Stats only

96-01

8-3-00

OPERATION/CONSTRUCTION MANAGERS

Municipal Services

PO Box 97, Garner, North Carolina 27529 (919) 772-5393

CIVIL/SANITARY ENGINEERS

Engineering Company, P.A.

PO Box 349, Boone, North Carolina 28607 (828) 262-1767

Fac/Perm/Co ID # Johnson | Date 7/19/12 | Doc ID# DIN

March 28, 2000

MAR 2001 Received Solid Waste Section

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

Re: Groundwater Sampling and Statistical Analysis
Wayne County Closed Sanitary Landfill (Dudley)
MESCO Project No. G01016.0

Dear Mr. Rose:

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

Statistical Analysis Methodology

Metals

An inter-well statistical analysis was conducted upon metals detected during the August 2, 2000 sampling event. Monitoring well MW-1 was defined as the background well, 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. Only the detected metal thallium with concentrations found below that of the background well MW-1 was eliminated and a statistical analysis was not conducted upon MW-5, MW-6, and MW-7. A total of eight metals were tested for statistical significance. The non-parametric tolerance interval method with 1/2ND substitution was utilized for zinc. For all other detected metals, the Poisson tolerance limit was used because the %ND was greater than 90%.

VOCs

All historical VOC detections in the background well MW-1 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).

Intrawell Analyses For those constituents that had been found to be statistically significant by the interwell analysis, further analyses were conducted to determine whether the statistical significance was caused by spatial variability. Shewhart-CUSUM control charts were generated for each of the triggered constituents to determine its baseline levels. Baseline levels in this context are defined as the background level derived from the data in a given downgradient well. It's important to note that Shewhart-CUSUM control charts requires a minimum of eight independent historical sampling events and a detection rate greater than 25% (%ND≤75%). Due to the detection rate requirement, Shewhart-CUSUM charts were not generated for vanadium in monitoring wells MW-3 and MW-8.

Results

Interwell analysis was performed on 8 metals detected during the August 2000 sampling event. Historical data compiled for monitoring well MW-1 was used as the baseline. Data distributions were reviewed using time series and box and whiskers plots (enclosed charts). Table 2 summarizes those metals that were found to be significantly higher than their background levels by inter-well analysis.

Table2. Interwell Analyses Summary

Well	Cr	Pb	Va
MW-3	x		x
MW-6	x		x
MW-7	x	x	x
MW-8	x	x	x

x=level significantly higher than the background level

The metals chromium and vanadium were detected at statistically significant levels at monitoring locations MW-3, MW-6, MW-7, and MW-8 according to interwell comparisons. MW-7 and MW-8, located along the south perimeter of the waste boundary, detected lead. All wells that showed VOC detections exceeded the expected number of VOC detections determined from the background data, indicating the possible presence of contamination in those wells at a 95% confidence level.

An intra-well analysis was conducted only upon those constituents that were initially found to be statistically significant. Stewhart-CUSUM control charts were generated and included in this report. Contrary to the inter-well analysis results, the intra-well analysis results show no statistical significance against their own background levels.

In general, intra-well analysis is conducted in order to differentiate true contamination from spatial variability. In this specific instance, however, the statistical insignificance may not necessarily suggest no occurrence of contamination resulted from the closed landfill. Intra-well comparison is based on the assumption that the site had no previous contamination prior to the inception of the monitoring; these intra-well analysis results may only reflect the conditions after the first sampling took place in September of 1994.

Concentration vs. Time graphs were formulated and examined in an effort to determine if trends exist in the original laboratory data. Some interesting observations were made that lead to a more in depth statistical investigation that should yield more accurate findings. In general, detections of metals and VOCs in all monitoring points appear to have increased since the last sampling event. This general trend is believed to be a product of an extraordinarily low amount of detections that occurred during the sampling event prior to this one conducted in February 2000. Not a single metal was detected upon the site during the previous sampling event. This same trend was encountered at a different site that was also sampled by Environment 1 just 2 weeks prior by the same technician and lab methods.

The metal chromium was found in concentrations significantly higher than the background levels within MW-3, MW-6, MW-7 and MW-8. Stewhart-CUSUM control charts were than formulated for these wells. Monitoring well MW-7 revealed a significant increase of chromium compared to it's own historical background data. The time series plot for MW-7 depicts consistent detections of chromium with a slight temporal decrease until this sampling event. However, a dramatic concentration increase occurred during this August 2000 sampling event, which is indicative of the presence of a possible outlier. An outlier, are those values that do not conform to the pattern established by other observations and can arise from errors in transcription, data-coding, analytical instrument failure, calibration error or underestimation of inherent spatial or temporal variability in constituent concentrations (Gibbons 1994). A Dixon's test for outliers was performed upon the suspected chromium within MW-4 and the results show at a 5% significance level that the result is indeed an outlier. A separate Stewhart-CUSUM control chart with the outlier eliminated was prepared and the CUSUM line returned under control.

Vanadium was also found in concentrations above it's own background levels via intra-well analysis in MW-6 and MW-7. The super elevated concentration of Vanadium within MW-7 also failed to conform to historical trends and was shown to be an outlier according to Dixon's test. When the erroneous value was screened the artificially increased standardized mean and CUSUM lines were brought back under control. An outlier concentration of vanadium in MW-6 was also reported during the February 1999 sampling event. Both the CUSUM line and the standardized mean line immediately detected this outlier. However, only the standardized mean line returns to control on the subsequent sampling events. The outlier value was removed from the historical data set and the CUSUM line was brought back under control.

The general increase of detections during this summer sampling event could partially be explained by the occurrence of an apparent seasonal trend of chromium within MW-7 and MW-8. After reviewing the time series plots for these two wells it became evident that the levels of chromium fluctuated between the summer and winter sampling events. Concentrations of chromium were historically elevated in the summer and lower in the winter. A Seasonal Kendall Test was implemented in an effort to detect seasonal trends in the data sets. The variation of the Mann-Kendall trend analysis proved the alternate hypothesis that a trend does exist and amounts of chromium are higher in the summer.

During this sampling event an increased amount of VOCs were detected in the monitoring wells when compared to the last sampling event. Three VOCs were detected within MW-6, two within MW-8 and one in MW-2. The Poisson prediction interval result on the pooled VOC detections indicates that the numbers of VOC detections in all these wells are significantly higher than the expected number of detections derived from the background well data. Time series plots for MW-6 and MW-8 show consistent historical detections of the VOCs chlorobenzene, 1,4 dichlorobenzene, and xylene until the last sampling event in which none of these parameters were found. However these VOCs were detected again during this sampling event in concentrations relatively close but slightly less than amounts detected during the last summer sampling event. MW-4 had 3 VOCs detected during the last February 2000 sampling event and these results were considered to be of an anomalous nature and was verified by no VOC detections found during this event. Intra-well analysis was conducted upon the wells with VOC detections and the

Shewhart-CUSUM charts illustrate no statistical significance against their own background levels. No Appendix II Semi-VOCs were detected over the entire site during this sampling event.

Conclusion

The interwell statistical analysis results on metals show that monitoring wells MW-3, MW-6, MW-7, and MW-8 contain levels of chromium and vanadium over the background levels during this sampling event. The metal lead was also detected above background levels within MW-7 and MW-8. However none of these parameters were found to be statistically significant when an intra-well analysis was performed. VOCs were detected within MW-2, MW-6 and MW-8 in concentrations above the background established by upgradient MW-1 but were found not to be above their own historical background levels. Several outliers have become apparent and the erroneous values have been temporarily removed from the data set because incorporating them to establish statistical limit estimates will often lead to biased and misleading results. An apparent seasonal trend of chromium within MW-7 and MW-8 was discovered which could partially explain the increased concentrations found during the summer sampling events. Overall, the observed levels of VOCs are still significantly higher than the background levels in MW-1. This coupled with the fact that the particular detections are chlorinated compounds, which are commonly found in groundwater sampled from contaminated municipal solid waste sites, suggests that an impact from the closed landfill is still present. However, a close examination of the time-series plots for historically detected VOCs suggests that the levels of VOCs are not increasing. This is also reflected by the fact that no intra-well analyses showed significant increase of VOC levels. Since the landfill has ceased operation, levels of VOCs are expected to decrease. The Wayne County Closed Landfill was sampled again on February 8, 2001 by Environment I of Greenville, NC. The results report and statistical analysis will be submitted to the section upon completion. 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. Lloyd Cook
Wayne County

Exceedance Scan
Wayne County Closed Sanitary Landfill (Dudley)

Well ID	Parameter Name [1]	Sample Date	Result	Unit	PQL [2]	MCL [3]	Exceedance
MW-1	Thallium, total	8/2/00	0.001	mg/l	0.001	-	
MW-2	Arsenic, total	8/2/00	0.010	mg/l	0.005	0.05	
MW-2	Chromium, total	8/2/00	0.012	mg/l	0.01	0.05	
MW-2	Lead, total	8/2/00	0.011	mg/l	0.01	0.015	
MW-2	Chlorobenzene	8/2/00	14.000	ug/l	5	50	
MW-3	Chromium, total	8/2/00	0.024	mg/l	0.01	0.05	
MW-3	Thallium, total	8/2/00	0.002	mg/l	0.001	-	
MW-3	Vanadium	8/2/00	0.065	mg/l	0.04	-	
MW-4	Thallium, total	8/2/00	0.002	mg/l	0.001	-	
MW-5	Thallium, total	8/2/00	0.001	mg/l	0.001	-	
MW-6	Chromium, total	8/2/00	0.044	mg/l	0.01	0.05	
MW-6	Lead, total	8/2/00	0.014	mg/l	0.01	0.015	
MW-6	Thallium, total	8/2/00	0.001	mg/l	0.001	-	
MW-6	Vanadium	8/2/00	0.066	mg/l	0.04	-	
MW-6	1,4-Dichlorobenzene	8/2/00	10	ug/l	5	75	
MW-6	Chlorobenzene	8/2/00	11	ug/l	5	50	
MW-6	Xylene	8/2/00	65	ug/l	5	530	
MW-7	Arsenic, total	8/2/00	0.013	mg/l	0.01	0.05	
MW-7	**Chromium, total**	**8/2/00**	**0.35**	**mg/l**	**0.01**	**0.05**	**0.3**
MW-7	**Lead, total**	**8/2/00**	**0.066**	**mg/l**	**0.01**	**0.015**	**0.051**
MW-7	Silver, total	8/2/00	0.011	mg/l	0.01	0.018	
MW-7	Thallium, total	8/2/00	0.001	mg/l	0.001	-	
MW-7	Vanadium	8/2/00	1.047	mg/l	0.04	-	
MW-7	Zinc, total	8/2/00	0.062	mg/l	0.05	2.1	
MW-8	**Chromium, total**	**8/2/00**	**0.14**	**mg/l**	**0.01**	**0.05**	**0.09**
MW-8	**Lead, total**	**8/2/00**	**0.031**	**mg/l**	**0.01**	**0.015**	**0.016**
MW-8	**Mercury**	**8/2/00**	**0.002**	**mg/l**	**0.0005**	**0.0011**	**0.0004**
MW-8	Vanadium	8/2/00	0.156	mg/l	0.04	-	
MW-8	1,4-Dichlorobenzene	8/2/00	28	ug/l	5	75	
MW-8	Chlorobenzene	8/2/00	14	ug/l	5	50	

[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
Wayne County Closed Sanitary Landfill (Dudley)

Background Well: MW-1

Arsenic, total

%ND	Normality	Method	ND Adj.	Upper Limit (a = 95%)	Unit
100	-	Poisson tolerance interval	ND	16.5	ug/l

Well	Result	Significance
MW-2	10	no
MW-7	13	no

Chromium, total

%ND	Normality	Method	ND Adj.	Upper Limit (a = 95%)	Unit
100	-	Poisson tolerance interval	ND	17	ug/l

Well	Result	Significance
MW-2	12	no
MW-3	24	yes
MW-6	44	yes
MW-7	350	yes
MW-8	140	yes

Lead, total

%ND	Normality	Method	ND Adj.	Upper Limit (a = 95%)	Unit
100	-	Poisson tolerance interval	ND	17	ug/l

Well	Result	Significance
MW-7	66	yes
MW-8	31	yes

Mercury, total

%ND	Normality	Method	ND Adj.	Upper Limit (a = 95%)	Unit
100	-	Poisson tolerance interval	ND	3	ug/l

Well	Result	Significance
MW-8	1.5	no

Silver, total

%ND	Normality	Method	ND Adj.	Upper Limit (a = 95%)	Unit
100	-	Poisson tolerance interval	ND	17.0	ug/l

Well	Result	Significance
MW-7	11	no

Tallium, total

%ND	Normality	Method	ND Adj.	Upper Limit (a = 95%)	Unit
92.857	-	Poisson tolerance interval	ND	16	ug/l

Well	Result	Significance
MW-3	2	no
MW-4	2	no

Vanadium

%ND	Normality	Method	ND Adj.	Upper Limit (a = 95%)	Unit
92.857	-	Poisson tolerance interval	1/2 ND	30	ug/l

Well	Result	Significance
MW-3	65	yes
MW-6	66	yes
MW-7	1047	yes
MW-8	156	yes

Zinc, total

%ND	Normality	Method	ND Adj.	Upper Limit (a = 95%)	Unit
85.7143	no	Non-parametric tolerance interval	1/2 ND	243	ug/l

Well	Result	Significance
MW-7	62	no

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

Summary of Pooled VOCs in Background Well (MW-1)
Wayne County Closed Sanitary Landfill (Dudley)

Constituent	Samples	NDs	% NDs
1,1,1,2-Tetrachloroethane	15	15	100.00
1,1,1-Trichloroethane	15	15	100.00
1,1,2,2-Tetrachloroethane	15	15	100.00
1,1,2-Trichloroethane	15	15	100.00
1,1-Dichloroethane	15	15	100.00
1,1-Dichloroethene	15	15	100.00
1,2,3-Trichloropropane	15	15	100.00
1,2-Dibromo-3-chloropropane	15	15	100.00
1,2-Dibromoethane	15	15	100.00
1,2-Dichlorobenzene	15	15	100.00
1,2-Dichloroethane	15	15	100.00
1,2-Dichloropropane	15	15	100.00
1,4-Dichlorobenzene	15	15	100.00
2-Butanone	15	15	100.00
2-Hexanone	15	15	100.00
4-Methyl-2-Pentanone	15	15	100.00
Acetone	15	15	100.00
Acrylonitrile	15	15	100.00
Benzene	15	15	100.00
Bromochloromethane	15	15	100.00
Bromodichloromethane	15	15	100.00
Bromoform	15	15	100.00
Bromomethane	15	15	100.00
Carbon disulfide	15	15	100.00
Carbon tetrachloride	15	15	100.00
Chlorobenzene	15	15	100.00
Chloroethane	15	15	100.00
Chloroform	15	15	100.00
Chloromethane	15	15	100.00
cis-1,2-Dichloroethene	15	15	100.00
cis-1,3-Dichloropropene	15	15	100.00
Chlorodibromomethane	15	15	100.00
Dibromomethane	14	14	100.00
Ethylbenzene	15	15	100.00
Iodomethane	15	15	100.00
Dichloromethane	15	15	100.00
Styrene	15	15	100.00
Tetrachloroethylene	15	15	100.00
Toluene	15	15	100.00
trans-1,2-Dichloroethene	15	15	100.00
trans-1,3-Dichloropropene	15	15	100.00
trans-1,4-Dichloro-2-butene	15	15	100.00
Trichloroethylene	15	15	100.00
Trichlorofluoromethane	15	15	100.00
Vinyl acetate	15	15	100.00
Vinyl chloride	15	15	100.00
Xylene	15	15	100.00
Total	**704**	**704**	**100.00**

Poisson Prediction Interval Based upon Pooled Background VOCs
Wayne County Closed Sanitary Landfill (Dudley)

All detected VOCs (Background Well: MW-1)

Constituent	MW-2	MW-6	MW-8
Chlorobenzene	x	x	x
1,4-Dichlorobenzene		x	x
Xylene		x	
Detection(s) per Scan	1.00	3.00	2.00

Total number of sampling events [n] = 15
Total number of detections in background wells [y] = 0
Number of comparisons (downgradient wells) [k] = 8
One-sided value of Student's t-statistic (95% confidence) [t] = 2.84215
Expected number of detections in a single future sample [y*] = **0.5393**

Statistically significant VOC detections at 95% confidence level within MW-2, MW-6, & MW-8

Intra-Well Analysis Summary (Metals)
Wayne County Closed Sanitary Landfill (Dudley)

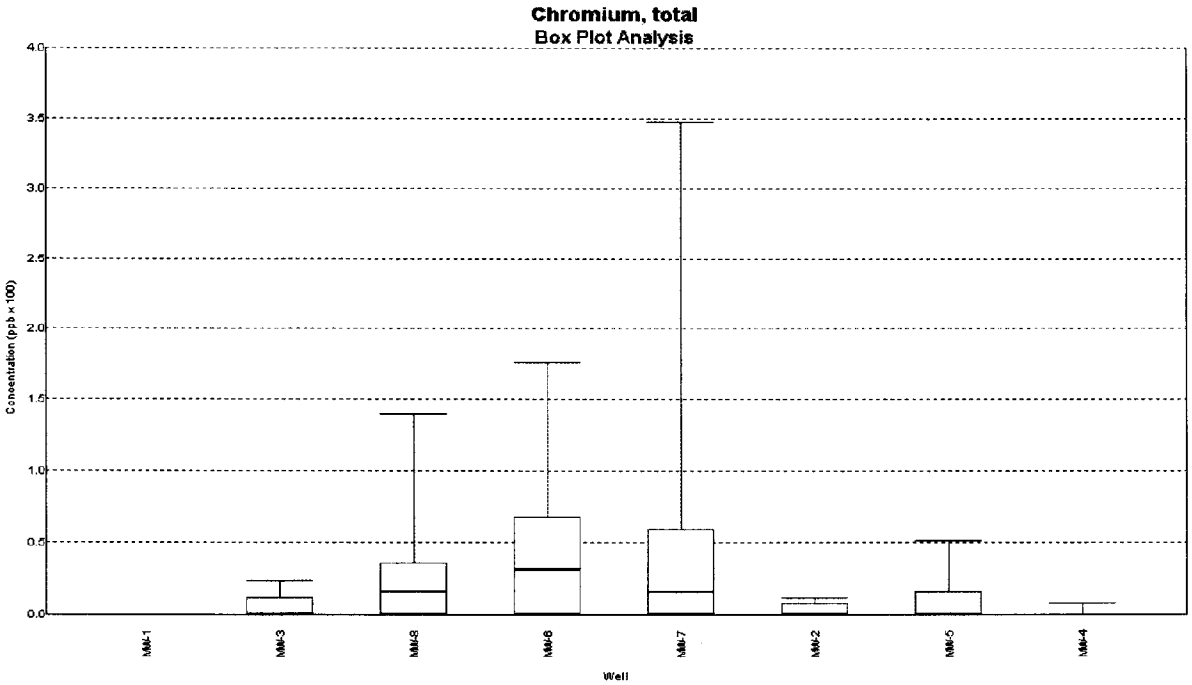
Well	Chromium	Lead	Vanadium	Chlorobenzene	1,4-Dichlorobenzene	Xylene
MW-2				no		
MW-3	no		N/A			
MW-6	no		no*	no	no	no
MW-7	no*	no	no*			
MW-8	no	no	N/A	no	no	

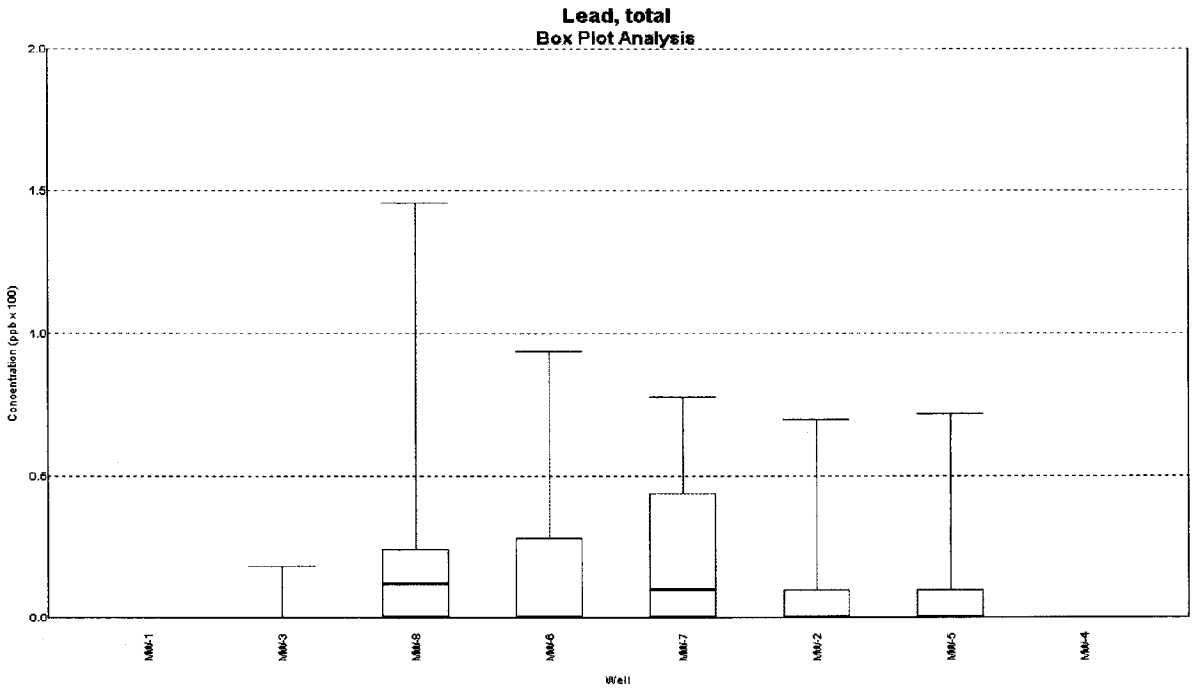
EXPLANATION

yes=detection statistically significant by intrawell analysis
no=detection not statistically significant by intrawell analysis
N/A=unable to run intrawell analysis de to insufficient number of detections or sampling events
* =outlier idenified and when eliminated intrawell CUSUM control chart result reversed

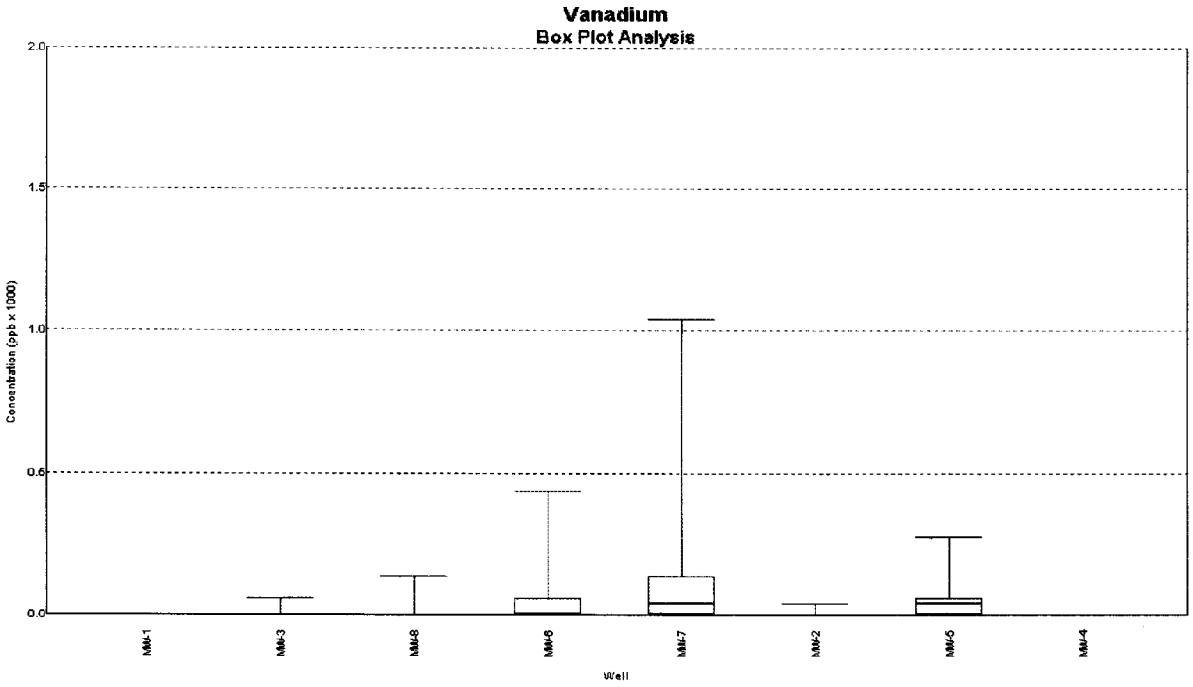
No constituent has statistically signficantly increased by Shewart-CUSUM Control chart.

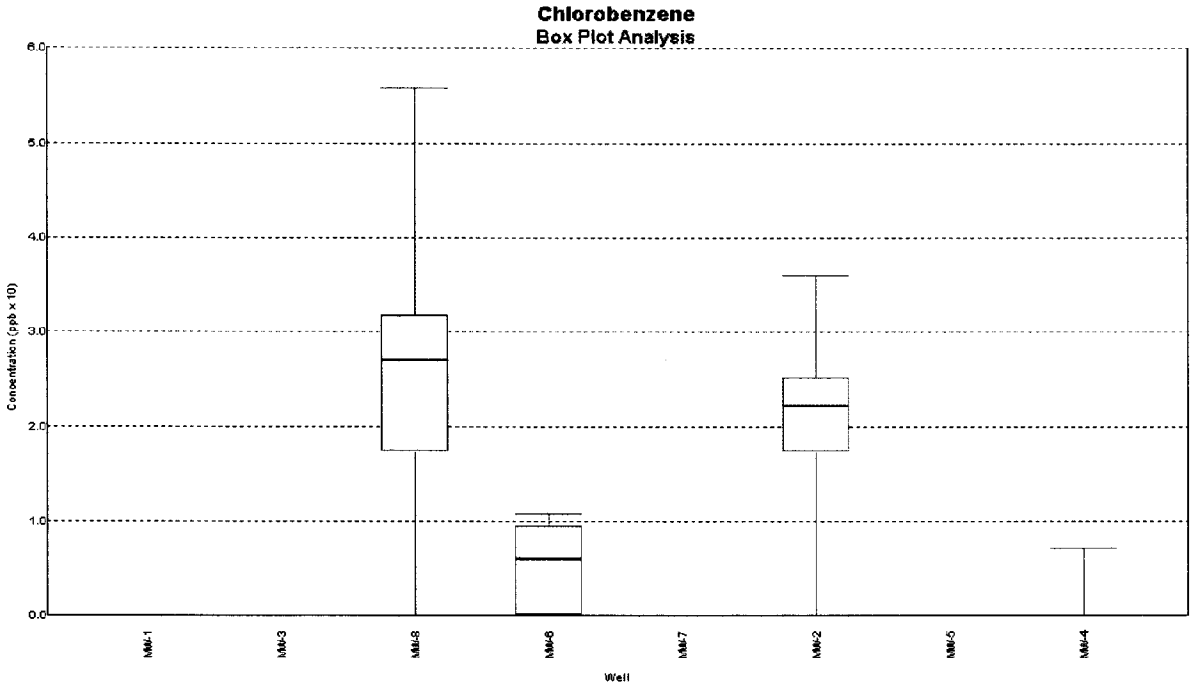
Box Plots for Select Constituents
Wayne County Closed Sanitary Landfill (Dudley)



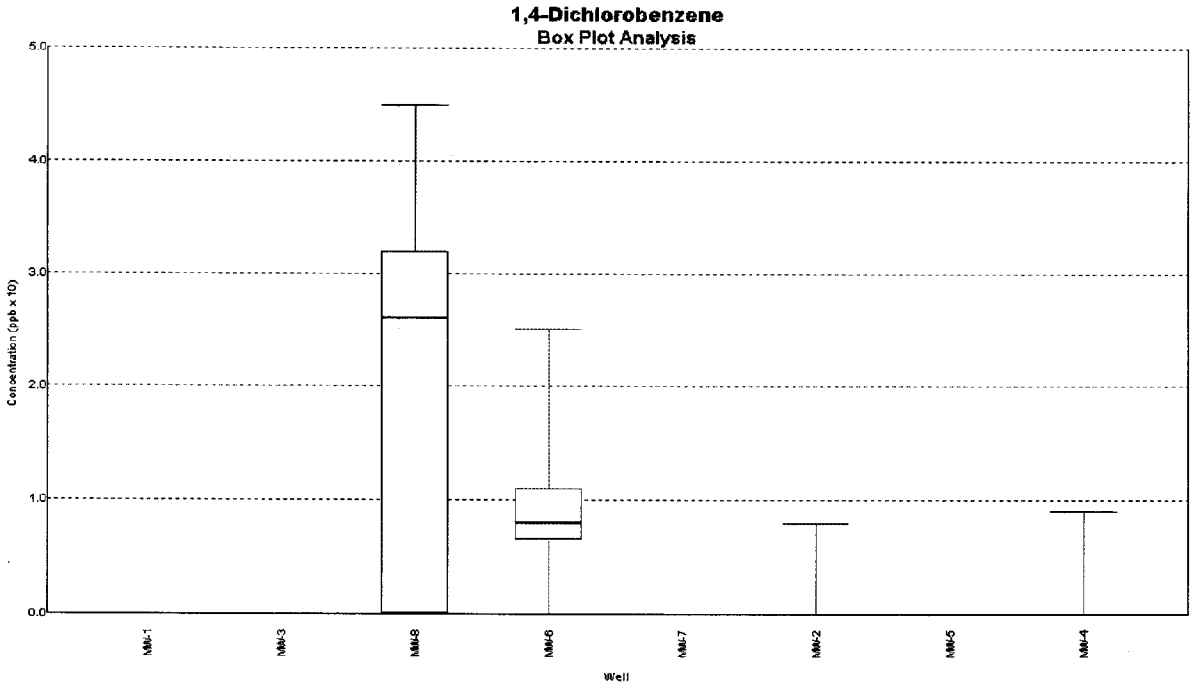


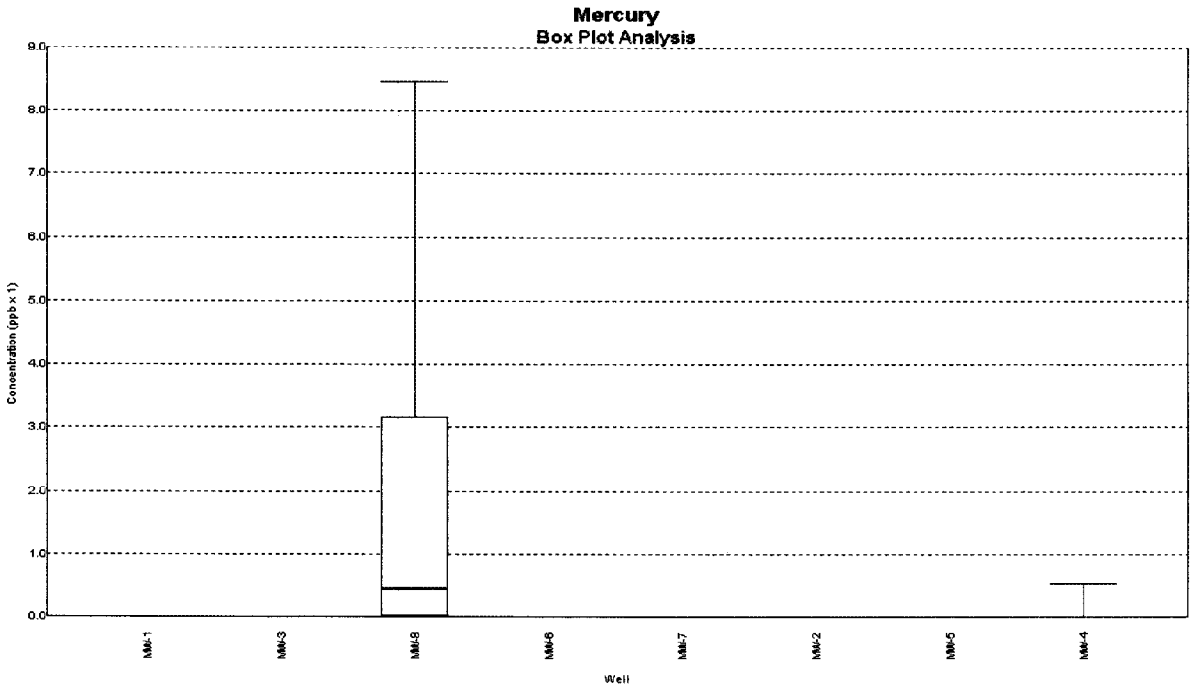
Box Plots for Select Constituents
Wayne County Closed Sanitary Landfill (Dudley)



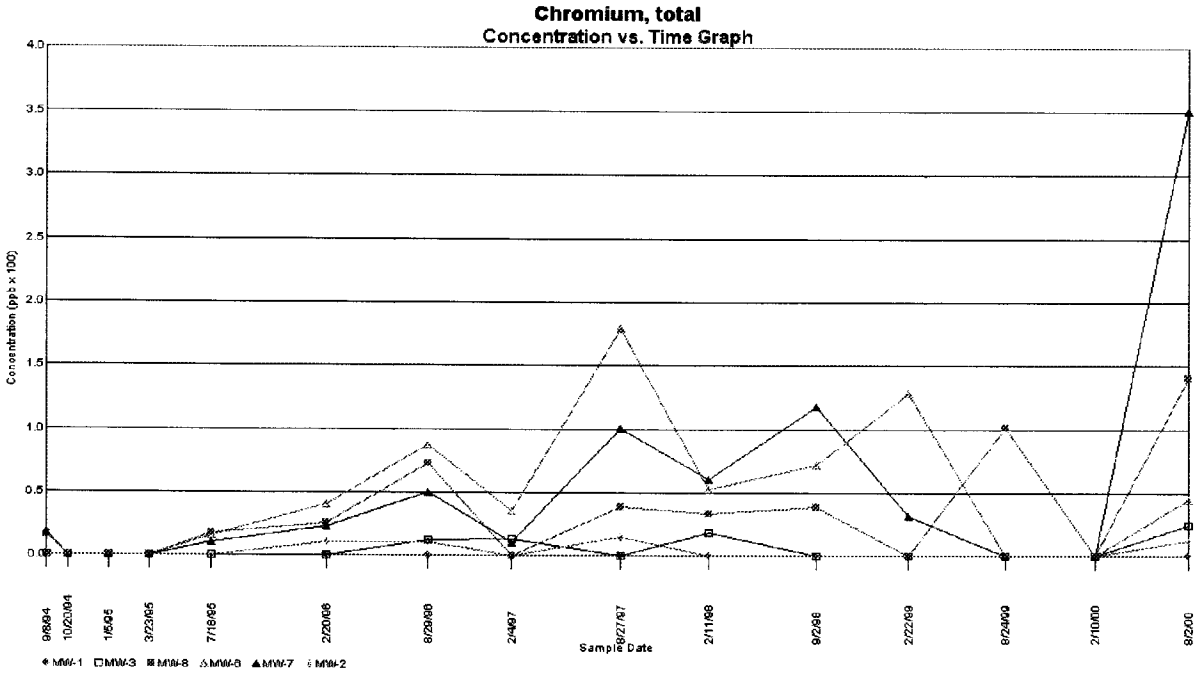


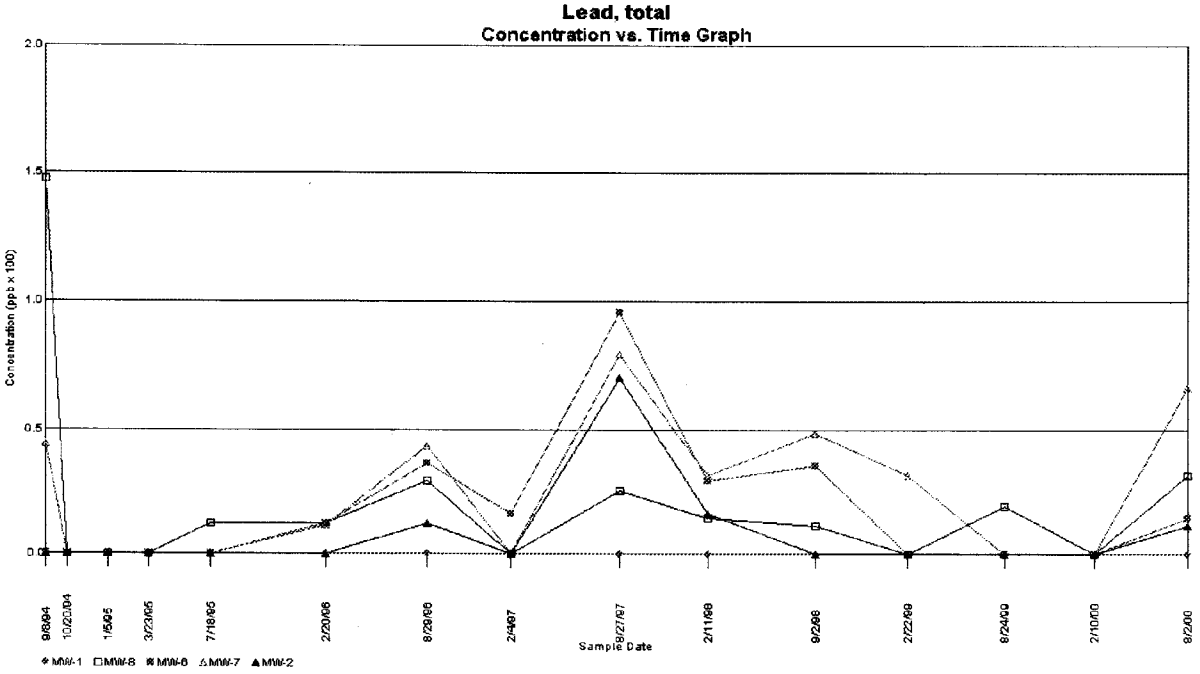
Box Plots for Select Constituents
Wayne County Closed Sanitary Landfill (Dudley)



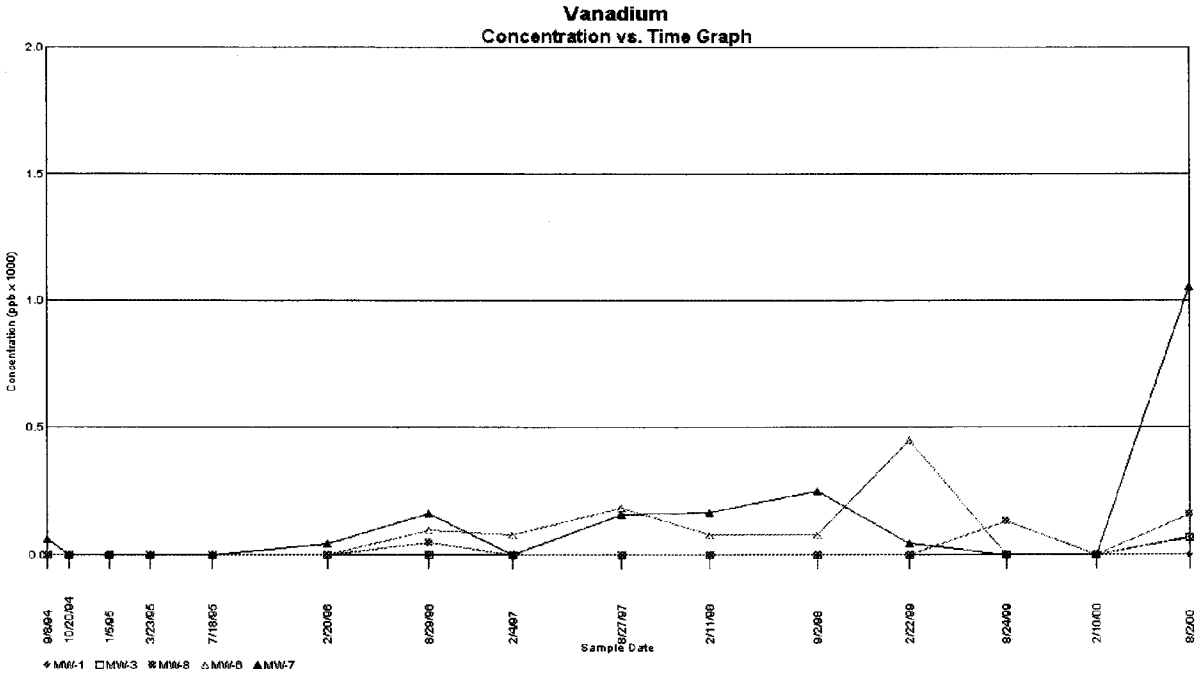


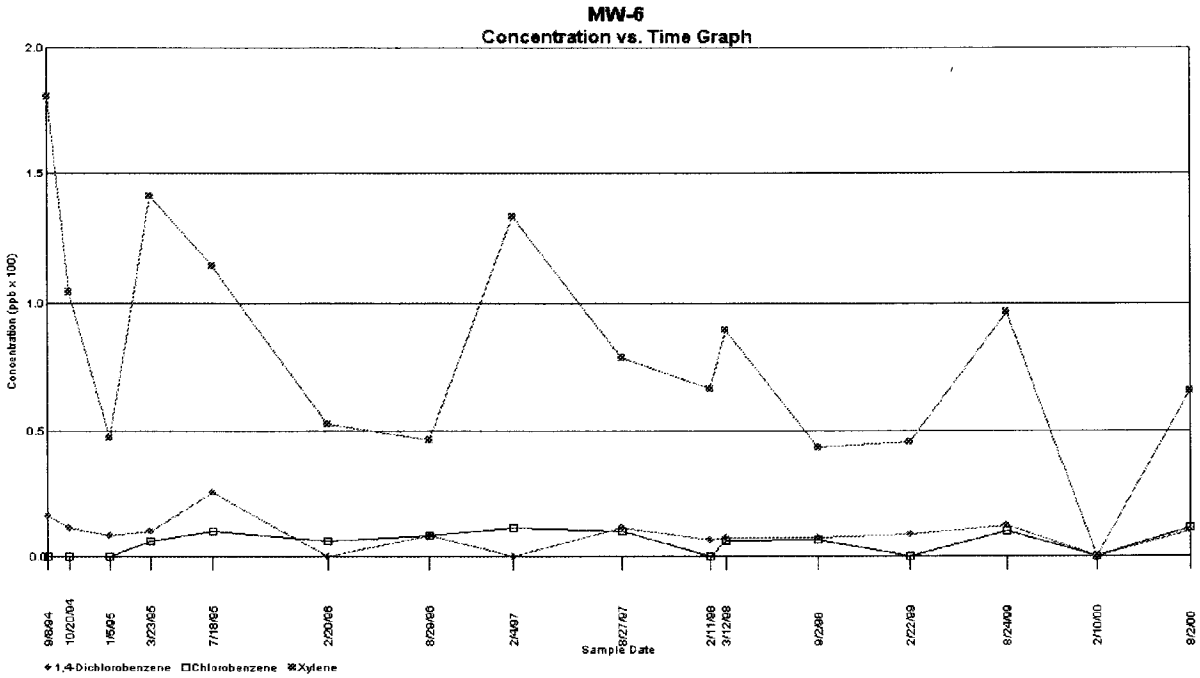
Time Series Plots for Select Constituents
Wayne County Closed Sanitary Landfill (Dudley)



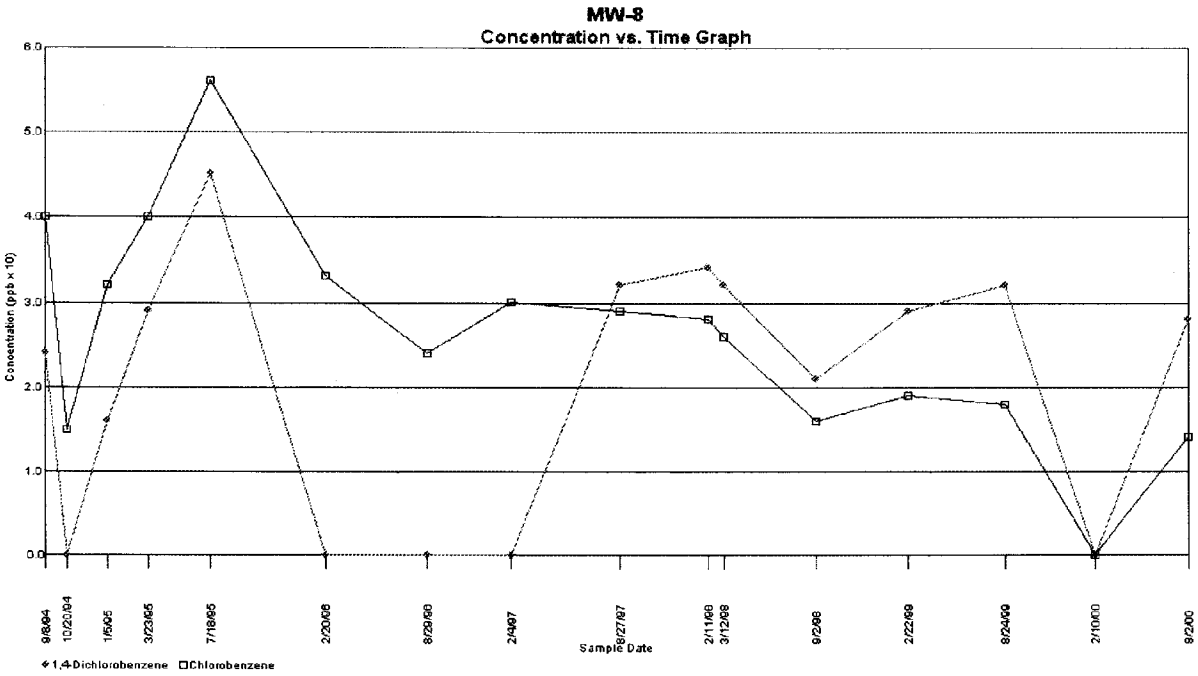


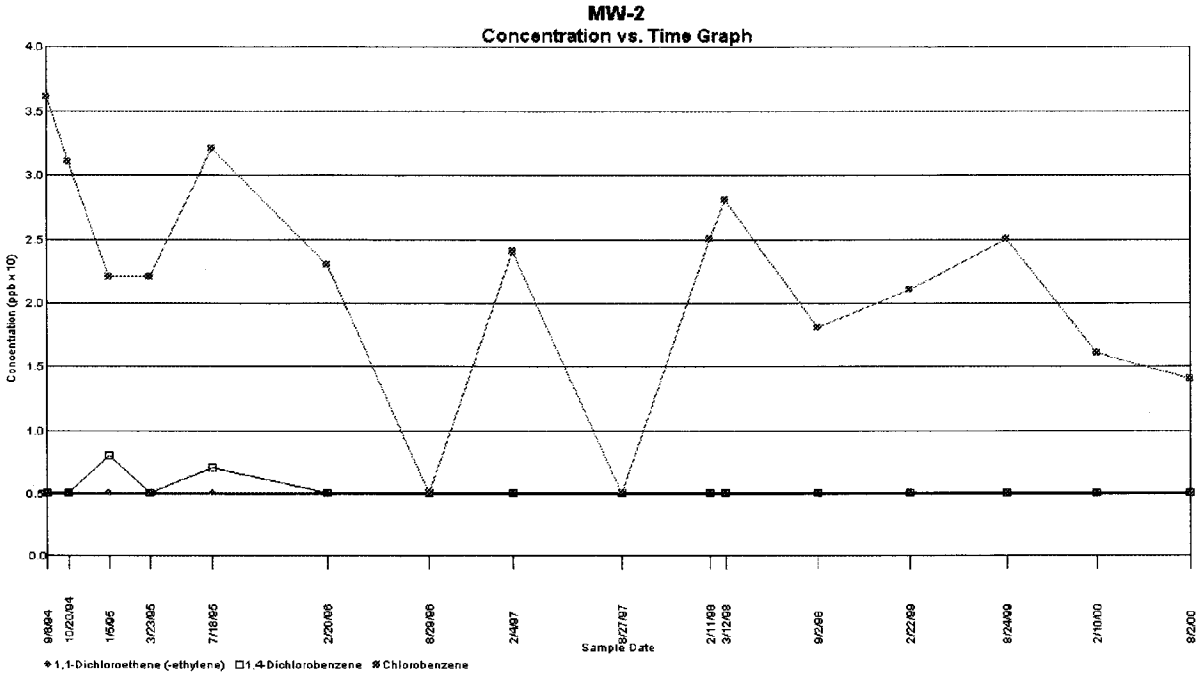
Time Series Plots for Select Constituents
Wayne County Closed Sanitary Landfill (Dudley)



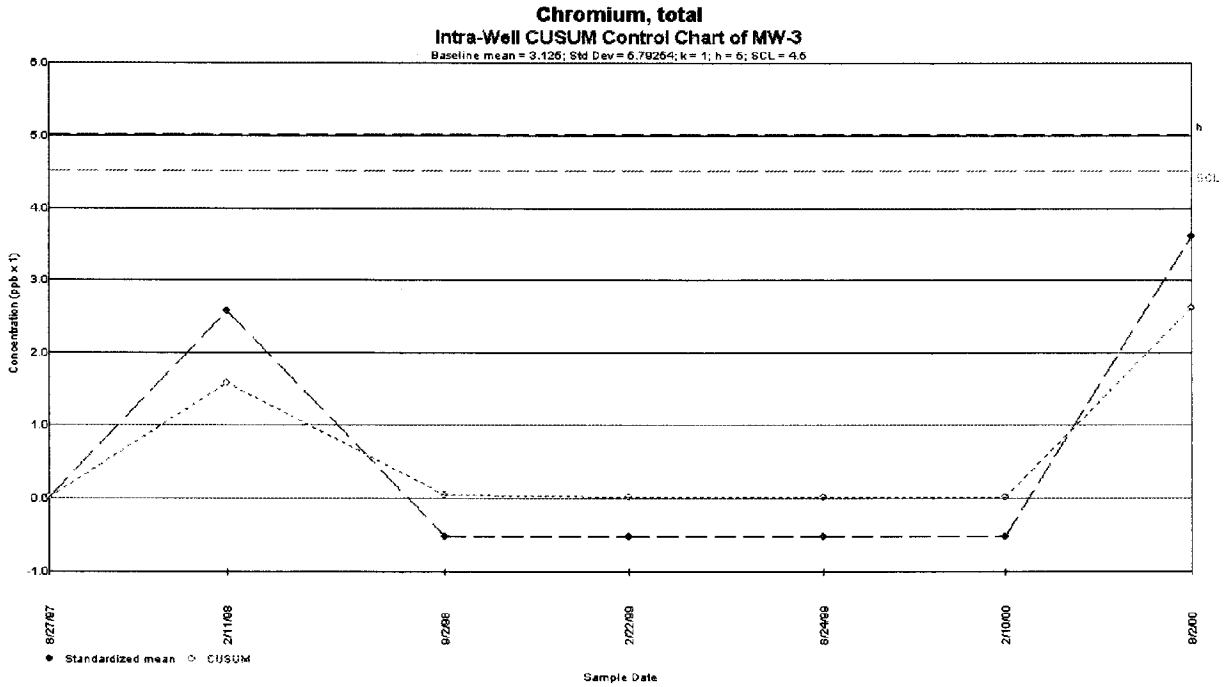


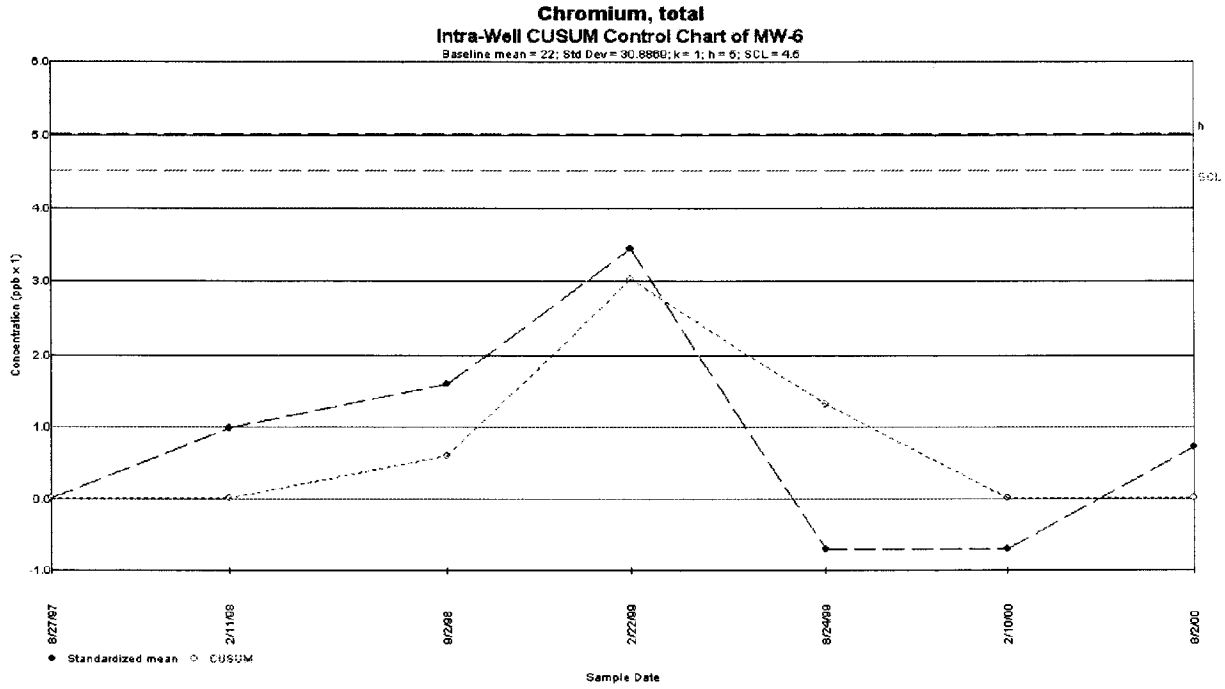
Time Series Plots for Select Constituents
Wayne County Closed Sanitary Landfill (Dudley)





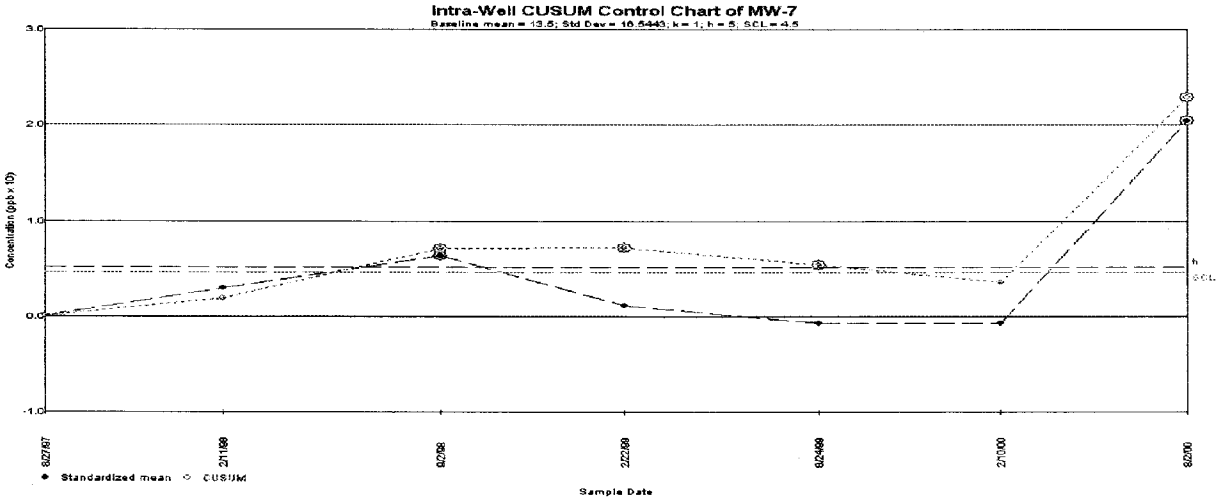
Shewart-CUSUM charts for selected constituents
Wayne County Closed Sanitary Landfill (Dudley)

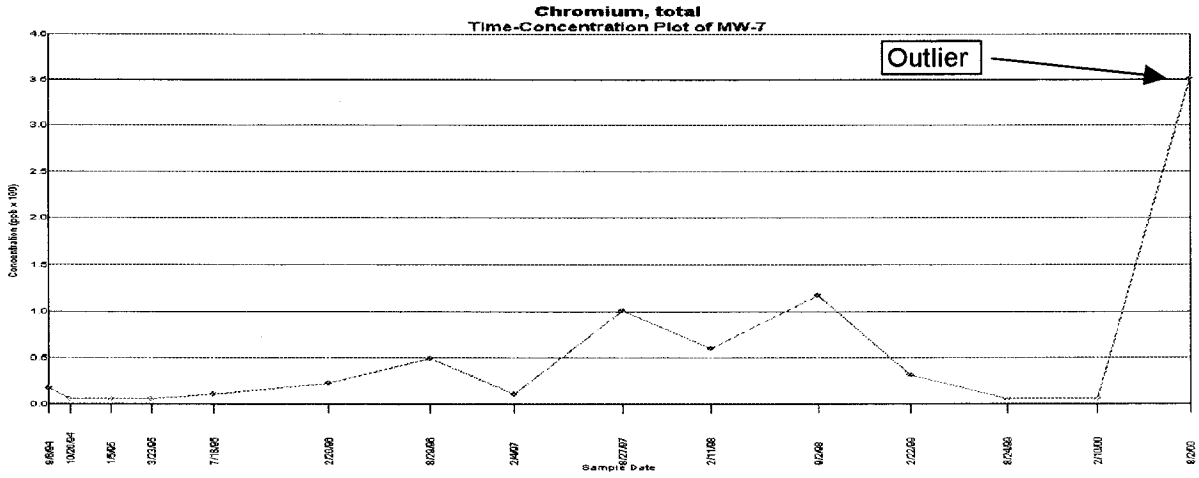




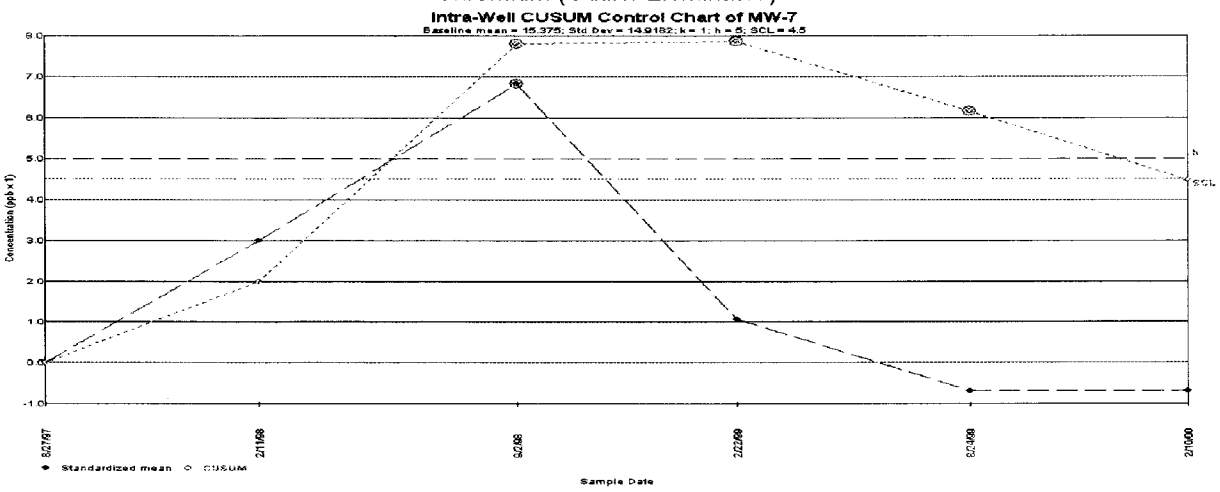
Shewart-CUSUM charts for selected constituents
Wayne County Closed Sanitary Landfill (Dudley)

Chromium (Outlier Included)

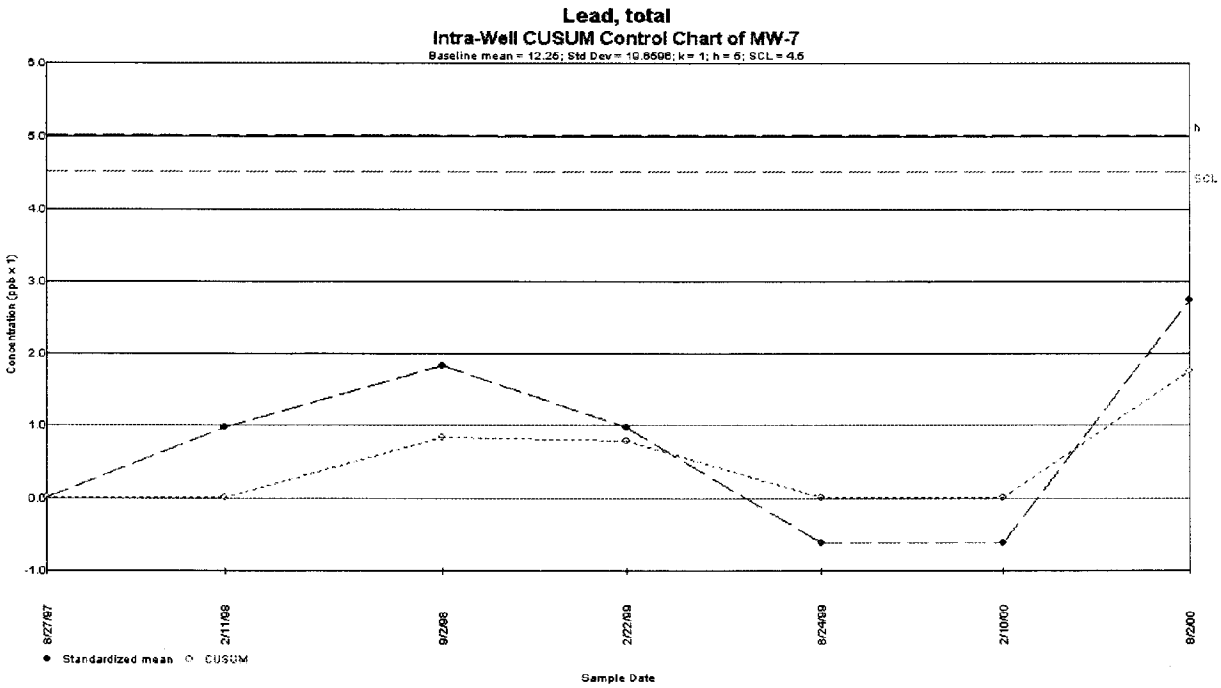


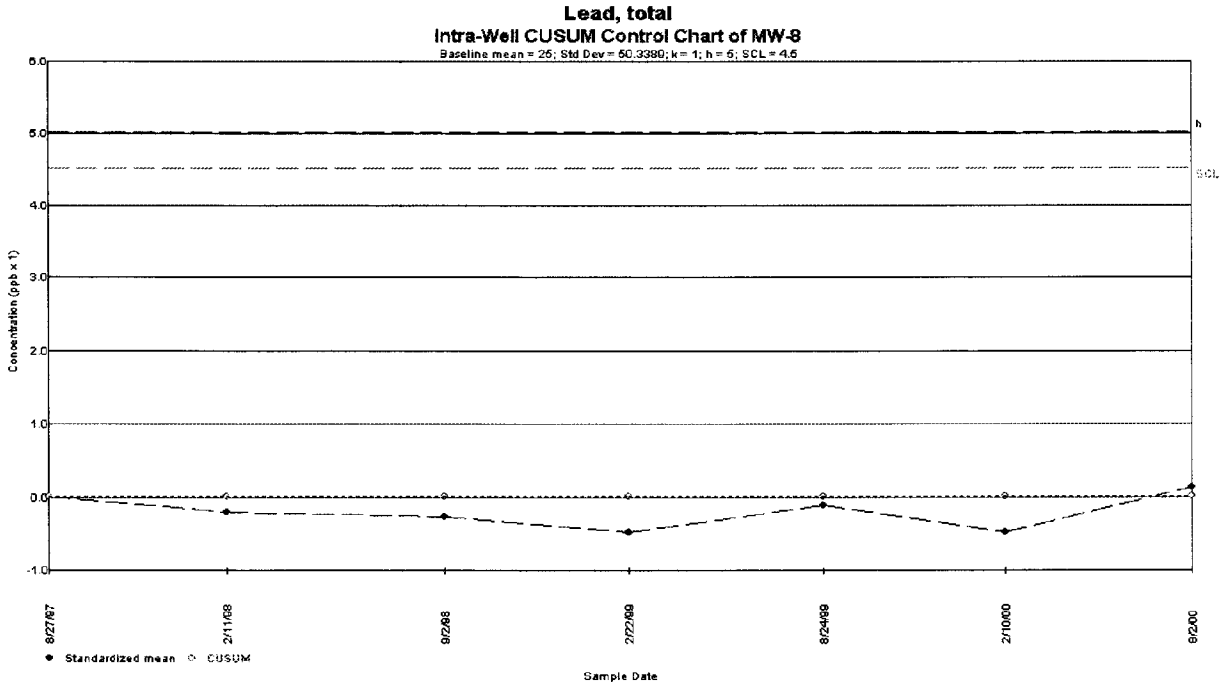


Chromium (Outlier Eleminated)



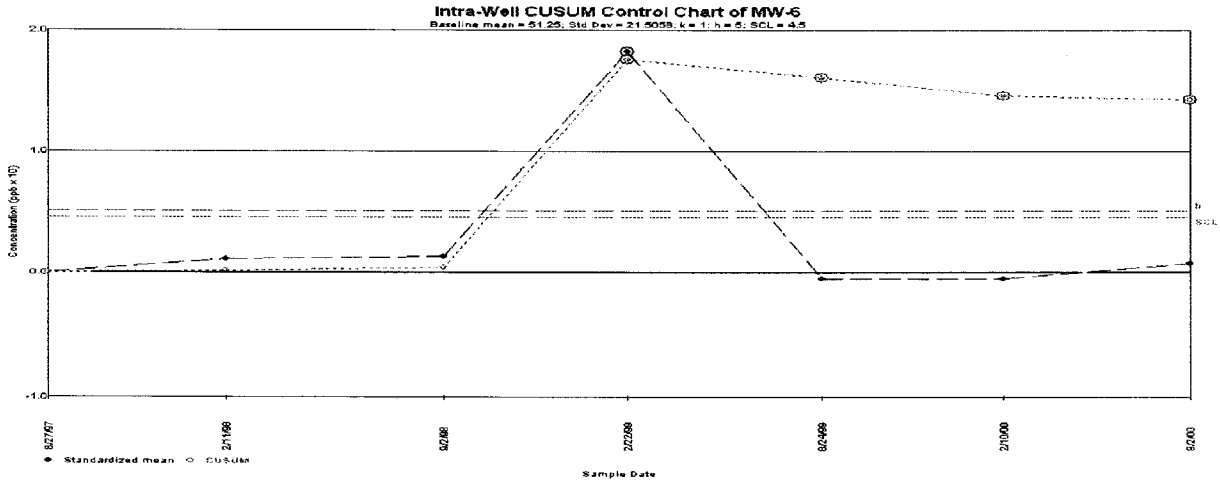
Shewart-CUSUM charts for selected constituents
Wayne County Closed Sanitary Landfill (Dudley)

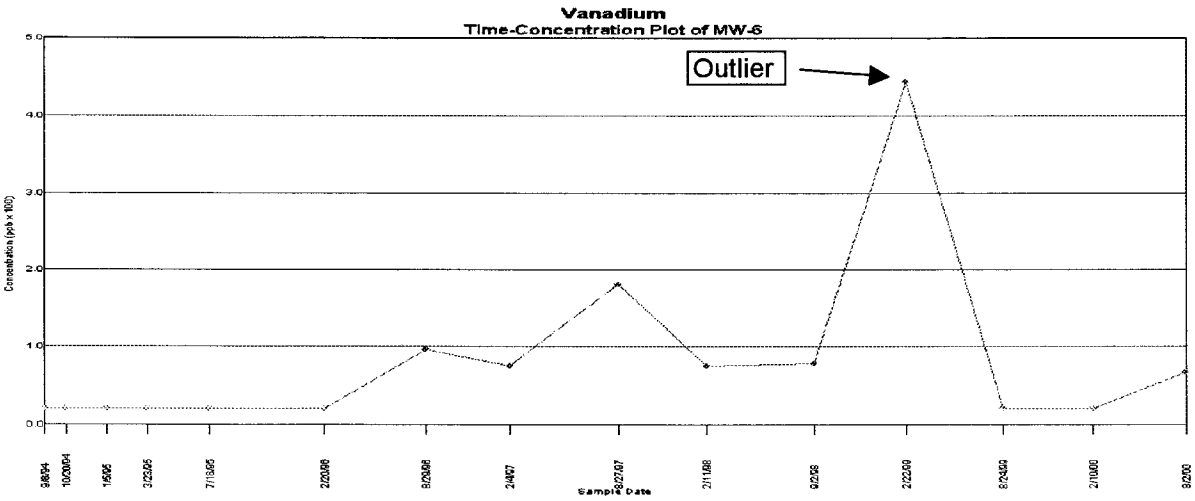




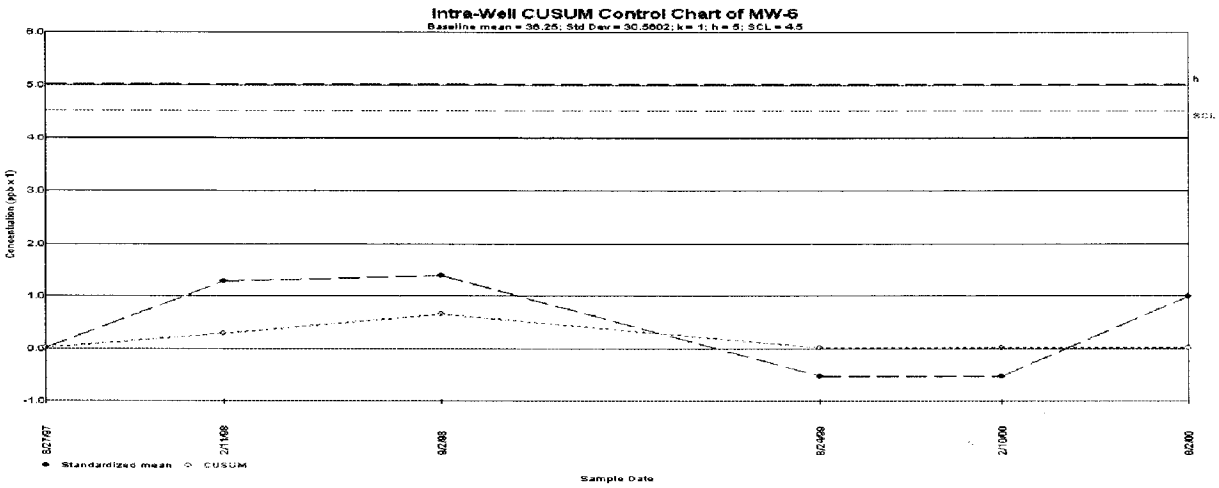
Shewart-CUSUM charts for selected constituents
Wayne County Closed Sanitary Landfill (Dudley)

Vanadium (Outlier Included)



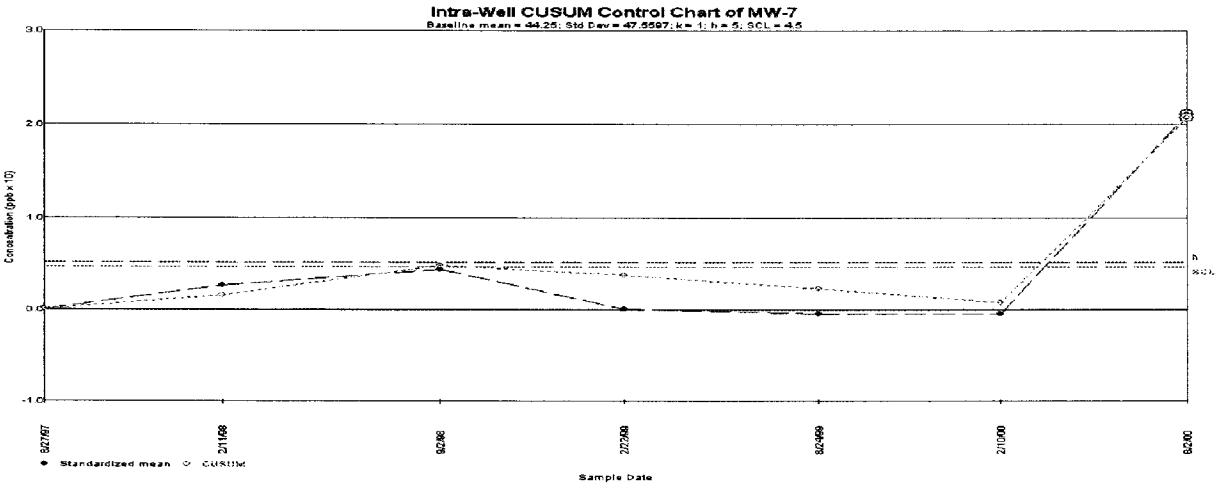


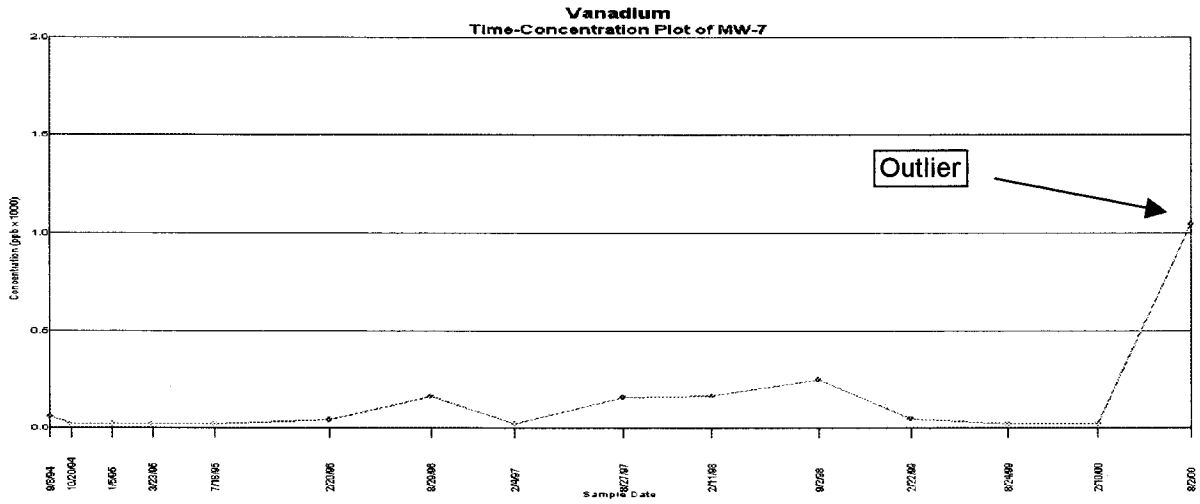
Vanadium (Outlier Eliminated)



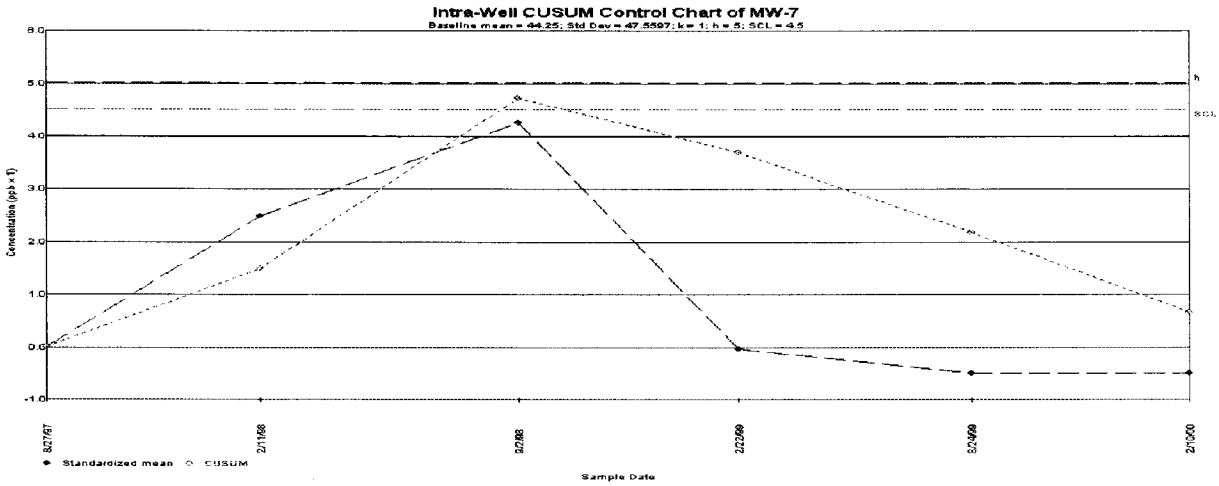
Shewart-CUSUM charts for selected constituents
Wayne County Closed Sanitary Landfill (Dudley)

Vanadium (Outlier Included)

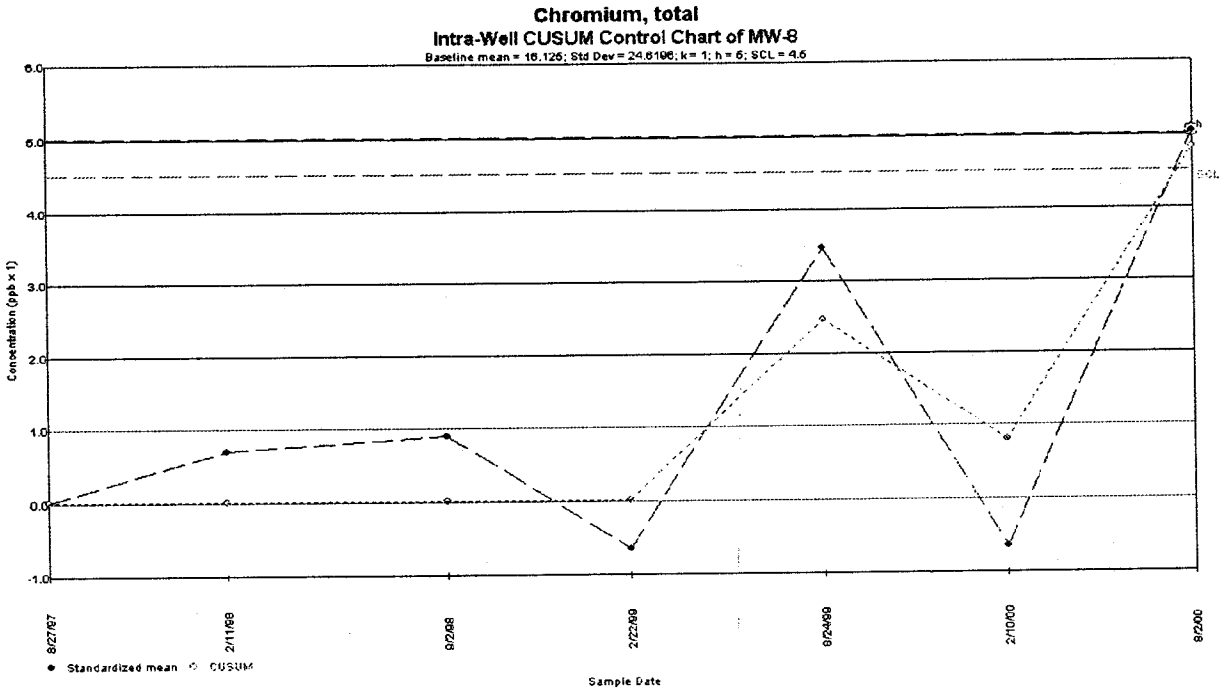


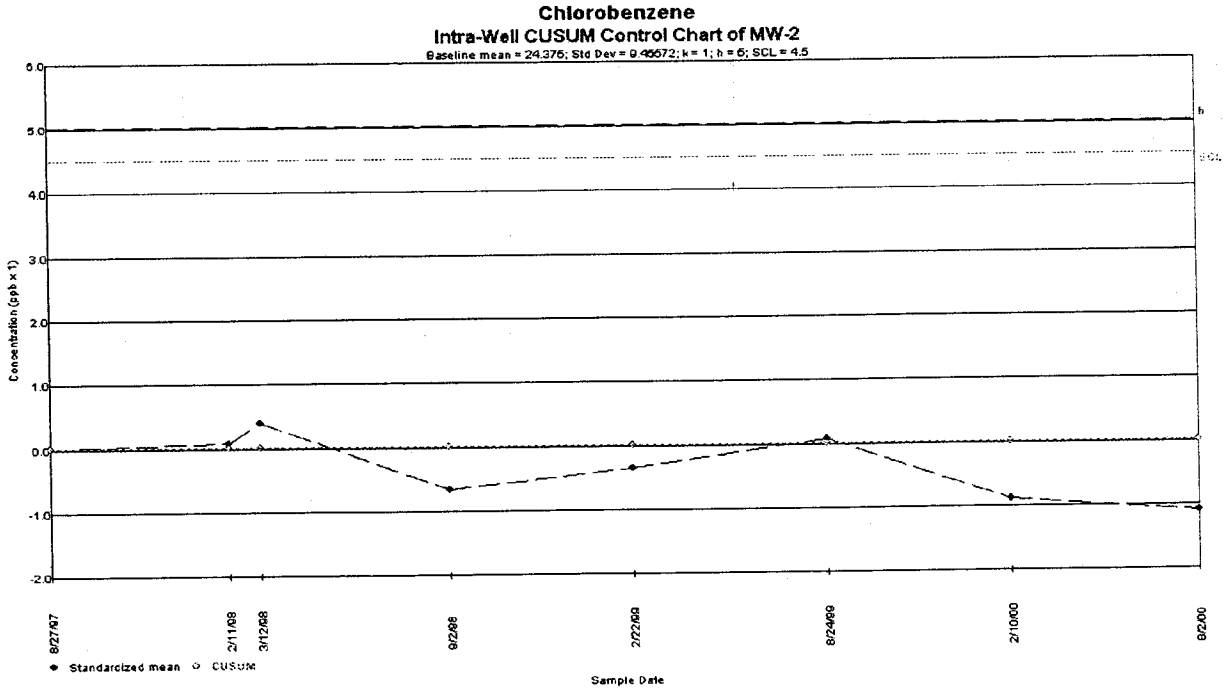


Vanadium (Outlier Eliminated)

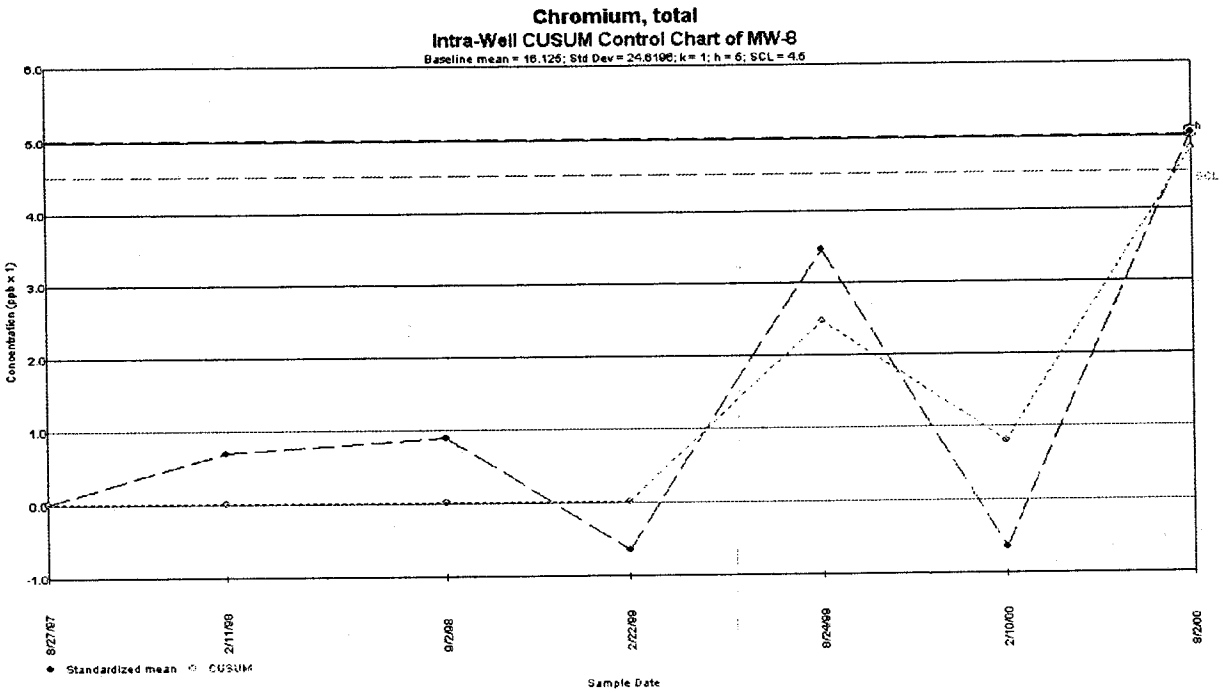


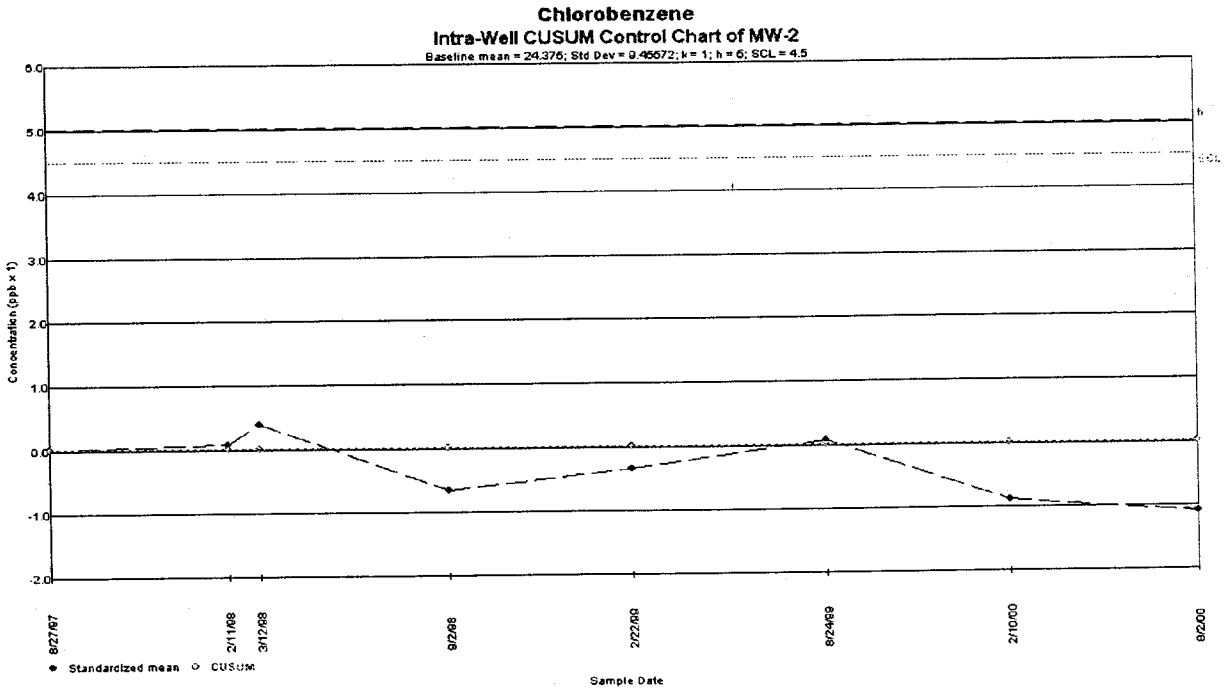
Shewart-CUSUM charts for selected constituents
Wayne County Closed Sanitary Landfill (Dudley)



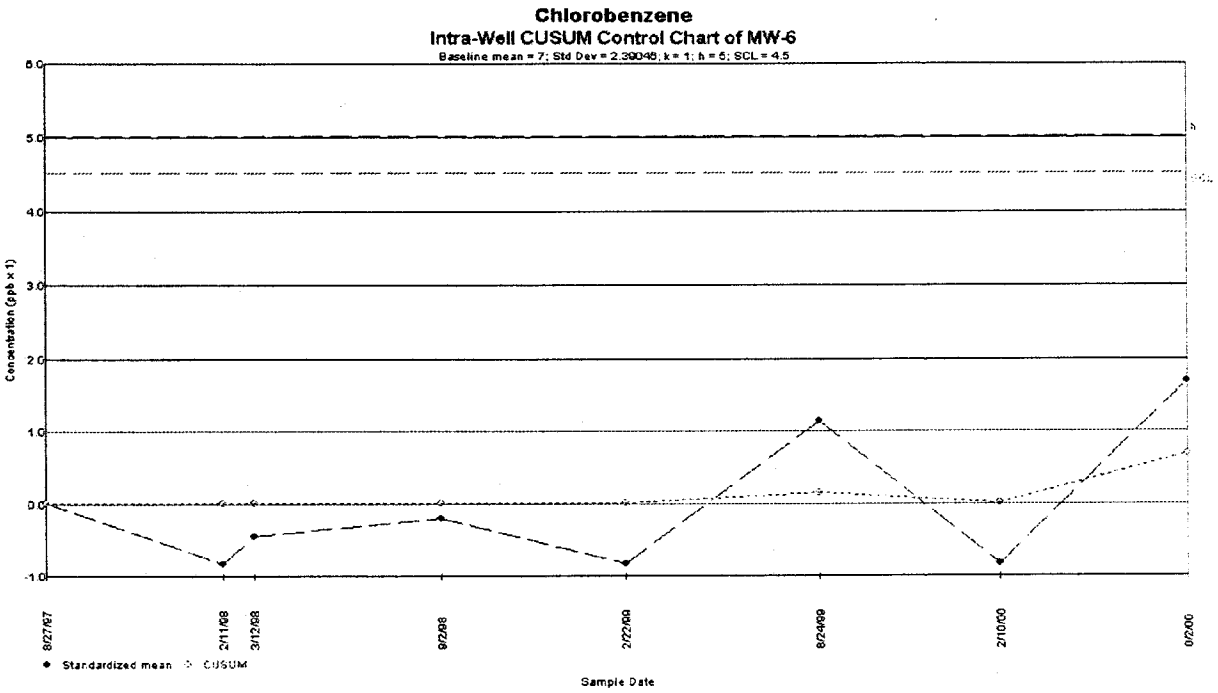


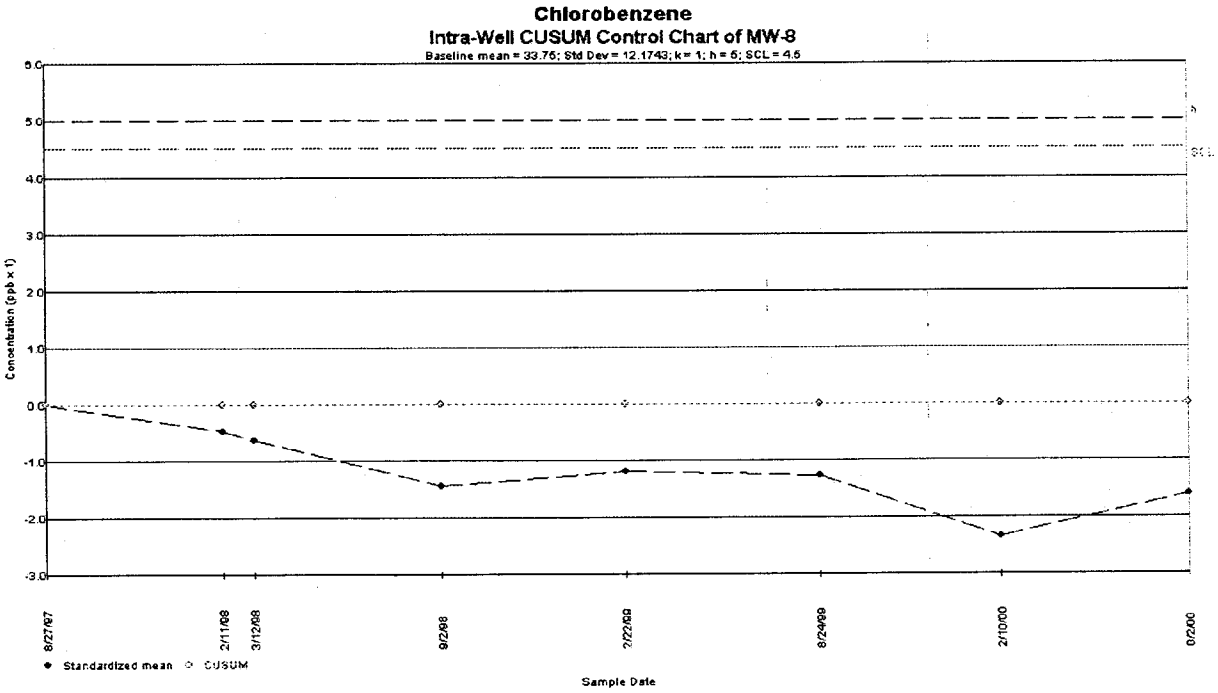
Shewart-CUSUM charts for selected constituents
Wayne County Closed Sanitary Landfill (Dudley)



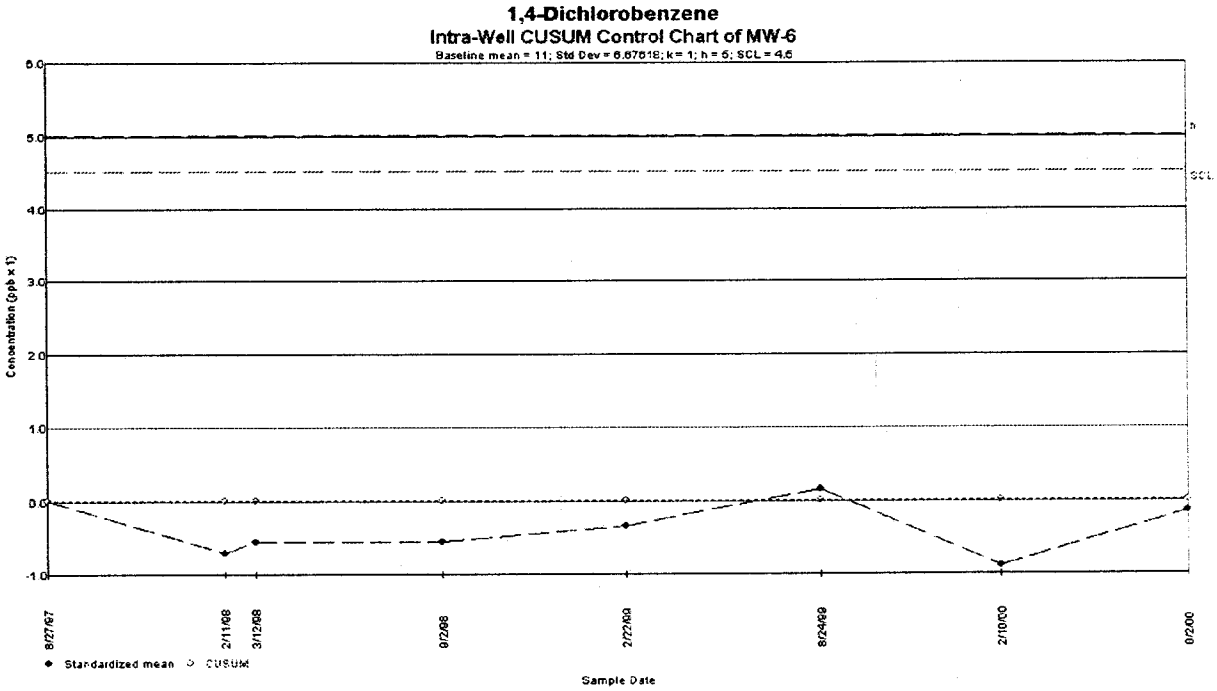


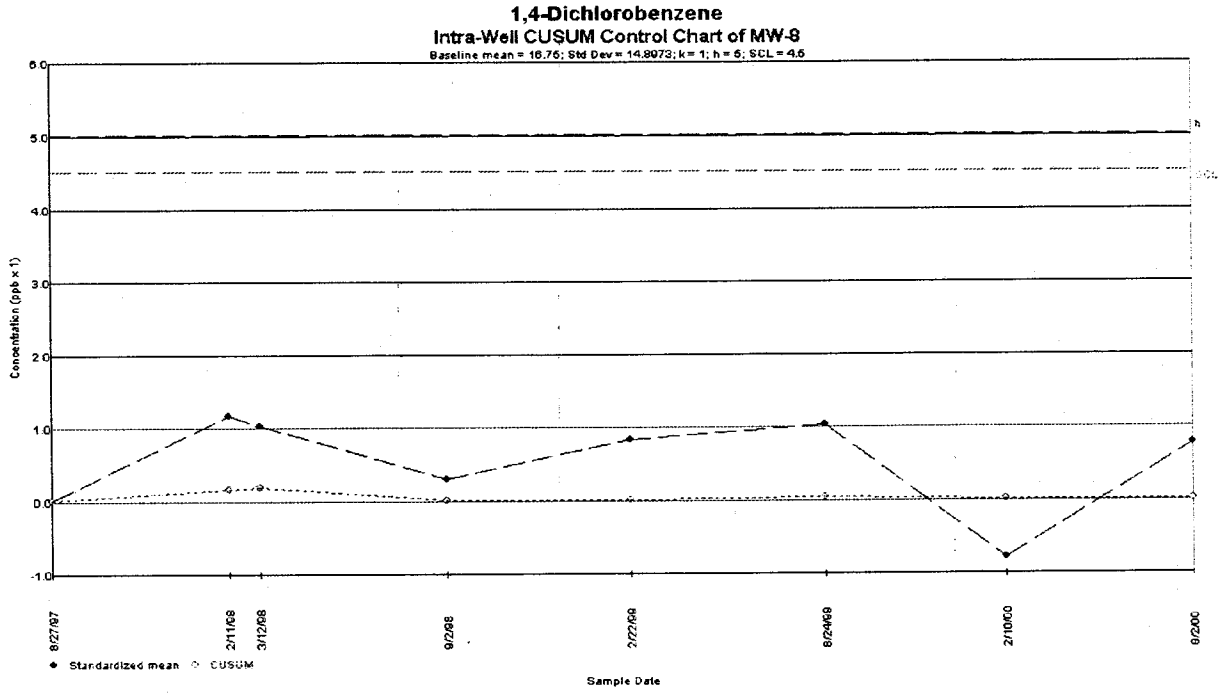
Shewart-CUSUM charts for selected constituents
Wayne County Closed Sanitary Landfill (Dudley)



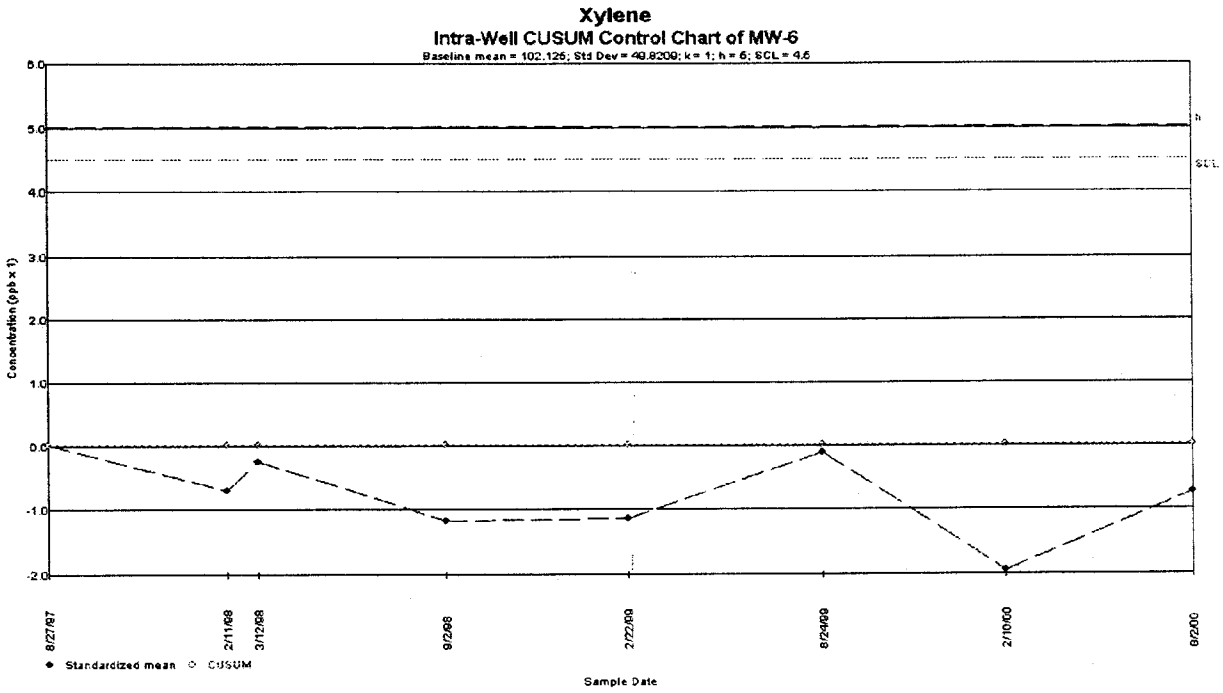


Shewart-CUSUM charts for selected constituents
Wayne County Closed Sanitary Landfill (Dudley)





Shewart-CUSUM charts for selected constituents
Wayne County Closed Sanitary Landfill (Dudley)



Basic Statistics

Basic Statistics
Parameter: Arsenic, total

Total Observations	104
Total Non-Detects	97
Pooled Mean	10.0673
Pooled Std Dev	0.766589
Background Mean	9.64286
Background Std Dev	1.33631

Background Wells
There is 1 background well

Well	Samples	Non-Detects	% ND	Total
MW-1	14	14	100	135

Well	Mean	Std Dev	Std Err	Rank Sum	Rank Mean
MW-1	9.64286	1.33631	0	686	49

Compliance Wells
There are 6 compliance wells

Well	Samples	Non-Detects	% ND	Total
MW-2	15	12	80	155
MW-3	15	15	100	150
MW-4	15	15	100	150
MW-6	15	14	93.3333	153
MW-7	15	12	80	154
MW-8	15	15	100	150

Well	Mean	Std Dev	Dif From Bkg	Std Err	Rank Sum	Rank Mean
MW-2	10.3333	1.04654	0.690476	0.282056	998	66.5333
MW-3	10	0	0.357143	0.282056	735	49
MW-4	10	0	0.357143	0.282056	735	49
MW-6	10.2	0.774597	0.557143	0.282056	824	54.9333
MW-7	10.2667	0.798809	0.62381	0.282056	998	66.5333
MW-8	10	0	0.357143	0.282056	735	49

Analysis of Variance Statistics

SS Wells	4.64789
SS Total	60.5288

Kruskal-Wallis Statistics

Non-Detect Rank	49
Background Rank Sum	686
Background Rank Mean	49
H Statistic	36.3457
H Adjusted for Ties	192.664

Basic Statistics
Parameter: Chromium, total

Total Observations	104
Total Non-Detects	67
Pooled Mean	25.8462
Pooled Std Dev	44.2438
Background Mean	10
Background Std Dev	0

Background Wells
There is 1 background well

Well	Samples	Non-Detects	% ND	Total
MW-1	14	14	100	140

Well	Mean	Std Dev	Std Err	Rank Sum	Rank Mean
MW-1	10	0	0	476	34

Compliance Wells
There are 6 compliance wells

Well	Samples	Non-Detects	% ND	Total
MW-2	15	11	73.3333	156
MW-3	15	11	73.3333	177
MW-4	15	14	93.3333	151
MW-6	15	6	40	709
MW-7	15	5	33.3333	816
MW-8	15	6	40	539

Well	Mean	Std Dev	Dif From Bkg	Std Err	Rank Sum	Rank Mean
MW-2	10.4	1.12122	0.4	15.4283	780	52
MW-3	11.8	4.00357	1.8	15.4283	816	54.4
MW-4	10.0667	0.258199	0.0666667	15.4283	579	38.6
MW-6	47.2667	50.2756	37.2667	15.4283	1382	92.1333
MW-7	54.4	88.7346	44.4	15.4283	1407	93.8
MW-8	35.9333	39.0356	25.9333	15.4283	1337	89.1333

Analysis of Variance Statistics

SS Wells	34427.1
SS Total	201624

Kruskal-Wallis Statistics

Non-Detect Rank	34
Background Rank Sum	476
Background Rank Mean	34
H Statistic	236.604
H Adjusted for Ties	322.94

Basic Statistics
Parameter: Mercury

Total Observations	59
Total Non-Detects	53
Pooled Mean	0.730508
Pooled Std Dev	1.12192
Background Mean	0.5
Background Std Dev	0

Background Wells
There is 1 background well

Well	Samples	Non-Detects	% ND	Total
MW-1	6	6	100	3

Well	Mean	Std Dev	Std Err	Rank Sum	Rank Mean
MW-1	0.5	0	0	162	27

Compliance Wells
There are 6 compliance wells

Well	Samples	Non-Detects	% ND	Total
MW-2	9	9	100	4.5
MW-3	7	7	100	3.5
MW-4	9	8	88.8889	4.6
MW-6	9	9	100	4.5
MW-7	9	9	100	4.5
MW-8	10	5	50	18.5

Well	Mean	Std Dev	Dif From Bkg	Std Err	Rank Sum	Rank Mean
MW-2	0.5	0	0	0.55621	243	27
MW-3	0.5	0	0	0.587133	189	27
MW-4	0.511111	0.0333333	0.0111111	0.55621	279	31
MW-6	0.5	0	0	0.55621	243	27
MW-7	0.5	0	0	0.55621	243	27
MW-8	1.85	2.53651	1.35	0.544972	465	46.5

Analysis of Variance Statistics

SS Wells	15.0912
SS Total	73.0051

Kruskal-Wallis Statistics

Non-Detect Rank	27
Background Rank Sum	162
Background Rank Mean	27
H Statistic	21.4627
H Adjusted for Ties	78.0006

Basic Statistics
Parameter: Silver, total

Total Observations	104
Total Non-Detects	103
Pooled Mean	10.0096
Pooled Std Dev	0.0980581
Background Mean	10
Background Std Dev	0

Background Wells
There is 1 background well

Well	Samples	Non-Detects	% ND	Total
MW-1	14	14	100	140

Well	Mean	Std Dev	Std Err	Rank Sum	Rank Mean
MW-1	10	0	0	728	52

Compliance Wells
There are 6 compliance wells

Well	Samples	Non-Detects	% ND	Total
MW-2	15	15	100	150
MW-3	15	15	100	150
MW-4	15	15	100	150
MW-6	15	15	100	150
MW-7	15	14	93.3333	151
MW-8	15	15	100	150

Well	Mean	Std Dev	Dif From Bkg	Std Err	Rank Sum	Rank Mean
MW-2	10	0	0	0.036452	780	52
MW-3	10	0	0	0.036452	780	52
MW-4	10	0	0	0.036452	780	52
MW-6	10	0	0	0.036452	780	52
MW-7	10.0667	0.258199	0.0666667	0.036452	872	58.1333
MW-8	10	0	0	0.036452	780	52

Analysis of Variance Statistics

SS Wells	0.0570513
SS Total	0.990385

Kruskal-Wallis Statistics

Non-Detect Rank	52
Background Rank Sum	728
Background Rank Mean	52
H Statistic	5.16293
H Adjusted for Ties	180.703

Basic Statistics
Parameter: Thallium, total

Total Observations	104
Total Non-Detects	99
Pooled Mean	8.89423
Pooled Std Dev	2.94255
Background Mean	9.35714
Background Std Dev	2.40535

Background Wells
There is 1 background well

Well	Samples	Non-Detects	% ND	Total
MW-1	14	13	92.8571	131

Well	Mean	Std Dev	Std Err	Rank Sum	Rank Mean
MW-1	9.35714	2.40535	0	789	56.3571

Compliance Wells
There are 6 compliance wells

Well	Samples	Non-Detects	% ND	Total
MW-2	15	15	100	132
MW-3	15	14	93.3333	133
MW-4	15	14	93.3333	133
MW-6	15	14	93.3333	132
MW-7	15	14	93.3333	132
MW-8	15	15	100	132

Well	Mean	Std Dev	Dif From Bkg	Std Err	Rank Sum	Rank Mean
MW-2	8.8	3.16679	-0.557143	1.12455	750	50
MW-3	8.86667	2.99682	-0.490476	1.12455	843	56.2
MW-4	8.86667	2.99682	-0.490476	1.12455	844	56.2667
MW-6	8.8	3.16679	-0.557143	1.12455	841	56.0667
MW-7	8.8	3.16679	-0.557143	1.12455	842	56.1333
MW-8	8.8	3.16679	-0.557143	1.12455	750	50

Analysis of Variance Statistics

SS Wells	3.55559
SS Total	891.837

Kruskal-Wallis Statistics

Non-Detect Rank	50
Background Rank Sum	789
Background Rank Mean	56.3571
H Statistic	24.2833
H Adjusted for Ties	176.714

Basic Statistics
Parameter: Zinc, total

Total Observations	104
Total Non-Detects	94
Pooled Mean	55.1827
Pooled Std Dev	44.1577
Background Mean	63.2143
Background Std Dev	53.6573

Background Wells
There is 1 background well

Well	Samples	Non-Detects	% ND	Total
MW-1	14	12	85.7143	885

Well	Mean	Std Dev	Std Err	Rank Sum	Rank Mean
MW-1	63.2143	53.6573	0	850	60.7143

Compliance Wells
There are 6 compliance wells

Well	Samples	Non-Detects	% ND	Total
MW-2	15	15	100	710
MW-3	15	15	100	710
MW-4	15	13	86.6667	1097
MW-6	15	13	86.6667	745
MW-7	15	12	80	745
MW-8	15	14	93.3333	847

Well	Mean	Std Dev	Dif From Bkg	Std Err	Rank Sum	Rank Mean
MW-2	47.3333	10.328	-15.881	16.5467	712.5	47.5
MW-3	47.3333	10.328	-15.881	16.5467	712.5	47.5
MW-4	73.1333	96.1241	9.91905	16.5467	895.5	59.7
MW-6	49.6667	12.8044	-13.5476	16.5467	885.5	59.0333
MW-7	49.6667	6.01981	-13.5476	16.5467	964	64.2667
MW-8	56.4667	37.5516	-6.74762	16.5467	807	53.8

Analysis of Variance Statistics

SS Wells	8522.37
SS Total	200840

Kruskal-Wallis Statistics

Non-Detect Rank	47.5
Background Rank Sum	850
Background Rank Mean	60.7143
H Statistic	48.0766
H Adjusted for Ties	183.758

Interwell Analyses for Metals

Poisson Tolerance Limit
Parameter: Arsenic, total

Poisson Count of 14 background Samples = 135
Degrees of Freedom = 272

95% Confidence Values
Chi-Squared Value (95% Confidence) = 311.467
Lambda (from Zack's formula) = 11.1238
Smallest Degrees of Freedom = 35
Upper Tolerance Limit (95%) = 16.5

99% Confidence Values
Chi-Squared Value (99% Confidence) = 329.181
Lambda (from Zack's formula) = 11.7565
Smallest Degrees of Freedom = 42
Upper Tolerance Limit (99%) = 20

	Date	Result	Impacted 95%	Impacted 99%
MW-2	9/8/94	ND<10	FALSE	FALSE
	10/20/94	ND<10	FALSE	FALSE
	1/5/95	ND<10	FALSE	FALSE
	3/23/95	ND<10	FALSE	FALSE
	7/18/95	ND<10	FALSE	FALSE
	2/20/96	ND<10	FALSE	FALSE
	8/29/96	ND<10	FALSE	FALSE
	2/4/97	ND<10	FALSE	FALSE
	8/27/97	ND<10	FALSE	FALSE
	2/11/98	11	FALSE	FALSE
	9/2/98	14	FALSE	FALSE
	2/22/99	ND<10	FALSE	FALSE
	8/24/99	ND<10	FALSE	FALSE
	2/10/00	ND<10	FALSE	FALSE
	8/2/00	10	FALSE	FALSE
MW-7	9/8/94	ND<10	FALSE	FALSE
	10/20/94	ND<10	FALSE	FALSE
	1/5/95	ND<10	FALSE	FALSE
	3/23/95	ND<10	FALSE	FALSE
	7/18/95	ND<10	FALSE	FALSE
	2/20/96	ND<10	FALSE	FALSE
	8/29/96	ND<10	FALSE	FALSE
	2/4/97	ND<10	FALSE	FALSE
	8/27/97	ND<10	FALSE	FALSE
	2/11/98	10	FALSE	FALSE
	9/2/98	11	FALSE	FALSE
	2/22/99	ND<10	FALSE	FALSE
	8/24/99	ND<10	FALSE	FALSE
	2/10/00	ND<10	FALSE	FALSE
	8/2/00	13	FALSE	FALSE

Poisson Tolerance Limit
Parameter: Chromium, total

Poisson Count of 14 background Samples = 140
Degrees of Freedom = 282

95% Confidence Values
Chi-Squared Value (95% Confidence) = 322.167
Lambda (from Zack's formula) = 11.506
Smallest Degrees of Freedom = 36
Upper Tolerance Limit (95%) = 17

99% Confidence Values
Chi-Squared Value (99% Confidence) = 340.17
Lambda (from Zack's formula) = 12.1489
Smallest Degrees of Freedom = 43
Upper Tolerance Limit (99%) = 20.5

	Date	Result	Impacted 95%	Impacted 99%
MW-2	9/8/94	ND<10	FALSE	FALSE
	10/20/94	ND<10	FALSE	FALSE
	1/5/95	ND<10	FALSE	FALSE
	3/23/95	ND<10	FALSE	FALSE
	7/18/95	ND<10	FALSE	FALSE
	2/20/96	10	FALSE	FALSE
	8/29/96	10	FALSE	FALSE
	2/4/97	ND<10	FALSE	FALSE
	8/27/97	14	FALSE	FALSE
	2/11/98	ND<10	FALSE	FALSE
	9/2/98	ND<10	FALSE	FALSE
	2/22/99	ND<10	FALSE	FALSE
	8/24/99	ND<10	FALSE	FALSE
	2/10/00	ND<10	FALSE	FALSE
	8/2/00	12	FALSE	FALSE
MW-7	9/8/94	17	FALSE	FALSE
	10/20/94	ND<10	FALSE	FALSE
	1/5/95	ND<10	FALSE	FALSE
	3/23/95	ND<10	FALSE	FALSE
	7/18/95	10	FALSE	FALSE
	2/20/96	22	TRUE	TRUE
	8/29/96	49	TRUE	TRUE
	2/4/97	10	FALSE	FALSE
	8/27/97	100	TRUE	TRUE
	2/11/98	60	TRUE	TRUE
	9/2/98	117	TRUE	TRUE
	2/22/99	31	TRUE	TRUE
	8/24/99	ND<10	FALSE	FALSE
	2/10/00	ND<10	FALSE	FALSE
	8/2/00	350	TRUE	TRUE
MW-3	9/8/94	ND<10	FALSE	FALSE
	10/20/94	ND<10	FALSE	FALSE
	1/5/95	ND<10	FALSE	FALSE

	3/23/95	ND<10	FALSE	FALSE
	7/18/95	ND<10	FALSE	FALSE
	2/20/96	ND<10	FALSE	FALSE
	8/29/96	12	FALSE	FALSE
	2/4/97	13	FALSE	FALSE
	8/27/97	ND<10	FALSE	FALSE
	2/11/98	18	TRUE	FALSE
	9/2/98	ND<10	FALSE	FALSE
	2/22/99	ND<10	FALSE	FALSE
	8/24/99	ND<10	FALSE	FALSE
	2/10/00	ND<10	FALSE	FALSE
	8/2/00	24	TRUE	TRUE
MW-6	9/8/94	ND<10	FALSE	FALSE
	10/20/94	ND<10	FALSE	FALSE
	1/5/95	ND<10	FALSE	FALSE
	3/23/95	ND<10	FALSE	FALSE
	7/18/95	15	FALSE	FALSE
	2/20/96	40	TRUE	TRUE
	8/29/96	87	TRUE	TRUE
	2/4/97	34	TRUE	TRUE
	8/27/97	178	TRUE	TRUE
	2/11/98	52	TRUE	TRUE
	9/2/98	71	TRUE	TRUE
	2/22/99	128	TRUE	TRUE
	8/24/99	ND<10	FALSE	FALSE
	2/10/00	ND<10	FALSE	FALSE
	8/2/00	44	TRUE	TRUE
MW-8	9/8/94	15	FALSE	FALSE
	10/20/94	ND<10	FALSE	FALSE
	1/5/95	ND<10	FALSE	FALSE
	3/23/95	ND<10	FALSE	FALSE
	7/18/95	17	FALSE	FALSE
	2/20/96	25	TRUE	TRUE
	8/29/96	72	TRUE	TRUE
	2/4/97	ND<10	FALSE	FALSE
	8/27/97	38	TRUE	TRUE
	2/11/98	33	TRUE	TRUE
	9/2/98	38	TRUE	TRUE
	2/22/99	ND<10	FALSE	FALSE
	8/24/99	101	TRUE	TRUE
	2/10/00	ND<10	FALSE	FALSE
	8/2/00	140	TRUE	TRUE

Dixon's Test for Outliers
Parameter: Chromium, total
Well: MW-7
For 15 Samples
5% Level of Significance

Iteration	Highest	Lowest	Critical	Outlier
1	0.724638	0	0.525	350
2	0.508929	0	0.546	None

Well	Date	Conc.	Outlier
MW-7	9/8/94	17	FALSE
	10/20/94	ND<5	FALSE
	1/5/95	ND<5	FALSE
	3/23/95	ND<5	FALSE
	7/18/95	10	FALSE
	2/20/96	22	FALSE
	8/29/96	49	FALSE
	2/4/97	10	FALSE
	8/27/97	100	FALSE
	2/11/98	60	FALSE
	9/2/98	117	FALSE
	2/22/99	31	FALSE
	8/24/99	ND<5	FALSE
	2/10/00	ND<5	FALSE
	8/2/00	350	TRUE

Seasonal Kendall Analysis
Parameter: Chromium, total
Well: MW-7

For Season 1

Xj	Xk	Xj - Xk	Positives	Negatives
ND<5 (3/23/95)	ND<5 (1/5/95)	0	0	0
22 (2/20/96)	ND<5 (1/5/95)	17	1	0
10 (2/4/97)	ND<5 (1/5/95)	5	2	0
60 (2/11/98)	ND<5 (1/5/95)	55	3	0
31 (2/22/99)	ND<5 (1/5/95)	26	4	0
ND<5 (2/10/00)	ND<5 (1/5/95)	0	4	0
22 (2/20/96)	ND<5 (3/23/95)	17	5	0
10 (2/4/97)	ND<5 (3/23/95)	5	6	0
60 (2/11/98)	ND<5 (3/23/95)	55	7	0
31 (2/22/99)	ND<5 (3/23/95)	26	8	0
ND<5 (2/10/00)	ND<5 (3/23/95)	0	8	0
10 (2/4/97)	22 (2/20/96)	-12	8	1
60 (2/11/98)	22 (2/20/96)	38	9	1
31 (2/22/99)	22 (2/20/96)	9	10	1
ND<5 (2/10/00)	22 (2/20/96)	-17	10	2
60 (2/11/98)	10 (2/4/97)	50	11	2
31 (2/22/99)	10 (2/4/97)	21	12	2
ND<5 (2/10/00)	10 (2/4/97)	-5	12	3
31 (2/22/99)	60 (2/11/98)	-29	12	4
ND<5 (2/10/00)	60 (2/11/98)	-55	12	5
ND<5 (2/10/00)	31 (2/22/99)	-26	12	6

S Statistic for season 0 = 12 - 6 = 6

Tied Group	Value	Members
1	5	3

Time Period	Observations
1/5/95	2
2/20/96	1
2/4/97	1
2/11/98	1
2/22/99	1
2/10/00	1

There are 1 time periods with multiple data

A = 66
B = 18
C = 6
D = 0
E = 6
F = 2
a = 798

b = 1890
c = 84
Group Variance for season 1 = 39.8095

For Season 2

Xj	Xk	Xj - Xk	Positives	Negatives
ND<5 (10/20/94)	17 (9/8/94)	-12	0	1
10 (7/18/95)	17 (9/8/94)	-7	0	2
49 (8/29/96)	17 (9/8/94)	32	1	2
100 (8/27/97)	17 (9/8/94)	83	2	2
117 (9/2/98)	17 (9/8/94)	100	3	2
ND<5 (8/24/99)	17 (9/8/94)	-12	3	3
350 (8/2/00)	17 (9/8/94)	333	4	3
10 (7/18/95)	ND<5 (10/20/94)	5	5	3
49 (8/29/96)	ND<5 (10/20/94)	44	6	3
100 (8/27/97)	ND<5 (10/20/94)	95	7	3
117 (9/2/98)	ND<5 (10/20/94)	112	8	3
ND<5 (8/24/99)	ND<5 (10/20/94)	0	8	3
350 (8/2/00)	ND<5 (10/20/94)	345	9	3
49 (8/29/96)	10 (7/18/95)	39	10	3
100 (8/27/97)	10 (7/18/95)	90	11	3
117 (9/2/98)	10 (7/18/95)	107	12	3
ND<5 (8/24/99)	10 (7/18/95)	-5	12	4
350 (8/2/00)	10 (7/18/95)	340	13	4
100 (8/27/97)	49 (8/29/96)	51	14	4
117 (9/2/98)	49 (8/29/96)	68	15	4
ND<5 (8/24/99)	49 (8/29/96)	-44	15	5
350 (8/2/00)	49 (8/29/96)	301	16	5
117 (9/2/98)	100 (8/27/97)	17	17	5
ND<5 (8/24/99)	100 (8/27/97)	-95	17	6
350 (8/2/00)	100 (8/27/97)	250	18	6
ND<5 (8/24/99)	117 (9/2/98)	-112	18	7
350 (8/2/00)	117 (9/2/98)	233	19	7
350 (8/2/00)	ND<5 (8/24/99)	345	20	7

S Statistic for season 1 = 20 - 7 = 13

Tied Group	Value	Members
1	5	2

Time Period	Observations
9/8/94	2
7/18/95	1
8/29/96	1
8/27/97	1
9/2/98	1
8/24/99	1
8/2/00	1

There are 1 time periods with multiple data

A = 18
B = 18
C = 0
D = 0
E = 2
F = 2
a = 1176
b = 3024
c = 112
Group Variance for season 2 = 63.369

Season	S	VAR(S)
1	6	39.8095
2	13	63.369
Sum	19	103.179

Z-Score = 1.77206
Comparison Level at 0.95% confidence level = 1.65463
1.77206 > 1.65463 indicating a seasonal trend

Seasonal Kendall Analysis
Parameter: Chromium, total
Well: MW-8

For Season 1

Xj	Xk	Xj - Xk	Positives	Negatives
ND<5 (3/23/95)	ND<5 (1/5/95)	0	0	0
25 (2/20/96)	ND<5 (1/5/95)	20	1	0
ND<5 (2/4/97)	ND<5 (1/5/95)	0	1	0
33 (2/11/98)	ND<5 (1/5/95)	28	2	0
ND<5 (2/22/99)	ND<5 (1/5/95)	0	2	0
ND<5 (2/10/00)	ND<5 (1/5/95)	0	2	0
25 (2/20/96)	ND<5 (3/23/95)	20	3	0
ND<5 (2/4/97)	ND<5 (3/23/95)	0	3	0
33 (2/11/98)	ND<5 (3/23/95)	28	4	0
ND<5 (2/22/99)	ND<5 (3/23/95)	0	4	0
ND<5 (2/10/00)	ND<5 (3/23/95)	0	4	0
ND<5 (2/4/97)	25 (2/20/96)	-20	4	1
33 (2/11/98)	25 (2/20/96)	8	5	1
ND<5 (2/22/99)	25 (2/20/96)	-20	5	2
ND<5 (2/10/00)	25 (2/20/96)	-20	5	3
33 (2/11/98)	ND<5 (2/4/97)	28	6	3
ND<5 (2/22/99)	ND<5 (2/4/97)	0	6	3
ND<5 (2/10/00)	ND<5 (2/4/97)	0	6	3
ND<5 (2/22/99)	33 (2/11/98)	-28	6	4
ND<5 (2/10/00)	33 (2/11/98)	-28	6	5
ND<5 (2/10/00)	ND<5 (2/22/99)	0	6	5

S Statistic for season 0 = 6 - 5 = 1

Tied Group	Value	Members
1	5	5

Time Period	Observations
1/5/95	2
2/20/96	1
2/4/97	1
2/11/98	1
2/22/99	1
2/10/00	1

There are 1 time periods with multiple data

A = 300
B = 18
C = 60
D = 0
E = 20
F = 2
a = 798

b = 1890
c = 84
Group Variance for season 1 = 27.1429

For Season 2

Xj	Xk	Xj - Xk	Positives	Negatives
ND<5 (10/20/94	15 (9/8/94)	-10	0	1
17 (7/18/95)	15 (9/8/94)	2	1	1
72 (8/29/96)	15 (9/8/94)	57	2	1
38 (8/27/97)	15 (9/8/94)	23	3	1
38 (9/2/98)	15 (9/8/94)	23	4	1
101 (8/24/99)	15 (9/8/94)	86	5	1
140 (8/2/00)	15 (9/8/94)	125	6	1
17 (7/18/95)	ND<5 (10/20/94	12	7	1
72 (8/29/96)	ND<5 (10/20/94	67	8	1
38 (8/27/97)	ND<5 (10/20/94	33	9	1
38 (9/2/98)	ND<5 (10/20/94	33	10	1
101 (8/24/99)	ND<5 (10/20/94	96	11	1
140 (8/2/00)	ND<5 (10/20/94	135	12	1
72 (8/29/96)	17 (7/18/95)	55	13	1
38 (8/27/97)	17 (7/18/95)	21	14	1
38 (9/2/98)	17 (7/18/95)	21	15	1
101 (8/24/99)	17 (7/18/95)	84	16	1
140 (8/2/00)	17 (7/18/95)	123	17	1
38 (8/27/97)	72 (8/29/96)	-34	17	2
38 (9/2/98)	72 (8/29/96)	-34	17	3
101 (8/24/99)	72 (8/29/96)	29	18	3
140 (8/2/00)	72 (8/29/96)	68	19	3
38 (9/2/98)	38 (8/27/97)	0	19	3
101 (8/24/99)	38 (8/27/97)	63	20	3
140 (8/2/00)	38 (8/27/97)	102	21	3
101 (8/24/99)	38 (9/2/98)	63	22	3
140 (8/2/00)	38 (9/2/98)	102	23	3
140 (8/2/00)	101 (8/24/99)	39	24	3

S Statistic for season 1 = 24 - 3 = 21

Tied Group	Value	Members
1	38	2

Time Period	Observations
9/8/94	2
7/18/95	1
8/29/96	1
8/27/97	1
9/2/98	1
8/24/99	1
8/2/00	1

There are 1 time periods with multiple data

A = 18
B = 18
C = 0
D = 0
E = 2
F = 2
a = 1176
b = 3024
c = 112
Group Variance for season 2 = 63.369

Season	S	VAR(S)
1	1	27.1429
2	21	63.369
Sum	22	90.5119

Z-Score = 2.20733
Comparison Level at 0.95% confidence level = 1.65463
2.20733 > 1.65463 indicating a seasonal trend

Poisson Tolerance Limit
Parameter: Lead, total

Poisson Count of 14 background Samples = 140
Degrees of Freedom = 282

95% Confidence Values
Chi-Squared Value (95% Confidence) = 322.167
Lambda (from Zack's formula) = 11.506
Smallest Degrees of Freedom = 36
Upper Tolerance Limit (95%) = 17

99% Confidence Values
Chi-Squared Value (99% Confidence) = 340.17
Lambda (from Zack's formula) = 12.1489
Smallest Degrees of Freedom = 43
Upper Tolerance Limit (99%) = 20.5

	Date	Result	Impacted 95%	Impacted 99%
MW-7	9/8/94	44	TRUE	TRUE
	10/20/94	ND<10	FALSE	FALSE
	1/5/95	ND<10	FALSE	FALSE
	3/23/95	ND<10	FALSE	FALSE
	7/18/95	ND<10	FALSE	FALSE
	2/20/96	11	FALSE	FALSE
	8/29/96	43	TRUE	TRUE
	2/4/97	ND<10	FALSE	FALSE
	8/27/97	79	TRUE	TRUE
	2/11/98	31	TRUE	TRUE
	9/2/98	48	TRUE	TRUE
	2/22/99	31	TRUE	TRUE
	8/24/99	ND<10	FALSE	FALSE
	2/10/00	ND<10	FALSE	FALSE
	8/2/00	66	TRUE	TRUE
MW-8	9/8/94	147	TRUE	TRUE
	10/20/94	ND<10	FALSE	FALSE
	1/5/95	ND<10	FALSE	FALSE
	3/23/95	ND<10	FALSE	FALSE
	7/18/95	12	FALSE	FALSE
	2/20/96	12	FALSE	FALSE
	8/29/96	29	TRUE	TRUE
	2/4/97	ND<10	FALSE	FALSE
	8/27/97	25	TRUE	TRUE
	2/11/98	14	FALSE	FALSE
	9/2/98	11	FALSE	FALSE
	2/22/99	ND<10	FALSE	FALSE
	8/24/99	19	TRUE	FALSE
	2/10/00	ND<10	FALSE	FALSE
	8/2/00	31	TRUE	TRUE

Poisson Tolerance Limit
Parameter: Mercury

Poisson Count of 6 background Samples = 3
Degrees of Freedom = 8

95% Confidence Values
Chi-Squared Value (95% Confidence) = 15.5073
Lambda (from Zack's formula) = 1.29228
Smallest Degrees of Freedom = 8
Upper Tolerance Limit (95%) = 3

99% Confidence Values
Chi-Squared Value (99% Confidence) = 20.0902
Lambda (from Zack's formula) = 1.67418
Smallest Degrees of Freedom = 12
Upper Tolerance Limit (99%) = 5

	Date	Result	Impacted 95%	Impacted 99%
MW-8	7/18/95	3.7	TRUE	FALSE
	2/20/96	8.5	TRUE	TRUE
	3/12/98	ND<0.5	FALSE	FALSE
	9/2/98	ND<0.5	FALSE	FALSE
	10/29/98	ND<0.5	FALSE	FALSE
	12/2/98	1	FALSE	FALSE
	2/22/99	ND<0.5	FALSE	FALSE
	8/24/99	1.3	FALSE	FALSE
	2/10/00	ND<0.5	FALSE	FALSE
	8/2/00	1.5	FALSE	FALSE

Poisson Tolerance Limit
Parameter: Thallium, total

Poisson Count of 14 background Samples = 131
Degrees of Freedom = 264

95% Confidence Values
Chi-Squared Value (95% Confidence) = 302.898
Lambda (from Zack's formula) = 10.8178
Smallest Degrees of Freedom = 34
Upper Tolerance Limit (95%) = 16

99% Confidence Values
Chi-Squared Value (99% Confidence) = 320.377
Lambda (from Zack's formula) = 11.442
Smallest Degrees of Freedom = 41
Upper Tolerance Limit (99%) = 19.5

	Date	Result	Impacted 95%	Impacted 99%
MW-4	9/8/94	ND<10	FALSE	FALSE
	10/20/94	ND<10	FALSE	FALSE
	1/5/95	ND<10	FALSE	FALSE
	3/23/95	ND<10	FALSE	FALSE
	7/18/95	ND<1	FALSE	FALSE
	2/20/96	ND<10	FALSE	FALSE
	8/29/96	ND<10	FALSE	FALSE
	2/4/97	ND<10	FALSE	FALSE
	8/27/97	ND<10	FALSE	FALSE
	2/11/98	ND<10	FALSE	FALSE
	9/2/98	ND<10	FALSE	FALSE
	2/22/99	ND<10	FALSE	FALSE
	8/24/99	ND<10	FALSE	FALSE
	2/10/00	ND<10	FALSE	FALSE
	8/2/00	2	FALSE	FALSE
MW-3	9/8/94	ND<10	FALSE	FALSE
	10/20/94	ND<10	FALSE	FALSE
	1/5/95	ND<10	FALSE	FALSE
	3/23/95	ND<10	FALSE	FALSE
	7/18/95	ND<1	FALSE	FALSE
	2/20/96	ND<10	FALSE	FALSE
	8/29/96	ND<10	FALSE	FALSE
	2/4/97	ND<10	FALSE	FALSE
	8/27/97	ND<10	FALSE	FALSE
	2/11/98	ND<10	FALSE	FALSE
	9/2/98	ND<10	FALSE	FALSE
	2/22/99	ND<10	FALSE	FALSE
	8/24/99	ND<10	FALSE	FALSE
	2/10/00	ND<10	FALSE	FALSE
	8/2/00	2	FALSE	FALSE

Poisson Tolerance Limit
Parameter: Vanadium

Poisson Count of 14 background Samples = 280
Degrees of Freedom = 562

95% Confidence Values
Chi-Squared Value (95% Confidence) = 618.259
Lambda (from Zack's formula) = 22.0807
Smallest Degrees of Freedom = 62
Upper Tolerance Limit (95%) = 30

99% Confidence Values
Chi-Squared Value (99% Confidence) = 642.921
Lambda (from Zack's formula) = 22.9615
Smallest Degrees of Freedom = 71
Upper Tolerance Limit (99%) = 34.5

	Date	Result	Impacted 95%	Impacted 99%
MW-3	9/8/94	ND<20	FALSE	FALSE
	10/20/94	ND<20	FALSE	FALSE
	1/5/95	ND<20	FALSE	FALSE
	3/23/95	ND<20	FALSE	FALSE
	7/18/95	ND<20	FALSE	FALSE
	2/20/96	ND<20	FALSE	FALSE
	8/29/96	ND<20	FALSE	FALSE
	2/4/97	ND<20	FALSE	FALSE
	8/27/97	ND<20	FALSE	FALSE
	2/11/98	ND<20	FALSE	FALSE
	9/2/98	ND<20	FALSE	FALSE
	2/22/99	ND<20	FALSE	FALSE
	8/24/99	ND<20	FALSE	FALSE
	2/10/00	ND<20	FALSE	FALSE
	8/2/00	65	TRUE	TRUE
MW-8	9/8/94	ND<20	FALSE	FALSE
	10/20/94	ND<20	FALSE	FALSE
	1/5/95	ND<20	FALSE	FALSE
	3/23/95	ND<20	FALSE	FALSE
	7/18/95	ND<20	FALSE	FALSE
	2/20/96	ND<20	FALSE	FALSE
	8/29/96	45	TRUE	TRUE
	2/4/97	ND<20	FALSE	FALSE
	8/27/97	ND<20	FALSE	FALSE
	2/11/98	ND<20	FALSE	FALSE
	9/2/98	ND<20	FALSE	FALSE
	2/22/99	ND<20	FALSE	FALSE
	8/24/99	130	TRUE	TRUE
	2/10/00	ND<20	FALSE	FALSE
	8/2/00	156	TRUE	TRUE
MW-7	9/8/94	57	TRUE	TRUE
	10/20/94	ND<20	FALSE	FALSE
	1/5/95	ND<20	FALSE	FALSE

	3/23/95	ND<20	FALSE	FALSE
	7/18/95	ND<20	FALSE	FALSE
	2/20/96	40	TRUE	TRUE
	8/29/96	157	TRUE	TRUE
	2/4/97	ND<20	FALSE	FALSE
	8/27/97	154	TRUE	TRUE
	2/11/98	162	TRUE	TRUE
	9/2/98	246	TRUE	TRUE
	2/22/99	42	TRUE	TRUE
	8/24/99	ND<20	FALSE	FALSE
	2/10/00	ND<20	FALSE	FALSE
	8/2/00	1047	TRUE	TRUE
MW-6	9/8/94	ND<20	FALSE	FALSE
	10/20/94	ND<20	FALSE	FALSE
	1/5/95	ND<20	FALSE	FALSE
	3/23/95	ND<20	FALSE	FALSE
	7/18/95	ND<20	FALSE	FALSE
	2/20/96	ND<20	FALSE	FALSE
	8/29/96	95	TRUE	TRUE
	2/4/97	75	TRUE	TRUE
	8/27/97	180	TRUE	TRUE
	2/11/98	75	TRUE	TRUE
	9/2/98	78	TRUE	TRUE
	2/22/99	443	TRUE	TRUE
	8/24/99	ND<20	FALSE	FALSE
	2/10/00	ND<20	FALSE	FALSE
	8/2/00	66	TRUE	TRUE

Dixon's Test for Outliers
Parameter: Vanadium
Well: MW-6

For 15 Samples
5% Level of Significance

Iteration	Highest	Lowest	Critical	Outlier
1	0.822695	0	0.525	443
2	0.6375	0	0.546	180
3	0.266667	0	0.521	None

Well	Date	Conc.	Outlier
MW-6	9/8/94	ND<20	FALSE
	10/20/94	ND<20	FALSE
	1/5/95	ND<20	FALSE
	3/23/95	ND<20	FALSE
	7/18/95	ND<20	FALSE
	2/20/96	ND<20	FALSE
	8/29/96	95	FALSE
	2/4/97	75	FALSE
	8/27/97	180	TRUE
	2/11/98	75	FALSE
	9/2/98	78	FALSE
	2/22/99	443	TRUE
	8/24/99	ND<20	FALSE
	2/10/00	ND<20	FALSE
	8/2/00	66	FALSE

Dixon's Test for Outliers
Parameter: Vanadium
Well: MW-7

For 15 Samples
5% Level of Significance

Iteration	Highest	Lowest	Critical	Outlier
1	0.861733	0	0.525	1047
2	0.393805	0	0.546	None

Well	Date	Conc.	Outlier
MW-7	9/8/94	57	FALSE
	10/20/94	ND<20	FALSE
	1/5/95	ND<20	FALSE
	3/23/95	ND<20	FALSE
	7/18/95	ND<20	FALSE
	2/20/96	40	FALSE
	8/29/96	157	FALSE
	2/4/97	ND<20	FALSE
	8/27/97	154	FALSE
	2/11/98	162	FALSE
	9/2/98	246	FALSE
	2/22/99	42	FALSE
	8/24/99	ND<20	FALSE
	2/10/00	ND<20	FALSE
	8/2/00	1047	TRUE

Non-Parametric Tolerance Interval
Parameter: Zinc, total

Total Percent Non-Detects = 82.7586%
Background Samples (n) = 14
Maximum Background Concentration = 243
Minimum Coverage = 80.7%
Average Coverage = 93.3333%

Well	Sample	Result	Impacted
MW-7	9/8/94	52	FALSE
MW-7	10/20/94	ND<25	FALSE
MW-7	1/5/95	ND<25	FALSE
MW-7	3/23/95	ND<25	FALSE
MW-7	7/18/95	ND<25	FALSE
MW-7	2/20/96	ND<25	FALSE
MW-7	8/29/96	ND<25	FALSE
MW-7	2/4/97	ND<25	FALSE
MW-7	8/27/97	ND<25	FALSE
MW-7	2/11/98	ND<25	FALSE
MW-7	9/2/98	ND<25	FALSE
MW-7	2/22/99	31	FALSE
MW-7	8/24/99	ND<25	FALSE
MW-7	2/10/00	ND<25	FALSE
MW-7	8/2/00	62	FALSE