ND<250	FALSE
MW-8	11/11/1996	66	FALSE
MW-8	6/24/1997	170	FALSE
MW-8	12/3/1997	200	FALSE
MW-8	6/4/1998	100	FALSE
MW-8	11/18/1998	120	FALSE
MW-8	5/13/1999	89	FALSE
MW-8	12/6/1999	54	FALSE
MW-8	5/17/2000	120	FALSE
MW-8	12/12/2000	110	FALSE
SW-5	12/7/1995	ND<250	FALSE
SW-5	6/24/1997	40	FALSE
SW-5	12/3/1997	43	FALSE
SW-5	6/4/1998	38	FALSE
SW-5	11/18/1998	33	FALSE
SW-5	5/13/1999	42	FALSE
SW-5	5/17/2000	56	FALSE
SW-5	12/12/2000	1100	TRUE

Non-Detects Replaced with 1/2 DL

Original Data

Non-Parametric Tolerance Interval

Parameter: Beryllium, total

Total Percent Non-Detects = 54.7619%
Background Samples (n) = 27
Maximum Background Concentration = 12.5
Minimum Coverage = 89.5%
Average Coverage = 96.4286%

Well	Sample	Result	Impacted
MW-5	10/1/1994	80	TRUE
MW-5	1/31/1995	19	TRUE
MW-5	2/15/1995	16	TRUE
MW-5	3/7/1995	16	TRUE
MW-5	12/7/1995	5	FALSE
MW-5	5/6/1996	4	FALSE
MW-5	11/11/1996	9	FALSE
MW-5	6/24/1997	2	FALSE
MW-5	12/3/1997	16	TRUE
MW-5	6/4/1998	13	TRUE
MW-5	11/18/1998	78	TRUE
MW-5	5/13/1999	6	FALSE
MW-5	12/6/1999	ND<0.5	FALSE
MW-5	5/17/2000	6.6	FALSE
MW-5	12/11/2000	7.6	FALSE

Parametric Tolerance Interval Analysis

Parameter: Chromium, total

Background mean = 2.64159
Background standard deviation = 1.84282
One-sided normal tolerance factor at 95% confidence = 1.73691
Tolerance factor calculation follows USEPA 1992 Guidance
Upper tolerance limit = 5.84241

Well	Date	Result	Impacted
MW-3	10/1/1994	ND<0.916291	FALSE
	1/31/1995	3.63759	FALSE
	2/15/1995	2.56495	FALSE
	3/7/1995	2.83321	FALSE
	12/7/1995	ND<1.60944	FALSE
	5/6/1996	ND<1.60944	FALSE
	11/11/1996	1.09861	FALSE
	6/24/1997	2.07944	FALSE
	12/3/1997	4.94164	FALSE
	6/4/1998	3.04452	FALSE
	11/18/1998	5.01064	FALSE
	5/13/1999	4.21951	FALSE
	12/6/1999	1.6864	FALSE
	5/17/2000	2.10413	FALSE
	12/11/2000	1.58924	FALSE
MW-6	10/1/1994	4.74493	FALSE
	1/31/1995	3.7612	FALSE
	2/15/1995	3.3322	FALSE
	3/7/1995	4.47734	FALSE
	12/6/1995	3.17805	FALSE
	5/6/1996	2.94444	FALSE
	11/11/1996	2.07944	FALSE
	6/24/1997	ND<0	FALSE
	12/3/1997	5.34711	FALSE
	6/4/1998	5.43808	FALSE
	11/18/1998	5.56068	FALSE
	5/13/1999	4.09434	FALSE
	12/6/1999	3.2581	FALSE
	5/17/2000	3.3673	FALSE
	12/11/2000	2.3979	FALSE
MW-5	10/1/1994	6.53669	TRUE
	1/31/1995	6.23832	TRUE
	2/15/1995	6.25767	TRUE
	3/7/1995	5.97126	TRUE
	12/7/1995	4.63473	FALSE
	5/6/1996	4.96284	FALSE
	11/11/1996	2.07944	FALSE
	6/24/1997	4.20469	FALSE
	12/3/1997	6.57925	TRUE
	6/4/1998	7.49554	TRUE
	11/18/1998	7.31322	TRUE
	5/13/1999	5.48064	FALSE
	12/6/1999	3.17805	FALSE
	5/17/2000	5.43808	FALSE
	12/11/2000	5.56068	FALSE

MW-8	10/1/1994	3.2581	FALSE
	1/31/1995	3.29584	FALSE
	2/15/1995	2.48491	FALSE
	3/7/1995	2.63906	FALSE
	12/6/1995	ND<1.60944	FALSE
	5/6/1996	ND<1.60944	FALSE
	11/11/1996	ND<0	FALSE
	6/24/1997	2.77259	FALSE
	12/3/1997	3.49651	FALSE
	6/4/1998	1.79176	FALSE
	11/18/1998	1.91692	FALSE
	5/13/1999	1.64866	FALSE
	12/6/1999	1.02962	FALSE
	5/17/2000	2.07944	FALSE
	12/12/2000	2.02815	FALSE
MW-7	10/1/1994	2.70805	FALSE
	1/31/1995	3.61092	FALSE
	2/15/1995	3.09104	FALSE
	3/7/1995	3.13549	FALSE
	12/6/1995	ND<1.60944	FALSE
	5/6/1996	ND<1.60944	FALSE
	11/11/1996	2.56495	FALSE
	6/24/1997	2.48491	FALSE
	12/3/1997	2.48491	FALSE
	6/4/1998	2.3979	FALSE
	11/18/1998	2.94444	FALSE
	5/13/1999	4.02535	FALSE
	12/6/1999	3.3673	FALSE
	5/17/2000	2.09186	FALSE
	12/12/2000	2.30259	FALSE

Shapiro-Wilks Test of Normality

Parameter: Chromium, total
Background Wells
Normality Test of Parameter Concentrations
K = 13; Samples = 27

i	x(i)	x(n-i+1)	x(n-1+1)-x(i)	a(n-i+1)	b(i)
1	0	6.01616	6.01616	0.4366	2.62665
2	0	5.99146	5.99146	0.3018	1.80822
3	0	5.82895	5.82895	0.2522	1.47006
4	0.832909	5.20401	4.3711	0.2152	0.94066
5	1.09861	4.78749	3.68888	0.1848	0.681705
6	1.09861	4.40672	3.30811	0.1584	0.524004
7	1.09861	4.30407	3.20545	0.1346	0.431454
8	1.60944	3.49651	1.88707	0.1128	0.212861
9	1.60944	3.21888	1.60944	0.0923	0.148551
10	1.60944	3.21888	1.60944	0.0728	0.117167
11	1.74047	3.04452	1.30406	0.054	0.070419
12	1.79176	2.63906	0.847298	0.0358	0.0303333
13	1.84055	2.63906	0.798508	0.0178	0.0142134
14	2.19722	2.19722	0		
15	2.63906	1.84055	-0.798508		
16	2.63906	1.79176	-0.847298		
17	3.04452	1.74047	-1.30406		
18	3.21888	1.60944	-1.60944		
19	3.21888	1.60944	-1.60944		
20	3.49651	1.60944	-1.88707		
21	4.30407	1.09861	-3.20545		
22	4.40672	1.09861	-3.30811		
23	4.78749	1.09861	-3.68888		
24	5.20401	0.832909	-4.3711		
25	5.82895	0	-5.82895		
26	5.99146	0	-5.99146		
27	6.01616	0	-6.01616		

Sum of b values = 9.07631
Sample Standard Deviation = 1.84282
W Statistic = 0.932993
5% Critical value of 0.923 is less than 0.932993
Data is normally distributed at 95% level of significance
1% Critical value of 0.894 is less than 0.932993
Data is normally distributed at 99% level of significance

Non-Parametric Tolerance Interval

Parameter: Cobalt, total

Total Percent Non-Detects = 9.72222%
Background Samples (n) = 27
Maximum Background Concentration = 770
Minimum Coverage = 89.5%
Average Coverage = 96.4286%

Well	Sample	Result	Impacted
MW-5	10/1/1994	900	TRUE
MW-5	1/31/1995	496	FALSE
MW-5	2/15/1995	454	FALSE
MW-5	3/7/1995	320	FALSE
MW-5	12/7/1995	88	FALSE
MW-5	5/6/1996	157	FALSE
MW-5	11/11/1996	76	FALSE
MW-5	6/24/1997	36	FALSE
MW-5	12/3/1997	350	FALSE
MW-5	6/4/1998	1400	TRUE
MW-5	11/18/1998	850	TRUE
MW-5	5/13/1999	81	FALSE
MW-5	12/6/1999	16	FALSE
MW-5	5/17/2000	64	FALSE
MW-5	12/11/2000	71	FALSE
MW-4R	10/1/1994	700	FALSE
MW-4R	1/31/1995	262	FALSE
MW-4R	2/15/1995	291	FALSE
MW-4R	3/7/1995	225	FALSE
MW-4R	12/6/1995	301	FALSE
MW-4R	5/6/1996	278	FALSE
MW-4R	11/11/1996	210	FALSE
MW-4R	6/24/1997	120	FALSE
MW-4R	12/3/1997	450	FALSE
MW-4R	6/4/1998	390	FALSE
MW-4R	11/18/1998	360	FALSE
MW-4R	5/13/1999	210	FALSE
MW-4R	12/6/1999	200	FALSE
MW-4R	5/17/2000	200	FALSE
MW-4R	12/11/2000	200	FALSE
MW-6	10/1/1994	ND<50	FALSE
MW-6	1/31/1995	25	FALSE
MW-6	2/15/1995	27	FALSE
MW-6	3/7/1995	37	FALSE
MW-6	12/6/1995	71	FALSE
MW-6	5/6/1996	34	FALSE
MW-6	11/11/1996	13	FALSE
MW-6	6/24/1997	20	FALSE
MW-6	12/3/1997	88	FALSE
MW-6	6/4/1998	48	FALSE
MW-6	11/18/1998	110	FALSE
MW-6	5/13/1999	28	FALSE

MW-6	12/6/1999	58	FALSE
MW-6	5/17/2000	31	FALSE
MW-6	12/11/2000	69	FALSE

Non-Parametric Tolerance Interval

Parameter: Copper, total

Total Percent Non-Detects = 55.1724%
Background Samples (n) = 27
Maximum Background Concentration = 260
Minimum Coverage = 89.5%
Average Coverage = 96.4286%

Well	Sample	Result	Impacted
MW-5	10/1/1994	1070	TRUE
MW-5	1/31/1995	757	TRUE
MW-5	2/15/1995	464	TRUE
MW-5	3/7/1995	676	TRUE
MW-5	12/7/1995	ND<100	FALSE
MW-5	5/6/1996	ND<100	FALSE
MW-5	11/11/1996	ND<5	FALSE
MW-5	6/24/1997	38	FALSE
MW-5	12/3/1997	270	TRUE
MW-5	6/4/1998	490	TRUE
MW-5	11/18/1998	1200	TRUE
MW-5	5/13/1999	120	FALSE
MW-5	12/6/1999	10	FALSE
MW-5	5/17/2000	120	FALSE
MW-5	12/11/2000	140	FALSE
MW-4R	10/1/1994	240	FALSE
MW-4R	1/31/1995	ND<100	FALSE
MW-4R	2/15/1995	ND<100	FALSE
MW-4R	3/7/1995	ND<100	FALSE
MW-4R	12/6/1995	ND<100	FALSE
MW-4R	5/6/1996	ND<100	FALSE
MW-4R	11/11/1996	ND<5	FALSE
MW-4R	6/24/1997	16	FALSE
MW-4R	12/3/1997	37	FALSE
MW-4R	6/4/1998	24	FALSE
MW-4R	11/18/1998	14	FALSE
MW-4R	5/13/1999	ND<1	FALSE
MW-4R	12/6/1999	ND<1	FALSE
MW-4R	5/17/2000	4.4	FALSE
MW-4R	12/11/2000	ND<1	FALSE
MW-6	10/1/1994	ND<50	FALSE
MW-6	1/31/1995	ND<100	FALSE
MW-6	2/15/1995	ND<100	FALSE
MW-6	3/7/1995	ND<100	FALSE
MW-6	12/6/1995	ND<100	FALSE
MW-6	5/6/1996	ND<100	FALSE
MW-6	11/11/1996	ND<5	FALSE
MW-6	6/24/1997	ND<5	FALSE
MW-6	12/3/1997	65	FALSE
MW-6	6/4/1998	64	FALSE
MW-6	11/18/1998	91	FALSE
MW-6	5/13/1999	29	FALSE

MW-6	12/6/1999	8.4	FALSE
MW-6	5/17/2000	20	FALSE
MW-6	12/11/2000	2.9	FALSE
MW-8	10/1/1994	ND<50	FALSE
MW-8	1/31/1995	ND<100	FALSE
MW-8	2/15/1995	ND<100	FALSE
MW-8	3/7/1995	ND<100	FALSE
MW-8	12/6/1995	ND<100	FALSE
MW-8	5/6/1996	ND<100	FALSE
MW-8	11/11/1996	ND<5	FALSE
MW-8	6/24/1997	22	FALSE
MW-8	12/3/1997	59	FALSE
MW-8	6/4/1998	ND<5	FALSE
MW-8	11/18/1998	ND<5	FALSE
MW-8	5/13/1999	ND<1	FALSE
MW-8	12/6/1999	3.2	FALSE
MW-8	5/17/2000	5.6	FALSE
MW-8	12/12/2000	4.4	FALSE

Non-Parametric Tolerance Interval

Parameter: Lead, total

Total Percent Non-Detects = 45.2381%
Background Samples (n) = 27
Maximum Background Concentration = 75
Minimum Coverage = 89.5%
Average Coverage = 96.4286%

Well	Sample	Result	Impacted
MW-5	10/1/1994	82	TRUE
MW-5	1/31/1995	118	TRUE
MW-5	2/15/1995	100	TRUE
MW-5	3/7/1995	85	TRUE
MW-5	12/7/1995	25	FALSE
MW-5	5/6/1996	20	FALSE
MW-5	11/11/1996	17	FALSE
MW-5	6/24/1997	ND<2.5	FALSE
MW-5	12/3/1997	50	FALSE
MW-5	6/4/1998	78	TRUE
MW-5	11/18/1998	280	TRUE
MW-5	5/13/1999	24	FALSE
MW-5	12/6/1999	ND<2.5	FALSE
MW-5	5/17/2000	18	FALSE
MW-5	12/11/2000	22	FALSE

Non-Parametric Tolerance Interval

Parameter: Nickel, total

Total Percent Non-Detects = 34.7222%
Background Samples (n) = 27
Maximum Background Concentration = 260
Minimum Coverage = 89.5%
Average Coverage = 96.4286%

Well	Sample	Result	Impacted
MW-5	10/1/1994	1510	TRUE
MW-5	1/31/1995	826	TRUE
MW-5	2/15/1995	508	TRUE
MW-5	3/7/1995	820	TRUE
MW-5	12/7/1995	180	FALSE
MW-5	5/6/1996	118	FALSE
MW-5	11/11/1996	ND<25	FALSE
MW-5	6/24/1997	ND<25	FALSE
MW-5	12/3/1997	300	TRUE
MW-5	6/4/1998	520	TRUE
MW-5	11/18/1998	1500	TRUE
MW-5	5/13/1999	150	FALSE
MW-5	12/6/1999	15	FALSE
MW-5	5/17/2000	130	FALSE
MW-5	12/11/2000	150	FALSE
MW-3	10/1/1994	180	FALSE
MW-3	1/31/1995	474	TRUE
MW-3	2/15/1995	243	FALSE
MW-3	3/7/1995	240	FALSE
MW-3	12/7/1995	ND<25	FALSE
MW-3	5/6/1996	72	FALSE
MW-3	11/11/1996	200	FALSE
MW-3	6/24/1997	130	FALSE
MW-3	12/3/1997	1200	TRUE
MW-3	6/4/1998	210	FALSE
MW-3	11/18/1998	700	TRUE
MW-3	5/13/1999	250	FALSE
MW-3	12/6/1999	98	FALSE
MW-3	5/17/2000	63	FALSE
MW-3	12/11/2000	16	FALSE
MW-6	10/1/1994	ND<50	FALSE
MW-6	1/31/1995	ND<25	FALSE
MW-6	2/15/1995	ND<25	FALSE
MW-6	3/7/1995	ND<25	FALSE
MW-6	12/6/1995	52	FALSE
MW-6	5/6/1996	69	FALSE
MW-6	11/11/1996	ND<25	FALSE
MW-6	6/24/1997	ND<25	FALSE
MW-6	12/3/1997	130	FALSE
MW-6	6/4/1998	88	FALSE
MW-6	11/18/1998	160	FALSE
MW-6	5/13/1999	40	FALSE

MW-6	12/6/1999	24	FALSE
MW-6	5/17/2000	22	FALSE
MW-6	12/11/2000	16	FALSE

Poisson Tolerance Limit

Parameter: Silver, total

Poisson Count of 27 background Samples = 162
Degrees of Freedom = 326

95% Confidence Values
Chi-Squared Value (95% Confidence) = 369.106
Lambda (from Zack's formula) = 6.8353
Smallest Degrees of Freedom = 24
Upper Tolerance Limit (95%) = 11

99% Confidence Values
Chi-Squared Value (99% Confidence) = 388.325
Lambda (from Zack's formula) = 7.19121
Smallest Degrees of Freedom = 30
Upper Tolerance Limit (99%) = 14

	Date	Result	Impacted 95%	Impacted 99%
MW-4R	10/1/1994	ND<10	FALSE	FALSE
	1/31/1995	ND<10	FALSE	FALSE
	2/15/1995	ND<10	FALSE	FALSE
	3/7/1995	ND<10	FALSE	FALSE
	12/6/1995	ND<10	FALSE	FALSE
	5/6/1996	ND<10	FALSE	FALSE
	11/11/1996	ND<5	FALSE	FALSE
	6/24/1997	ND<5	FALSE	FALSE
	12/3/1997	ND<2	FALSE	FALSE
	6/4/1998	ND<2	FALSE	FALSE
	11/18/1998	ND<2	FALSE	FALSE
	5/13/1999	ND<2	FALSE	FALSE
	12/6/1999	ND<2	FALSE	FALSE
	5/17/2000	2.5	FALSE	FALSE
	12/11/2000	ND<2	FALSE	FALSE

Alexander County Closed Landfill

Non-Parametric Tolerance Interval

Parameter: Vanadium

Total Percent Non-Detects = 38.8889%
Background Samples (n) = 27
Maximum Background Concentration = 330
Minimum Coverage = 89.5%
Average Coverage = 96.4286%

Well	Sample	Result	Impacted
MW-8	10/1/1994	ND<25	FALSE
MW-8	1/31/1995	ND<20	FALSE
MW-8	2/15/1995	ND<20	FALSE
MW-8	3/7/1995	ND<20	FALSE
MW-8	12/6/1995	ND<20	FALSE
MW-8	5/6/1996	ND<20	FALSE
MW-8	11/11/1996	6	FALSE
MW-8	6/24/1997	57	FALSE
MW-8	12/3/1997	55	FALSE
MW-8	6/4/1998	12	FALSE
MW-8	11/18/1998	9.6	FALSE
MW-8	5/13/1999	ND<2.5	FALSE
MW-8	12/6/1999	ND<2.5	FALSE
MW-8	5/17/2000	8	FALSE
MW-8	12/12/2000	6.4	FALSE
MW-5	10/1/1994	1770	TRUE
MW-5	1/31/1995	489	TRUE
MW-5	2/15/1995	392	TRUE
MW-5	3/7/1995	533	TRUE
MW-5	12/7/1995	137	FALSE
MW-5	5/6/1996	112	FALSE
MW-5	11/11/1996	52	FALSE
MW-5	6/24/1997	160	FALSE
MW-5	12/3/1997	480	TRUE
MW-5	6/4/1998	520	TRUE
MW-5	11/18/1998	1700	TRUE
MW-5	5/13/1999	170	FALSE
MW-5	12/6/1999	19	FALSE
MW-5	5/17/2000	190	FALSE
MW-5	12/11/2000	180	FALSE
MW-6	10/1/1994	ND<25	FALSE
MW-6	1/31/1995	ND<20	FALSE
MW-6	2/15/1995	ND<20	FALSE
MW-6	3/7/1995	100	FALSE
MW-6	12/6/1995	ND<20	FALSE
MW-6	5/6/1996	ND<20	FALSE
MW-6	11/11/1996	9	FALSE
MW-6	6/24/1997	8	FALSE
MW-6	12/3/1997	18	FALSE
MW-6	6/4/1998	100	FALSE
MW-6	11/18/1998	130	FALSE
MW-6	5/13/1999	26	FALSE

Vanadium

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MW-6	12/6/1999	15	FALSE
MW-6	5/17/2000	15	FALSE
MW-6	12/11/2000	5.8	FALSE

Non-Detects Replaced with 1/2 DL

Original Data

Parametric Tolerance Interval Analysis

Parameter: Zinc, total

Background mean = 4.06883
Background standard deviation = 1.09708
One-sided normal tolerance factor at 95% confidence = 1.73691
Tolerance factor calculation follows USEPA 1992 Guidance
Upper tolerance limit = 5.97437

Well	Date	Result	Impacted
MW-8	10/1/1994	4.2485	FALSE
	1/31/1995	4.5326	FALSE
	2/15/1995	4.65396	FALSE
	3/7/1995	ND<3.21888	FALSE
	12/6/1995	4.60517	FALSE
	5/6/1996	ND<3.21888	FALSE
	11/11/1996	2.30259	FALSE
	6/24/1997	4.86753	FALSE
	12/3/1997	4.36945	FALSE
	6/4/1998	3.95124	FALSE
	11/18/1998	2.94444	FALSE
	5/13/1999	ND<1.60944	FALSE
	12/6/1999	3.04452	FALSE
	5/17/2000	3.8712	FALSE
	12/12/2000	3.46574	FALSE
MW-5	10/1/1994	8.27129	TRUE
	1/31/1995	7.81601	TRUE
	2/15/1995	7.40853	TRUE
	3/7/1995	7.69166	TRUE
	12/7/1995	6.23441	TRUE
	5/6/1996	5.8944	FALSE
	11/11/1996	5.43808	FALSE
	6/24/1997	5.1358	FALSE
	12/3/1997	6.75693	TRUE
	6/4/1998	7.31322	TRUE
	11/18/1998	7.64969	TRUE
	5/13/1999	5.85793	FALSE
	12/6/1999	3.97029	FALSE
	5/17/2000	5.85793	FALSE
	12/11/2000	5.96615	FALSE
MW-6	10/1/1994	4.86753	FALSE
	1/31/1995	ND<3.21888	FALSE
	2/15/1995	ND<3.21888	FALSE
	3/7/1995	4.79579	FALSE
	12/6/1995	ND<3.21888	FALSE
	5/6/1996	ND<3.21888	FALSE
	11/11/1996	2.70805	FALSE
	6/24/1997	4.20469	FALSE
	12/3/1997	5.19296	FALSE
	6/4/1998	4.94164	FALSE
	11/18/1998	4.94164	FALSE
	5/13/1999	4.04305	FALSE
	12/6/1999	3.82864	FALSE
	5/17/2000	3.85015	FALSE
	12/11/2000	3.04452	FALSE

Non-Detects Replaced with 1/2 DL

Log-Transformed

Alexander County Closed Landfill

MW-4R	10/1/1994	6.64639	TRUE
	1/31/1995	5.04343	FALSE
	2/15/1995	4.85203	FALSE
	3/7/1995	4.7185	FALSE
	12/6/1995	ND<3.21888	FALSE
	5/6/1996	4.12713	FALSE
	11/11/1996	3.3673	FALSE
	6/24/1997	4.35671	FALSE
	12/3/1997	4.60517	FALSE
	6/4/1998	4.14313	FALSE
	11/18/1998	3.82864	FALSE
	5/13/1999	3.63759	FALSE
	12/6/1999	3.13549	FALSE
	5/17/2000	4.34381	FALSE
	12/11/2000	3.82864	FALSE

Non-Parametric Tolerance Interval

Parameter: 1,1-Dichloroethane

Total Percent Non-Detects = 15.493%
Background Samples (n) = 27
Maximum Background Concentration = 22
Minimum Coverage = 89.5%
Average Coverage = 96.4286%

Well	Sample	Result	Impacted
MW-5	10/1/1994	11	FALSE
MW-5	1/31/1995	12	FALSE
MW-5	2/15/1995	8	FALSE
MW-5	3/7/1995	7	FALSE
MW-5	12/7/1995	14	FALSE
MW-5	5/6/1996	16	FALSE
MW-5	11/11/1996	16	FALSE
MW-5	6/24/1997	15	FALSE
MW-5	12/3/1997	19	FALSE
MW-5	6/4/1998	22	FALSE
MW-5	11/18/1998	11.2	FALSE
MW-5	5/13/1999	15	FALSE
MW-5	12/6/1999	13	FALSE
MW-5	5/17/2000	10	FALSE
MW-5	12/11/2000	11	FALSE
MW-4R	10/1/1994	14	FALSE
MW-4R	1/31/1995	17	FALSE
MW-4R	2/15/1995	17	FALSE
MW-4R	3/7/1995	14	FALSE
MW-4R	12/6/1995	11	FALSE
MW-4R	5/6/1996	13	FALSE
MW-4R	11/11/1996	16	FALSE
MW-4R	6/24/1997	13	FALSE
MW-4R	6/4/1998	10	FALSE
MW-4R	11/18/1998	10.1	FALSE
MW-4R	5/13/1999	15	FALSE
MW-4R	12/6/1999	18	FALSE
MW-4R	5/17/2000	12	FALSE
MW-4R	12/11/2000	15	FALSE
MW-7	10/1/1994	16	FALSE
MW-7	1/31/1995	26	TRUE
MW-7	2/15/1995	29	TRUE
MW-7	3/7/1995	25	TRUE
MW-7	12/6/1995	25	TRUE
MW-7	5/6/1996	26	TRUE
MW-7	11/11/1996	16	FALSE
MW-7	6/24/1997	19	FALSE
MW-7	12/3/1997	17	FALSE
MW-7	6/4/1998	14	FALSE
MW-7	11/18/1998	8.8	FALSE
MW-7	5/13/1999	13	FALSE
MW-7	12/6/1999	17	FALSE

1,1-Dichloroethane

MW-7	5/17/2000	15	FALSE
MW-7	12/12/2000	15	FALSE

Non-Detects Replaced with 1/2 DL

Original Data