

**Municipal
Services****Engineering
Company, P.A.**

November 1, 2005

Mr. Matt Gamble
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
Iredell County Subtitle D Landfill, phase 3
MESCO Project No. G05029.0

Dear Mr. Gamble:

Municipal Engineering Company, P.A. (MESCO), sampled the Iredell County Subtitle D Landfill phase 3 area located in Statesville NC for the Appendix I list of metals and volatile organic constituents (VOCs) on July 20 & 25, 2005 as part of the detection monitoring program. Environmental Conservation Laboratories, Inc. (ENCO) of Orlando, FL completed the laboratory analysis of the leachate from the forcemain and the Cary, NC lab completed the remaining analysis. The laboratory results and statistical analysis are included herein.

All detected constituents were analyzed for regulatory exceedance with reference to North Carolina Groundwater Standards. The results are shown in the enclosed table titled "Exceedance Scan". No parameters were detected above the NCGW2L Standard.

Low concentrations of the metals cobalt and lead were detected within shallow compliance well MW-19S. Thallium was also found slightly above the PQL within a water sample obtained from upgradient surface water SW-5. No VOCs were detected during this sampling event with the exception of the leachate sample obtained from the contained forcemain.

All of the monitoring locations outlined in the approved monitoring plan were sampled during this event. Water levels were obtained from several additional piezometers west of the phase 3 area which were installed for the hydrogeologic design study for the proposed phase 4 landfill. These readings were utilized to supplement the water elevations from the monitoring wells to construct a more accurate potentiometric surface.

MESCO completed the enclosed potentiometric map with groundwater elevations on the day of sampling, flow rates and direction. The field data sheet and chain of custody is also enclosed.

The premer statistical analysis as required by the Solid Waste Section has also been completed by MESCO. The purpose of these analyses is to determine, in comparison to background levels, statistical significance of constituents detected from the monitoring well locations for the Subtitle D phase 3 landfill during the July 2005 event.

Statistical Analysis Methodology

Metals

MESCO conducted an interwell statistical analysis on all of the detected metals. Historical data from monitoring well MW-17 were defined as the background wells, and an upper tolerance limit (UTL) with 95% coverage was computed for each detected constituent from the background data at a 95% level of confidence. 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 total of 2 metals were tested for statistical significance. For cobalt and lead the non-parametric tolerance limit method with 1/2 ND substitution was used because the %ND was between 50% - 90% and the data was not normally distributed.

Intrawell Analyses

Intrawell Analyses were attempted only upon those constituents that were initially found to be statistically significant by interwell analysis. In general, intrawell analysis is conducted in order to differentiate true contamination from spatial variability. Baseline levels in this context are defined as the background level derived from the data in a given downgradient well. Intrawell analyses through Shewhart-CUSUM control charts require a minimum of eight independent historical sampling events and a detection rate greater than 25% (%ND≤75%). Due to the sampling event criteria intrawell analysis could not be conducted for this sampling event.

Results

Historical data compiled for monitoring well MW-17 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 statistically significant by interwell comparison analysis.

Table 2. Interwell Analyses Summary

Well	Cobalt
MW-19S	x

x=level significantly higher than the background level

The numbers of metal detections have continuously decreased compared to historical baseline results. The decrease in total metals detected within the samples can likely be attributed to a decrease in turbidity over time through further development of the wells via low flow pumping. Concentrations of cobalt were found to have increased according to interwell analysis within MW-19S. However, intrawell analysis could not be completed for thallium since the formulation of Shewhart-CUSUM charts require a detection rate greater than 25%.

Conclusion

The statistical analysis results conducted on metals indicate no signs of inorganic contamination originating from the Iredell County Subtitle D Landfill phase 3. Although cobalt within MW-19S was found to have increased according to interwell analysis the metal is naturally occurring in the groundwater. Cobalt concentrations within MW-19S have actually decreased to the lowest levels found in that location ever and the pre-operation sampling event conducted on July 17, 2002 yielded the highest concentrations.

The facility will continue detection monitoring and will be sampled for the complete Appendix I list of constituents again in January 2006. If you have any questions regarding this report, please contact me at (919) 772-5393 or by email at jpfohl@mesco.com.

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

A handwritten signature in blue ink that reads "Jonathan Pfohl". The signature is written in a cursive style with a large initial 'J'.

Jonathan Pfohl
Environmental Specialist

Enclosures
cc: Mr. David Lambert
Iredell County

Exceedance Scan
Iredell County Subtitle D Landfill, phase 3

Well ID	Parameter Name¹	Sample Date	Result	Unit	PQL²	NCGW2L³	Exceedance
MW-19S	Cobalt	07/20/2005	0.033	mg/L	0.01		
MW-19S	Lead	07/20/2005	0.014	mg/L	0.01	0.015	
SW-5	Thallium	07/25/2005	0.011	mg/L	0.01		
FORCEMAIN	Barium	07/20/2005	0.6	mg/L	0.5	2	
FORCEMAIN	Zinc	07/20/2005	0.066	mg/L	0.05	2.1	
FORCEMAIN	Phosphorus, Total	07/20/2005	0.72	mg/L	0.03		
FORCEMAIN	Toluene	07/20/2005	8	ug/L	5	1000	
FORCEMAIN	Xylene	07/20/2005	12	ug/L	5	530	
FORCEMAIN	Ethylbenzene	07/20/2005	8	ug/L	5	29	

¹ Table only contains detected constituents.

² PQL = Practical Quantitation Limit

³ NCGW2L = North Carolina Ground Water 2L Standard

**Hydrologic Properties at Monitoring Well Locations
Iredell County Subtitle D Landfill, phase 3**

Monitoring Well	Hydraulic Conductivity (cm/sec)	Effective Porosity (%)	Hydraulic Gradient	Flow Rate (ft/yr)	Flow Direction	Water Table Depth (ft)	Water Table Elev. (ft)
MW-17	3.73E-05	21.70%	0.02	4	S83E	35.31	819.04
MW-18	7.43E-04	21.70%	0.02	68	S31E	8.43	792.29
MW-19S	4.54E-04	21.70%	0.02	49	S62E	5.92	787.67
MW-19D	2.81E-03	21.70%	n/a	n/a	S62E	8.35	787.46
MW-20	9.50E-04	21.70%	0.02	70	S8E	5.6	790.33
MW-21S	1.67E-05	21.70%	0.57	45	S82E	34.18	789.79
MW-21D	9.08E-07	21.70%	n/a	n/a	S82E	31.9	790.86

NOTE: Values for hydraulic conductivity on all wells and peizometers determined via slug test by MESCO
Hydrologic Gradient taken from the July 20, 2005 sampling event.

$$Q = -\frac{K}{n_e} \cdot \frac{dh}{dl} \quad \text{where}$$

K = hydraulic conductivity
 ne = effective porosity
 dh = head difference
 dl = horizontal distance

**Inter-Well Analyses Summary
Iredell County Subtitle D Landfill, phase 3**

Background Well: (MW-17)

Cobalt, total

%ND	Normality	Method	ND Adj.	Upper Limit (a = 95%)	Unit
60	-	Non-parametric tolerance interval	1/2 ND	9.6	ug/l

Well	Result	Significance
MW-19S	33	Yes

Lead, total

%ND	Normality	Method	ND Adj.	Upper Limit (a = 95%)	Unit
60	-	Non-parametric tolerance interval	1/2 ND	15	ug/l

Well	Result	Significance
MW-19S	14	no

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

Intra-Well Analysis Summary (Metals)
Iredell County Subtitle D Landfill, phase 3

Well	Cobalt
MW-19S	n/a

EXPLANATION

yes=detection statistically significant by intrawell analysis

no=detection not statistically significant by intrawell analysis

n/a=unable to run intrawell analysis due to insufficient sampling events

Bold=Detected in exceedance of the Standard

**Unable to determine if metals have statistically increased via
Intra-Well Analysis**

**Summary of Pooled VOCs in Background Wells (MW-1A, MW-1B, and MW-1C)
Iredell County Subtitle D Landfill, phase 3**

Constituent	Samples	NDs	% NDs
1,1,1,2-Tetrachloroethane	5	5	100.00
1,1,1-Trichloroethane	5	5	100.00
1,1,2,2-Tetrachloroethane	5	5	100.00
1,1,2-Trichloroethane	5	5	100.00
1,1-Dichloroethane	5	5	100.00
1,1-Dichloroethene	5	5	100.00
1,2,3-Trichloropropane	5	5	100.00
1,2-Dibromo-3-chloropropane	5	5	100.00
1,2-Dibromoethane	5	5	100.00
1,2-Dichlorobenzene	5	5	100.00
1,2-Dichloroethane	5	5	100.00
1,2-Dichloropropane	5	5	100.00
1,4-Dichlorobenzene	5	5	100.00
2-Butanone	5	5	100.00
2-Hexanone	5	5	100.00
4-Methyl-2-Pentanone	5	5	100.00
Acetone	5	5	100.00
Acrylonitrile	5	5	100.00
Benzene	5	5	100.00
Bromochloromethane	5	5	100.00
Bromodichloromethane	5	5	100.00
Bromoform	5	5	100.00
Bromomethane	5	5	100.00
Carbon disulfide	5	5	100.00
Carbon tetrachloride	5	5	100.00
Chlorobenzene	5	5	100.00
Chlorodibromomethane	5	5	100.00
Chloroethane	5	5	100.00
Chloroform	5	5	100.00
Chloromethane	5	5	100.00
cis-1,2-Dichloroethene	5	5	100.00
cis-1,3-Dichloropropene	5	5	100.00
Dibromomethane	5	5	100.00
Dichloromethane	5	5	100.00
Ethylbenzene	5	5	100.00
Iodomethane	5	5	100.00
Styrene	5	5	100.00
Tetrachloroethylene	5	5	100.00
Toluene	5	5	100.00
trans-1,2-Dichloroethene	5	5	100.00
trans-1,3-Dichloropropene	5	5	100.00
trans-1,4-Dichloro-2-butene	5	5	100.00
Trichloroethylene	5	5	100.00
Trichlorofluoromethane	5	5	100.00
Vinyl acetate	5	5	100.00
Vinyl chloride	5	5	100.00
Xylene	5	5	100.00
Total	235	235	100.00

**Poisson Prediction Interval Based upon Pooled Background VOCs
Iredell County Subtitle D Landfill, phase 3**

All detected VOCs (Background Well: MW-17)

Constituent

NONE

Detection(s) per Scan 0.00

Total number of sampling events [n] = 5

Total number of detections in background wells [y] = 0

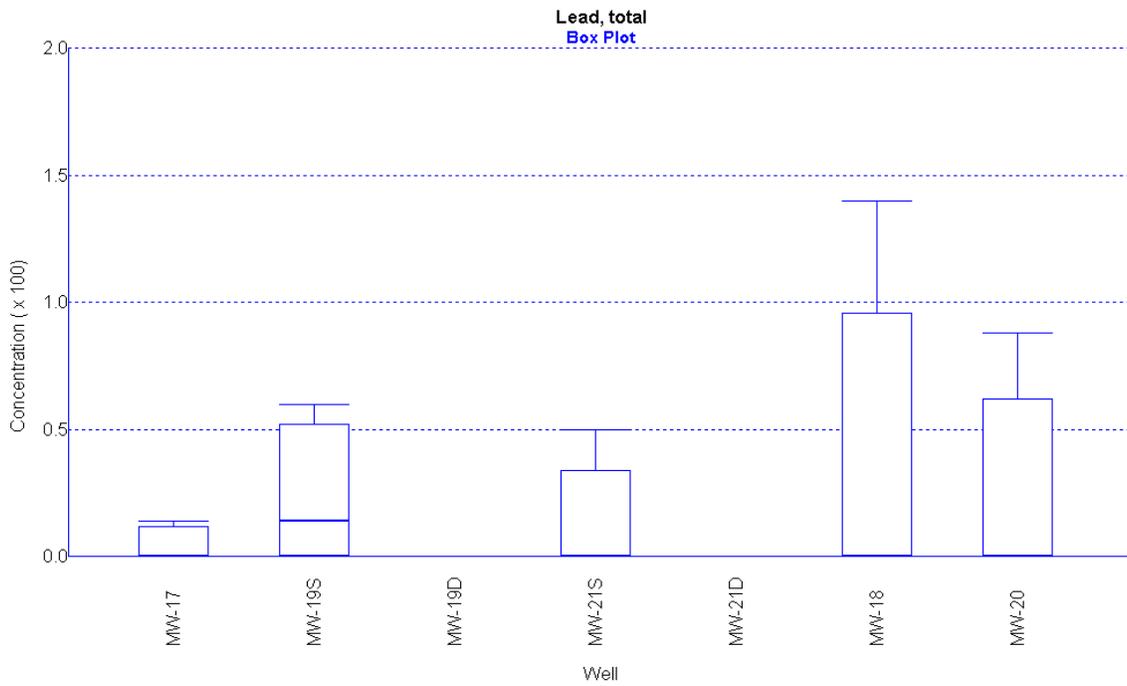
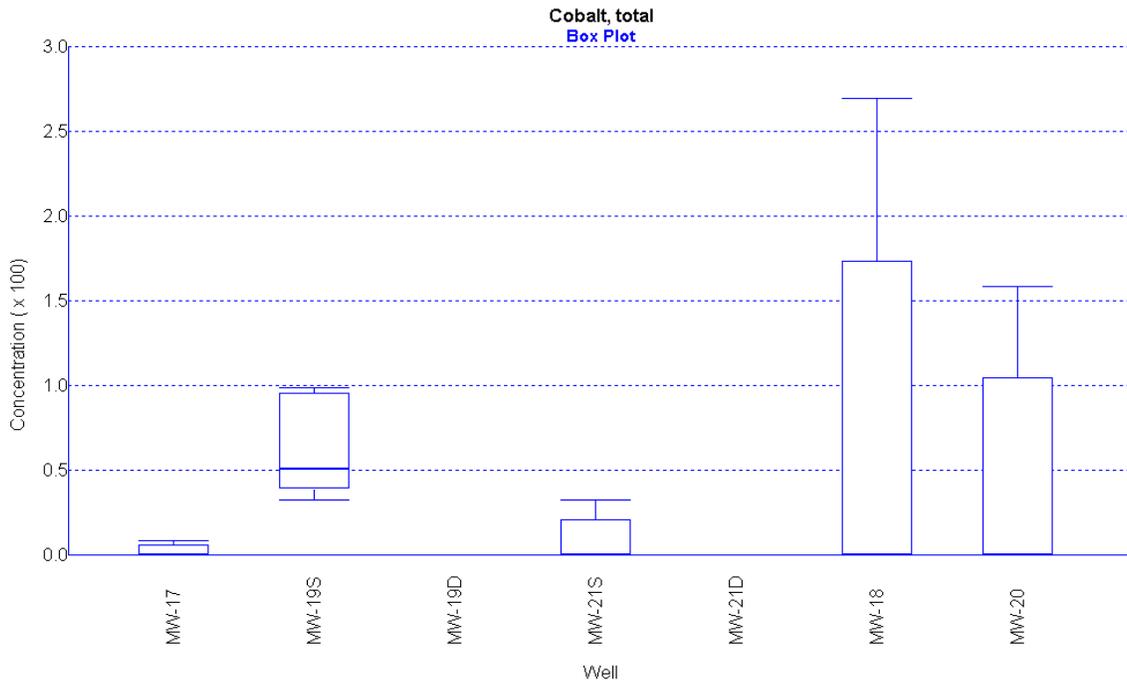
Number of comparisons (downgradient wells) [k] = 6

One-sided value of Student's t-statistic (95% confidence) [t] = 4.38

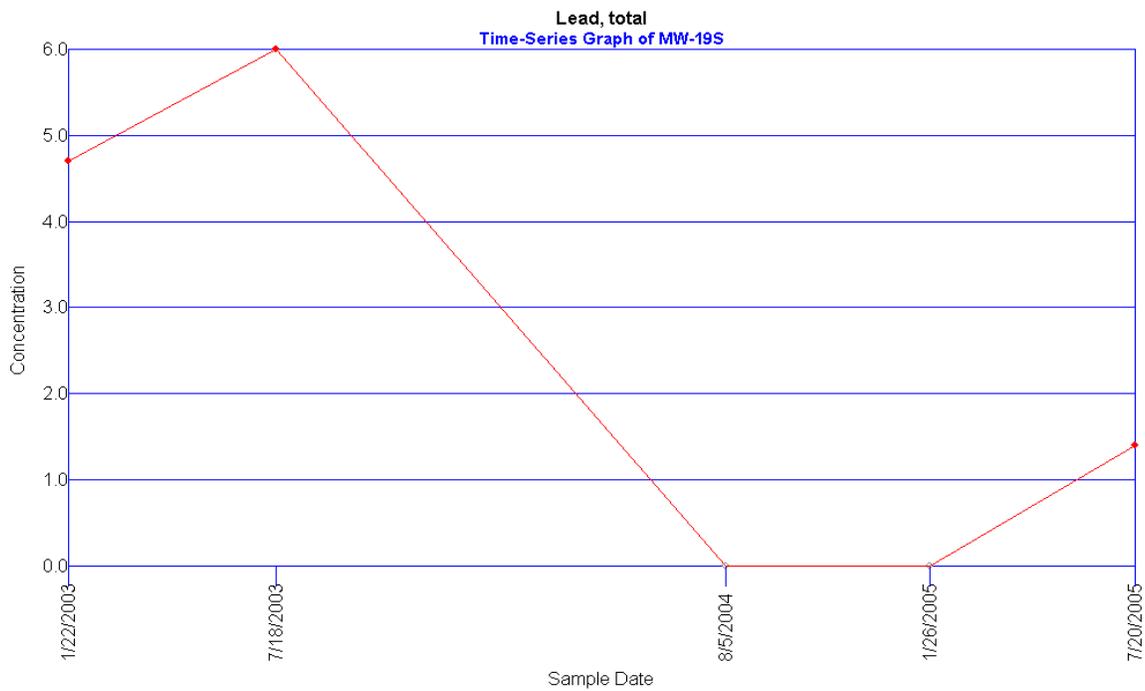
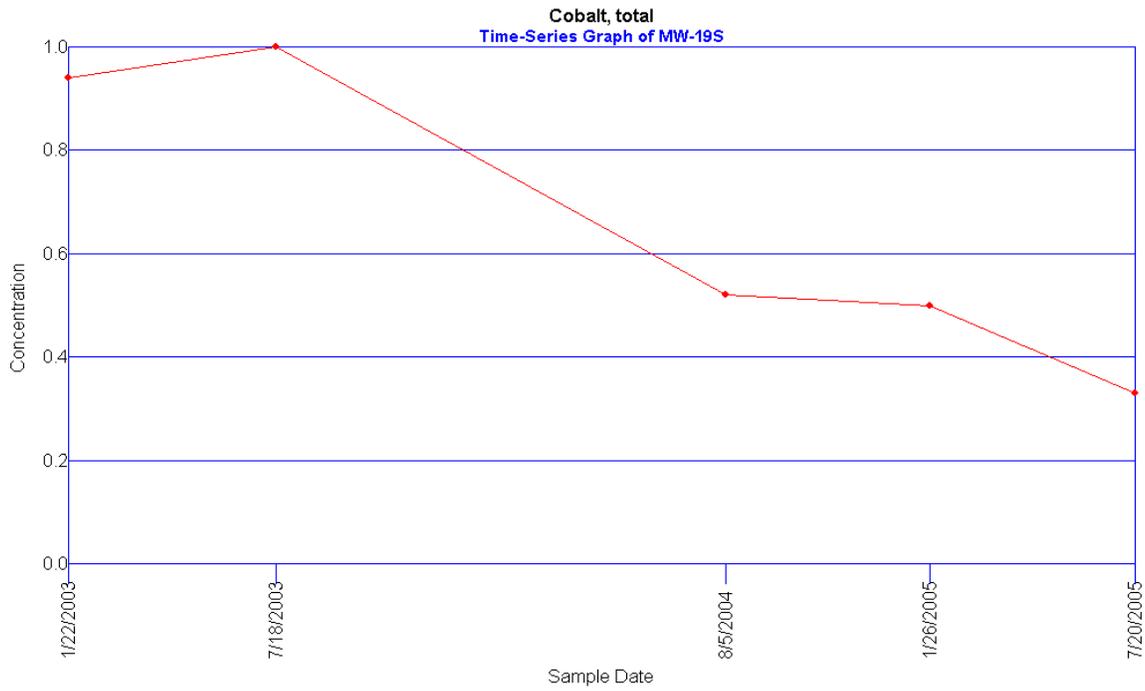
Expected number of detections in a single future sample [y*] = **3.83**

NO Statistically significant VOC detections at 95% confidence level

Box Plots for Select Constituents
Iredell County Subtitle D Landfill, phase 3

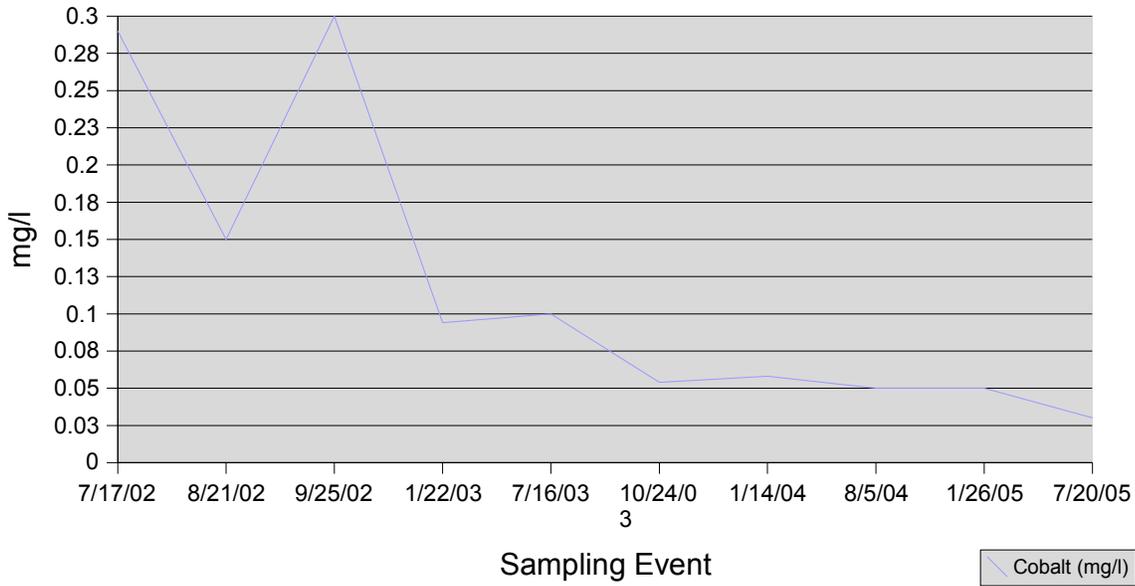


Time Series Plots for Select Constituents
Iredell County Subtitle D Landfill, phase 3



Time Series Plots for Select Constituents
Iredell County Subtitle D Landfill, phase 3

MW-19S



	7/17/02	8/21/02	9/25/02	1/22/03	7/16/03	10/24/03	1/14/04	8/5/04	1/26/05	7/20/05
Cobalt (mg/l)	0.29	0.15	0.3	0.09	0.1	0.05	0.06	0.05	0.05	0.03
Type	Baler	Baler	Baler	Baler	Baler	Baler	Pump	Pump	Pump	Pump

7/17/02 event pre-operation baseline