Semi-Annual Water Quality and Statistical Analysis Report

Prepared for

Greene County Active C&D over Closed MSW Landfill
Walstonburg, North Carolina

March 2011

Permit Number: 40-02
MESCO Project Number: G10010.0

Submittal: July 25, 2011

P.O. BOX 97
Garner, NC 27529
License No. C-0281

Municipal Services Garner, NC
Engineering Company, P.A. Boone, NC
Municipal Engineering Services Company, P.A.
Garner, Boone and Morehead City, North Carolina

DENR USE ONLY: ☐ Paper Report ☐ Electronic Data - Email CD (data loaded: Yes / No) Doc/Event #:

NC DENR
Division of Waste Management - Solid Waste

Environmental Monitoring Reporting Form

Notice: This form and any information attached to it are "Public Records" as defined in NC General Statute 132-1. As such, these documents are available for inspection and examination by any person upon request (NC General Statute 132-6).

Instructions:

- **Prepare one form for each individually monitored unit.**
- **Please type or print legibly.**
- Attach a notification table with values that attain or exceed NC 2L groundwater standards or NC 2B surface water standards. The notification must include a preliminary analysis of the cause and significance of each value. (e.g. naturally occurring, off-site source, pre-existing condition, etc.).
- Attach a notification table of any groundwater or surface water values that equal or exceed the reporting limits.
- Attach a notification table of any methane gas values that attain or exceed explosive gas levels. This includes any structures on or nearby the facility (NCAC 13B .1629 (4)(a)(i).
- Send the original signed and sealed form, any tables, and Electronic Data Deliverable to: Compliance Unit, NCDENR-DWM, Solid Waste Section, 1646 Mail Service Center, Raleigh, NC 27699-1646.

Solid Waste Monitoring Data Submittal Information

Name of entity submitting data (laboratory, consultant, facility owner):

Municipal Engineering Services Company, PA

Contact for questions about data formatting. Include data preparer's name, telephone number and E-mail address:

Name: Jonathan Pfohl Phone: (919) 772-5393

E-mail: jpfohl@mesco.com

Facility name:	Facility Address:	Facility Permit #	NC Landfill Rule: (.0500 or .1600)	Actual sampling dates (e.g., October 20-24, 2006)
Greene County Active C&D over Closed Unlined MSWLF	105 Landfill Road Walstonburg, NC 27888	40-02	.1600	March 21, 2011

Environmental Status: (Check all that apply)

☐ Initial/Background Monitoring ☒ Detection Monitoring ☒ Assessment Monitoring ☒ Corrective Action

Type of data submitted: (Check all that apply)

☒ Groundwater monitoring data from monitoring wells
☐ Groundwater monitoring data from private water supply wells
☐ Leachate monitoring data
☒ Surface water monitoring data
☐ Methane gas monitoring data
☒ Corrective action data (specify) MNA Analysis for MW-1R and MW-4
☐ Other(specify)

Notification attached?

☐ No. No groundwater or surface water standards were exceeded.
☒ Yes, a notification of values exceeding a groundwater or surface water standard is attached. It includes a list of groundwater and surface water monitoring points, dates, analytical values, NC 2L groundwater standard, NC 2B surface water standard or NC Solid Waste GWPS and preliminary analysis of the cause and significance of any concentration.
☐ Yes, a notification of values exceeding an explosive methane gas limit is attached. It includes the methane monitoring points, dates, sample values and explosive methane gas limits.

Certification

To the best of my knowledge, the information reported and statements made on this data submittal and attachments are true and correct. Furthermore, I have attached complete notification of any sampling values meeting or exceeding groundwater standards or explosive gas levels, and a preliminary analysis of the cause and significance of concentrations exceeding groundwater standards. I am aware that there are significant penalties for making any false statement, representation, or certification including the possibility of a fine and imprisonment.

Madeline German, PG — Geologist — (919) 772-5393

Facility Representative Name (Print) — Title — (Area Code) Telephone Number

Signature — 7-25-2011 Date

Affix NC Licensed/ Professional Geologist Seal

NORTH CAROLINA LICENSED SEAL 2275 7/25/2011 GEOLOGIST MADELINE GERMAN

PO Box 97, Garner, NC 27529

Facility Representative Address

C-0281

NC PE Firm License Number (if applicable effective May 1, 2009)

Revised 6/2009

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OPERATION/CONSTRUCTION MANAGERS

Municipal Services

CIVIL/SANITARY ENGINEERS

Engineering Company, P.A.

July 25, 2011

Ms. Jaclynne Drummond
Solid Waste Section
Division of Waste Management
North Carolina Department of Environment and Natural Resources
401 Oberlin Road, Suite 150
Raleigh, NC 27605

Re: Semi-Annual Water Quality and Statistical Analysis Report
Greene County Closed Active C&D and Closed Unlined MSWLF
MESCO Project No. G10010.0

Dear Ms. Drummond:

Introduction

The Greene County active Construction and Demolition (C&D) over closed unlined MSWLF, permit #40-02, located near Walstonburg, NC is required to submit semi-annual water quality and statistical analysis reports as prescribed by the NC Solid Waste Section (SWS) rules/regulations as promulgated in 15A NCAC 13B.

This sampling event was performed by Environment 1 (E1) personnel of Greenville, NC on March 21, 2011 in accordance with the established semi-annual monitoring schedule. Sampling locations and parameters are outlined in the Sampling and Analysis Plan (SAP) presented in the *Corrective Action Plan* (CAP), approved February 2010.

As specified in 15A NCAC 13B.1632(j) and the SWS Environmental Monitoring Report Form, this report contains sampling procedures, field and laboratory results groundwater and surface water characterization. Detection tables, a hyrdrogeologic properties table, a monitoring network field observations table, field parameter data results, potentiometric map, statistical analysis, quality assurance/quality control data, and laboratory analytical data results with chain-of-custody (C-O-C) are included. A corrective action summary including monitored natural attenuation (MNA) tables and screening models is presented in **Appendix B**.

Sampling Procedure

E1 reportedly collected groundwater samples from five downgradient groundwater monitoring wells (MW-4, MW-5, MW-6, MW-7 and MW-8), one background well (MW-1R), and one downstream surface water sampling point (Downstream). Surface water point Upstream was reported as dry. Quality control measures implemented during this event included submittal and subsequent quantification of blanks equipment (EB), field (FB) and travel (TB). Water quality monitoring locations are depicted on the single-day potentiometric map (**Plate 2**). Surface water sampling locations are provided on the surface water monitoring location map (**Plate 3**).

Sampling was reported to be conducted using methodology outlined in the NCDENR *Solid Waste Section Guidelines for Groundwater, Soil, and Surface Water Sampling* revised April 2008. The depth to water in each well was gaged prior to purging to quantify the static water level. During purging, field parameters pH, specific conductance, temperature, dissolved oxygen (DO), oxidation reduction potential (ORP) and turbidity measurements were recorded. E1 field personnel reportedly collected samples in laboratory prepared pre-preserved containers and transported them to their laboratory in Greenville, NC under chain of custody (C-O-C) protocol.

PO Box 97, Garner, North Carolina 27529 (919) 772-5393
PO Box 828, Morehead City, NC 28557 (252) 726-9481 PO Box 349, Boone, North Carolina 28607 (828) 262-1767

Field Parameter Data

The field parameter data, presented in **Appendix C,** suggests the monitored groundwater is slightly acidic with relatively low specific conductance.

Laboratory Results

E1 reported laboratory analysis for Appendix I and Appendix II exclusive constituents (defined in this report as constituents not also listed in Appendix I) detected during the September 27, 2011 semi-annual sampling event. Additionally, Microseeps was subcontracted for specialty analysis of several SWS recommended MNA parameters for MW-4 and background well MW-1R in accordance with corrective action. A sampling and analysis summary is presented as **Table 1**.

Water sample analytical results were reported to the laboratory specific Method Detection Limits (MDL), which are quantifiable at or below the current Solid Waste Section detection limits (SWSL). **Table 2** summarizes constituents detected in the water samples in concentrations above the current SWSL, Groundwater Protection Standards (GWP), North Carolina Groundwater Standards (2L) or the North Carolina Surface Water Standards (2B) for the applicable Class C water body. **Table 3** summarizes Appendix II exclusive constituents detected above the MDL. Laboratory results and C-O-Cs are presented in **Appendix C**.

Quality Control

The closed MSWLF has a cohesive clay cap to reduce peculation/leachate generation, utilizes in-situ institutional controls, and has no known potential receptors within 2,000 feet of the property boundary.

Chloromethane was detected above the MDL in the blanks EB and FB; however, the data set appears uninfluenced by false positives or high bias attributed to field and/or laboratory artifact contamination.

Groundwater Samples

Total metals were not detected in concentrations above their respective 2L Standards during this event.

The VOCs benzene and vinyl chloride were detected in concentrations above their respective 2L Standards in samples collected from MW-4. The horizontal impact beyond MW-4 is defined by lack of quantifiable VOC concentrations in samples collected from MW-7 and MW-8. A site map depicting VOCs detected in concentrations exceeding the 2L Standard is presented on **Plate 4.**

No select Appendix II exclusive constituents were detected in concentrations over the SWSL or the applicable established Standards.

Surface Water Samples

No constituents were detected above the SWSL or the applicable 2B Standard in the surface water point Downstream, located downstream of the facility along an unnamed tributary of Sandy Run.

Statistical Analysis

A statistical analysis was performed on Appendix I constituents detected above SWSL in groundwater samples during this event. The statistical comparison between baseline and current groundwater analytical data is consistent with US EPA guidance documents and meets or exceeds the performance criteria specified in 15A NCAC 13B.1362. The statistical analysis methodologies, summary tables, graphs, and worksheets are presented in **Appendix A**.

Interwell analysis results, at a 95% confidence interval, indicate metals have not exhibited a statistically significant increase (SSI) in concentration over background levels established by background well MW-1R. Total metal concentrations decreased 89% since the previous semi-annual event.

Due to the lack of historical VOC detections in the background well, the detection of any quantifiable VOC in the downgradient wells is considered a statistically significant detection per Poisson Prediction Interval analysis. VOCs were detected in MW-4 in quantifiable concentrations. A qualitative evaluation of VOC concentrations over time did not indicate an increasing trend.

Goundwater and Surface Water Characterization

A single-day potentiometric map of the uppermost aquifer is presented on **Plate 2**, using ground water elevation data reported by E1 for this event. Groundwater flow direction and rates were calculated based on reported data and are included in **Table 4**. Estimated flow direction was easterly with flow rates ranging from approximately 4 ft./yr. (MW-1R) to 474 ft./yr. (MW-8) for an average of approximately 100 ft./yr.

Findings

The laboratory results and statistical analysis suggest the surficial aquifer in close proximity to MW-4 is impacted by low level dissolved phase Appendix I VOCs (benzene and vinyl chloride) in concentrations above the 2L Standard. Detected VOCs do not appear to have increased in concentration. The plume is defined inside the compliance boundary because MW-7 and MW-8 remain un-impacted.

Closing

Water quality monitoring including MNA analysis will continue; the next sampling event is tentatively scheduled for September 2011. Please contact us by phone at (919) 772-5393, or by email at jpfohl@mesco.com or mgerman@mesco.com with questions or comments.

Sincerely,

MUNICIPAL ENGINEERING SERVICES CO., P.A.

Jonathan Pfohl
Environmental Specialist

Madeline German, P
Licensed Geologist

NORTH CAROLINA LICENSED SEAL 2275 GEOLOGIST MADELINE GERMAN

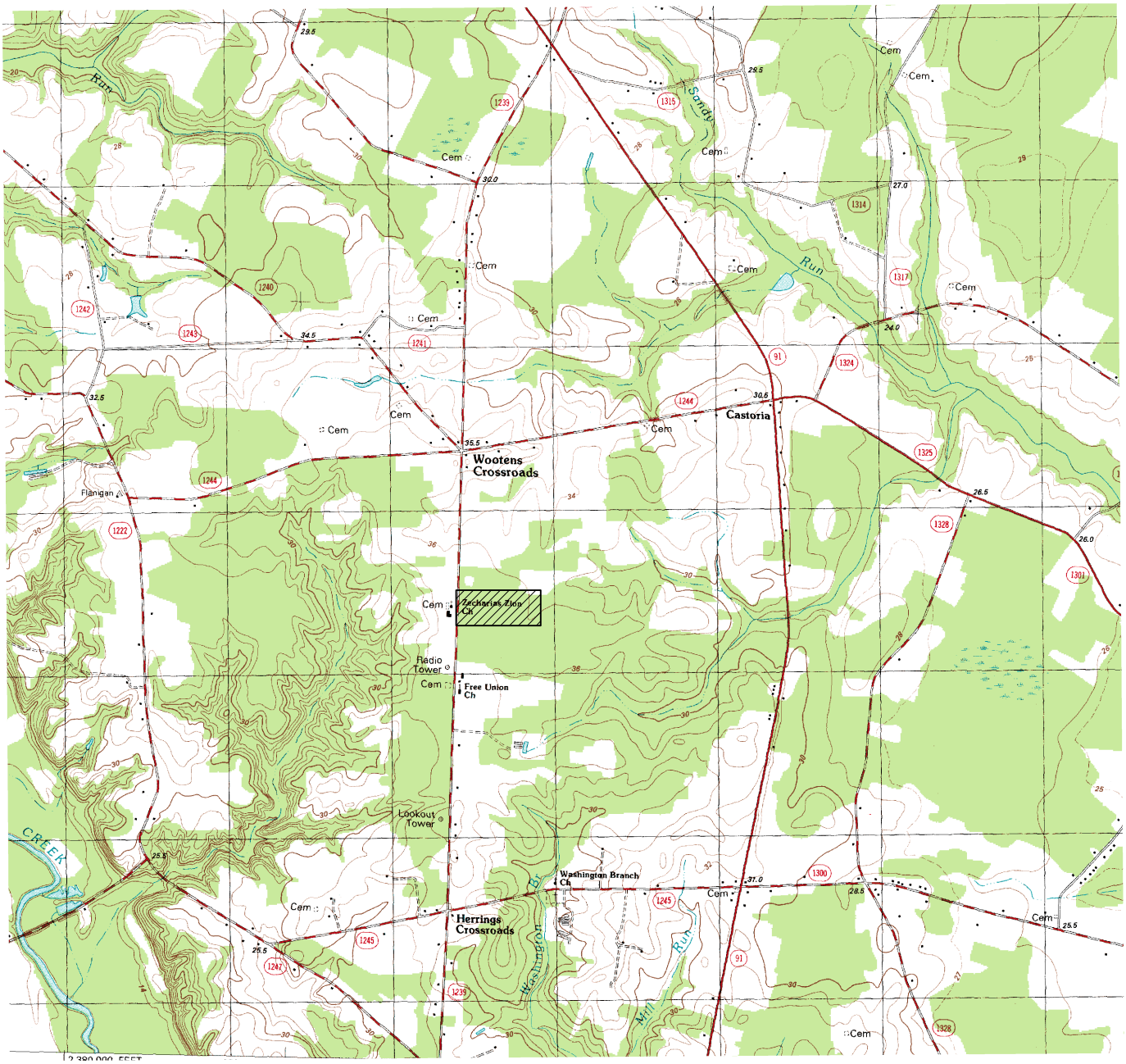
Enclosures
cc: Mr. David Jones
Greene County

Figures

Topographic Map with Site Location

Semi-Annual Water Quality Monitoring Report

Greene County Active C&D over Closed MSWLF



QUADRANGLE LEGEND

ROAD CLASSIFICATION

Primary highway, hard surface

Light-duty road, hard or improved surface

Secondary highway, hard surface

Unimproved road

Interstate Route

U. S. Route

State Route

Municipal Services Engineering Company

Garner, NC

Boone, NC

PLATE 1

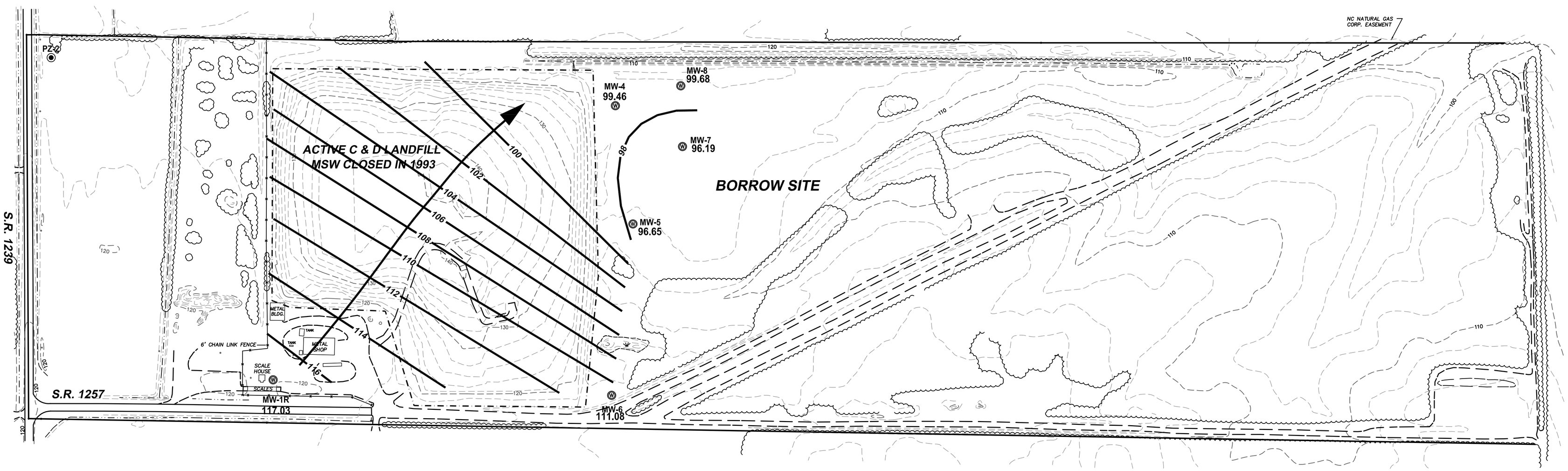
NOTE: Topographical map assembled from corresponding USGS 7.5-min. quadrangles of the subject region.

LEGEND

- EXISTING DIVERSION DITCH
- 120 EXISTING CONTOURS
- PROPERTY LINE
- ESTIMATED EXTENT OF UNLINED MSWLF
- MW-1R MONITORING WELL
- PZ-2 PIEZOMETER
- 94.29 GROUNDWATER ELEVATION
- 112 GROUNDWATER CONTOUR
- GENERAL GROUNDWATER FLOW DIRECTION

NOTES

THIS MAP WAS GENERATED FROM AERIAL PHOTOS FLOWN ON 2-22-94 BY TRIANGLE AERIAL MAPPING, SUPPLEMENTED WITH SURVEYS BY MUNICIPAL ENGINEERING SERVICES CO., P.A.



WELL #	TOP OF CASING ELEVATION (FT)	DEPTH TO WATER BTOC (FT)	GROUNDWATER ELEVATION (FT)
MW-1R	121.78	4.75	117.03
MW-4	117.89	18.43	99.46
MW-5	115.76	19.11	96.65
MW-6	117.41	6.33	111.08
MW-7	110.48	14.29	96.19
MW-8	111.36	11.68	99.68

Environment 1 reported depth to water on March 21, 2011

GRAPHIC SCALE

120 0 60 120 240 480

(IN FEET)
1 inch = 120 ft.

PLATE 2

Municipal Services Engineering Company, P.A.
P.O. BOX 97, GARNER, N.C. 27529 (919) 772-5393
P.O. BOX 349, BOONE, N.C. 28607 (828) 262-1767
LICENSE NUMBER: C-0281

ACTIVE C&D OVER CLOSED MSW LANDFILL FACILITY
GREENE COUNTY NORTH CAROLINA

DATE	BY	REV.	DESCRIPTION

SINGLE DAY POTENTIOMETRIC MAP (UPPERMOST AQUIFER) 3/21/2011

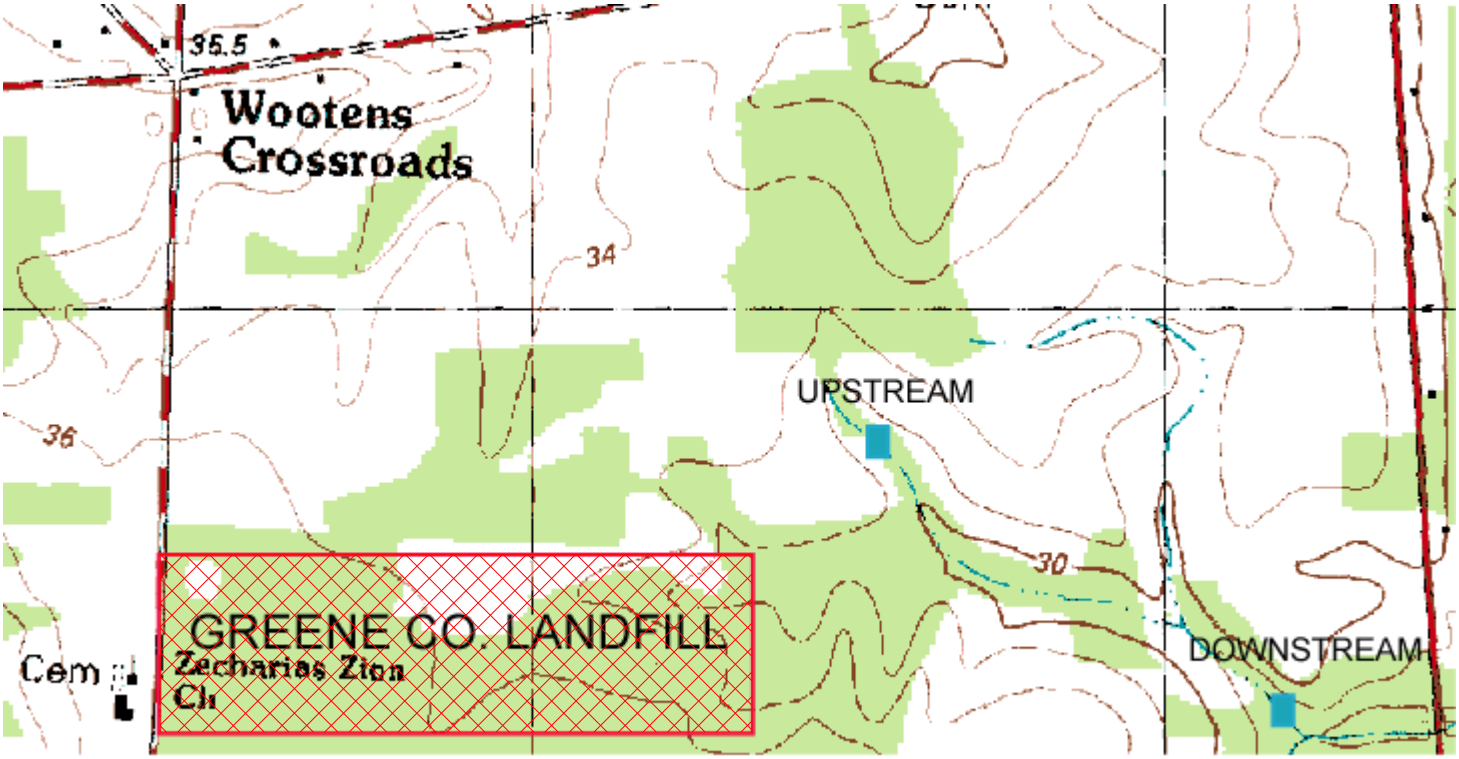
SCALE: 1" = 120'
DATE: 6/15/11
DRWN. BY: J. PFOHL
CHKD. BY: M. GERMAN
PROJECT NUMBER G10010.0
DRAWING NO. PLATE 2
SHEET NO. 1 OF 1

Surface Water Monitoring Locations

Unnamed Tributary of Sandy Run (Class "C" Water body)

Semi-Annual Water Quality Monitoring Report

Greene County Active C&D over Closed MSWLF



SCALE 1:1200 FT

QUADRANGLE LEGEND

ROAD CLASSIFICATION

Primary highway, hard surface

Light-duty road, hard or improved surface

Secondary highway, hard surface

Unimproved road

Interstate Route

U. S. Route

State Route

Municipal Services Engineering Company

Garner, NC

Boone, NC

PLATE 3

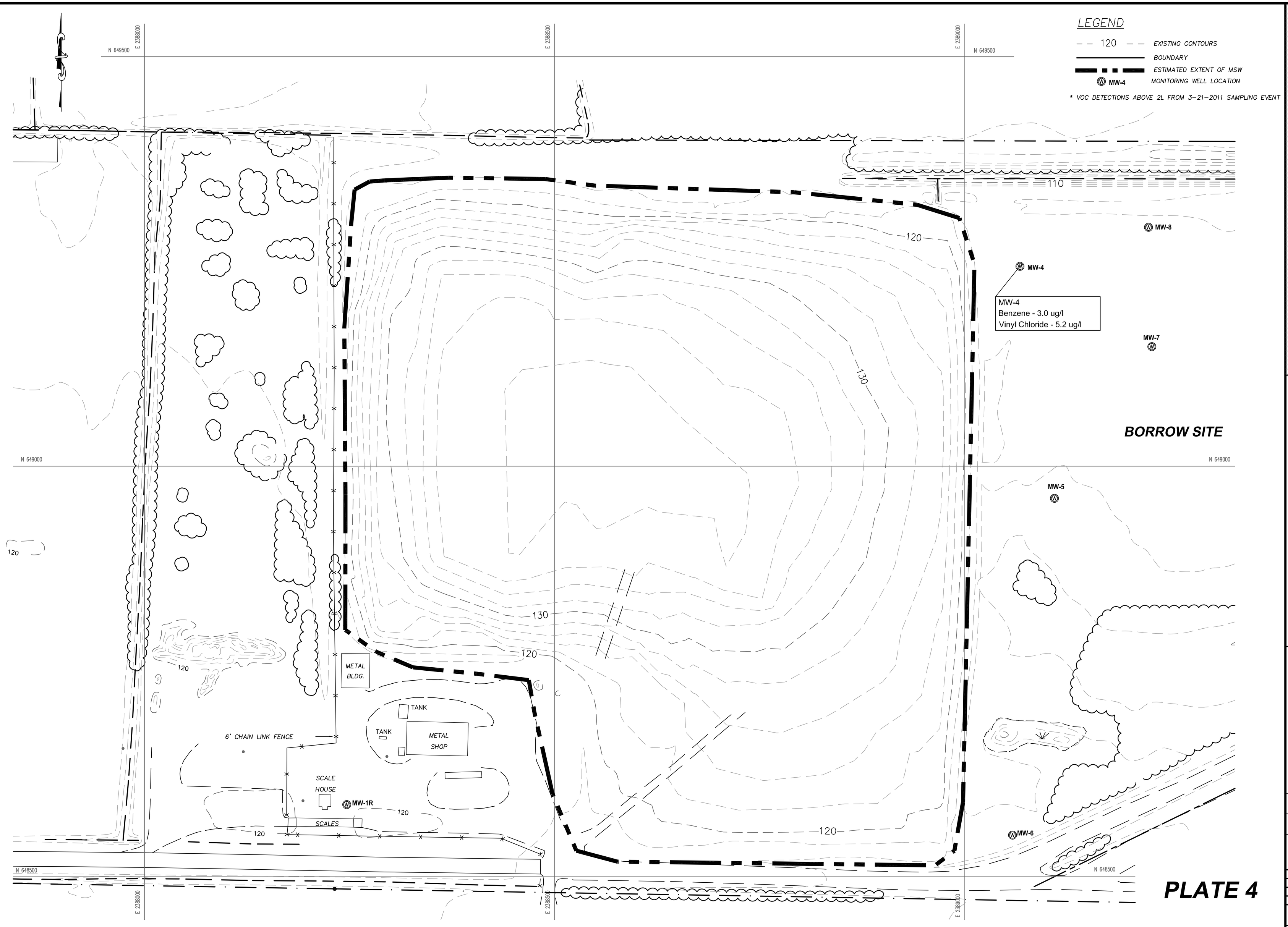


PLATE 4

Municipal Services Engineering Company, P.A.
P.O. BOX 97, GARNER, N.C. 27529 (919) 772-5393
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LICENSE NUMBER: C-0281

GREENE COUNTY
CONSTRUCTION & DEMOLITION
LANDFILL FACILITY
GREENE COUNTY, NORTH CAROLINA

DATE	BY	REV.	DESCRIPTION

VOC DETECTIONS
ABOVE 2L STANDARD

SCALE:	1" = 50'
DATE:	05/18/2011
DRWN. BY:	M. GERMAN
CHKD. BY:	M. GERMAN
PROJECT NUMBER	G10010.0
DRAWING NO.	PLATE 4
SHEET NO.	1 OF 1

Tables

Table 1
Sampling and Analysis Summary
March 21, 2011

		App. I		App. II			MNA														Field Parameter				
	Reason Not Sampled	VOCs	Total Metals	Semivolatile Organics (SVOCs)	Mercury	Tin	VFA	Hydrogen	Methane/Ethene/Ethane	Dissolved CO2	Alkalinity	Sulfate	Sulfide	Chloride	TOC	COD	BOD	Iron	Nitrate	Turbidity	Dissolved Oxygen (DO)	Oxidation Reduction Potential (ORP)	Temperature	Conductivity	pH
		Lab EPA 8260B	Lab EPA200.8	Lab EPA 8270C	Lab EPA 200.8	Lab EPA200.8	Lab AM23G	Lab AM20GAX	Lab AM20GAX	Lab SM4500CO2C	Lab SM2320B	Lab SM426C	Lab SM18 4500-S2D	Lab SM4500-CLB	Lab SM 5310C	Lab HACH8000	Lab SM5210B	Lab SM3111B	Lab EPA353.2	Lab SM2130B	Field Meter	Field Meter	Field Meter	Field Meter	Field Meter
MW-1R		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
MW-4		x	x		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
MW-5		x	x		x	x														x	x	x	x	x	x
MW-6		x	x	x		x														x	x	x	x	x	x
MW-7		x	x			x														x	x	x	x	x	x
MW-8		x	x			x														x	x	x	x	x	x
Downstream		x	x																	x	x	x	x	x	x
Upstream	Dry																								
EB		x	x	x	x	x																			
FB		x	x																						
TB		x	x																						

App I & II = Appendix Lists from current 40 CFR 258

Table 2
Detections in Water Samples Above SWSL, GWP, 2L, or 2B (Appendix I)
March 21, 2011

Sample ID	Parameter Name [1]	Sample Date	Result	Unit	MDL [2]	SWSL [3]	2L [4]	2B [5]	GWP [6]	Exceedance	Preliminary Cause
MW-1R	Barium	3/21/2011	252	ug/l	0.02	100	700				
MW-1R	Thallium	3/21/2011	0.3 j	ug/l	0.02	5.5			0.28	0.02	
MW-4	1,4-Dichlorobenzene	3/21/2011	2.9	ug/l	0.39	1	**6**				
MW-4	**Benzene**	**3/21/2011**	**3**	**ug/l**	**0.24**	**1**	**1**			**2**	**L & LFG**
MW-4	Cis-1,2-Dichloroethene	3/21/2011	6.2	ug/l	0.25	5	70				
MW-4	Vanadium	3/21/2011	4.8 j	ug/l	0.14	25			3.5	1.3	
MW-4	**Vinyl Chloride**	**3/21/2011**	**5.4**	**ug/l**	**0.63**	**1**	**0.03**			**5.37**	**L & LFG**
MW-6	Vanadium	3/21/2011	8 j	ug/l	0.14	25			3.5	4.5	
MW-8	Lead	3/21/2011	15	ug/l	0.02	10	15				
MW-8	Vanadium	3/21/2011	21.6 j	ug/l	0.14	25			3.5	18.1	
EB	**Chloromethane**	**3/21/2011**	**3**	**ug/l**	**0.77**	**1**	**2.6**			**0.4**	**A**
FB	Chloromethane	3/21/2011	2.2	ug/l	0.77	1	2.6				

[1] MDL = Method Detection Limit
[2] SWSL = Solid Waste Section Reporting Limit
[3] 2L = North Carolina 15A NCAC 2L Groundwater Quality Standard
[4] 2B = North Carolina 15 NCAC 2B Surface Water Quality Standard for this Specific Stream Classification
[5] GWP = Groundwater Protection Standard
j =Defined by laboratory as Between MDL and SWSL
A = Artifact Contamination from Field or Laboratory
L = Leachate
LFG = Landfill Gas
NE = Not Established
BOLD = Concentration > 2L, or 2B Standard

Table 3
Detections in Water Samples Above MDL (Appendix II Exclusive)
March 21, 2011

Sample ID	Parameter Name	Sample Date	Result	Unit	MDL [1]	SWSL [2]	2L [3]	GWP [4]	Exceedance	Preliminary Cause
MW-1R	Tin	3/21/11	0.41 j	ug/l	0.16	100	NE	NE		
MW-4	Tin	3/21/11	0.52 j	ug/l	0.16	100	NE	NE		
MW-4	Sulfide	9/27/10	386 j	ug/l	100	1000	NE	NE		
MW-5	Mercury	3/21/11	0.13 j	ug/l	0.05	0.2	1.1			
MW-5	Tin	3/21/11	0.44 j	ug/l	0.16	100	NE	NE		
MW-6	Tin	3/21/11	0.46 j	ug/l	0.16	100	NE	NE		
MW-7	Tin	3/21/11	0.43 j	ug/l	0.16	100	NE	NE		
MW-8	Tin	3/21/11	0.67 j	ug/l	0.16	100	NE	NE		

[1] MDL = Method Detection Limit
[2] SWSL = Solid Waste Section Reporting Limit
[3] 2L = North Carolina 15A NCAC 2L Groundwater Quality Standard
[4] GWP = Groundwater Protection Standard
j =Defined by laboratory as Between MDL and SWSL
BOLD = Concentration >2L, or 2B Standard

Table 4
Hydrologic Properties at Monitoring Well Locations
March 21, 2011

Monitoring Well	Hydraulic Conductivity (cm/sec)	Effective Porosity (%)	Hydraulic Gradient	Flow Rate (ft/yr)	Flow Direction	Depth to Water (ft btoc)	Water Elevation (ft amsl)
MW-1R	1.20E-04	37%	0.013	4	N41E	4.75	117.03
MW-4	1.10E-04	40%	0.019	6	S46E	18.43	99.46
MW-5	1.40E-04	37%	0.089	35	N78E	19.11	96.65
MW-6	1.90E-04	43%	0.042	19	N28E	6.33	111.08
MW-7	1.98E-04	7%	0.021	61	S11E	14.29	96.19
MW-8	1.14E-03	7%	0.028	474	S06E	11.68	99.68

NOTE: Data for hydraulic conductivities for wells except MW-7 & MW-8 obtained from GAI Consultants' Water Quality Modifications (October, 1994)
Data for hydraulic conductivities for MW-7 & MW-8 obtained from slug tests performed by MESCO (June, 2007)
Hydrologic gradient from water level elevations on March 21, 2011
Flow rate (Q) is defined by the equation:

where

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

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

Min v_x: 4
Mean v_x: 100
Median v_x: 27
Max v_x: 474

Appendix A
Statistical Analysis

Statistical Analysis Methodology

Statistical Analysis Methodologies

A statistical analysis was performed on metal and VOC detections utilizing Chemstat software, developed specifically for RCRA Subtitle D sites, conforming to current EPA and SWS protocols. A step-wise approach was utilized to evaluate trends in groundwater quality to identify a potential release from the landfill. Analytical data underwent preliminary data evaluation to reduce the data set and to determine if any "outliers" (defined as data that appears to be incongruent with respect to historical results) or seasonality exists that may potentially effect the results of the subsequent statistical analysis. Statistical tests were evaluated at the 0.05 level of significance, 95% confidence level, and were conducted as one-tailed tests. Statistical background values were calculated using un-manipulated data from historical semi-annual sampling events for this facility from 1994 to the current event. Historical data compiled for monitoring well(s) were used as the baseline. Groundwater data from the downgradient well(s) were compared to the pooled background groundwater data (inter-well) using methods which varied depending on the percentage of non-detects. If applicable, further intra-well analysis was conducted to compare current data from a single well to it's own historical data. Parameters that indicated statistical significance based on previous tests were evaluated to estimate the change in concentration over time to determine if there is an upward trend.

Preliminary Data Evaluation

A preliminary data screening was conducted on detections. Parameter concentrations detected below quantifiable levels (SWSL) and below levels detected in the background well were eliminated and statistical analysis was not conducted for that particular constituent/well.

Data distributions were reviewed using box and whiskers plots. In order to evaluate variability in concentrations with respect to time and season, time series plots were generated for select constituents. Time series plots were also visually evaluated for seasonality and "outliers". Suspected outliers were further evaluated through Dixon's Test for Outliers or Rosner's Test for Outliers depending on the number of samples and the data distribution. Outliers are generally not censored from the current or historical data set prior to statistical analysis but are further evaluated and/or qualified as necessary.

Inter-well Analyses

Inter-well statistical analysis was conducted on total metals detected during this sampling event. Monitoring well MW-1R was defined as the background well. 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 1 summarizes the methods used for 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.

Poisson Prediction Interval (VOCs)

Historical VOC detections in background well MW-1R were pooled to determine the total number of detections; from which the expected number of detections in a single downgradient 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 student's 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 with 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).

Determine Data Trend Over Time

Further qualitative evaluation is employed to determine trends in concentration over time on parameters indicating statistical significance. Implementation of Mann-Kendall Trend Analysis or Sen's Slope Analysis is generally used to determine if the concentration trend is increasing, decreasing, or constant.

Statistical Analysis Summary
Tables & Graphs

Inter-Well Analysis Summary (Metals)
March 21, 2011

Background Well: MW-1R

Lead, total

%ND	Normality	Method	ND Adj.	Upper Limit (a = 95%)	Unit
77.78	-	Non-parametric Tolerance Interval	1/2ND	32	ug/l

Well	Result	Significance
MW-8	15	no

NOTE: Bold-faced monitoring points indicate detected levels exceed 2L Standard

No Metals Exhibited a SSI
Per Interwell Analysis at a 95% Confidence Level

Summary of Pooled Appendix I VOCs in Background Well (MW-1R)
March 21, 2011

Constituent	Samples	NDs	% NDs
1,1,1,2-Tetrachloroethane	36	36	100.00
1,1,1-Trichloroethane	36	36	100.00
1,1,2,2-Tetrachloroethane	36	36	100.00
1,1,2-Trichloroethane	36	36	100.00
1,1-Dichloroethane	36	36	100.00
1,1-Dichloroethene	36	36	100.00
1,2,3-Trichloropropane	36	36	100.00
1,2-Dibromo-3-chloropropane	36	36	100.00
1,2-Dibromoethane	36	36	100.00
1,2-Dichlorobenzene	36	36	100.00
1,2-Dichloroethane	36	36	100.00
1,2-Dichloropropane	36	36	100.00
1,4-Dichlorobenzene	36	36	100.00
2-Butanone	36	36	100.00
2-Hexanone	36	36	100.00
4-Methyl-2-Pentanone	36	36	100.00
Acetone	36	36	100.00
Acrylonitrile	36	36	100.00
Benzene	36	36	100.00
Bromochloromethane	36	36	100.00
Bromodichloromethane	36	36	100.00
Bromoform	36	36	100.00
Bromomethane	36	36	100.00
Carbon disulfide	36	36	100.00
Carbon tetrachloride	36	36	100.00
Chlorobenzene	36	36	100.00
Chloroethane	36	36	100.00
Chloroform	36	36	100.00
Chloromethane	36	36	100.00
cis-1,2-Dichloroethene	36	36	100.00
cis-1,3-Dichloropropene	36	36	100.00
Chlorodibromomethane	36	36	100.00
Dibromomethane	36	36	100.00
Ethylbenzene	36	36	100.00
Iodomethane	36	36	100.00
Dichloromethane	36	36	100.00
Styrene	36	36	100.00
Tetrachloroethylene	36	36	100.00
Toluene	36	36	100.00
trans-1,2-Dichloroethene	36	36	100.00
trans-1,3-Dichloropropene	36	36	100.00
trans-1,4-Dichloro-2-butene	36	36	100.00
Trichloroethylene	36	36	100.00
Trichlorofluoromethane	36	36	100.00
Vinyl acetate	36	36	100.00
Vinyl chloride	36	36	100.00
Xylene	36	36	100.00
Total	**1692**	**1692**	**100.00**

Poisson Prediction Interval Based upon Pooled Background Appendix I VOCs
March 21, 2011

Detected VOCs >SWSL (Background Well: MW-1R)

Well	1,4-DCB	Benzene	cis-1,2-DCE	VCM	Total Cumulative Concentration	Total Detections >SWSL
2L	**6**	**1**	**70**	**0.030**	**-**	**-**
MW-4	2.9	**3**	6.2	**5.4**	17.5	4
TOTAL	2.9	3	6.2	5.4	17.5	4

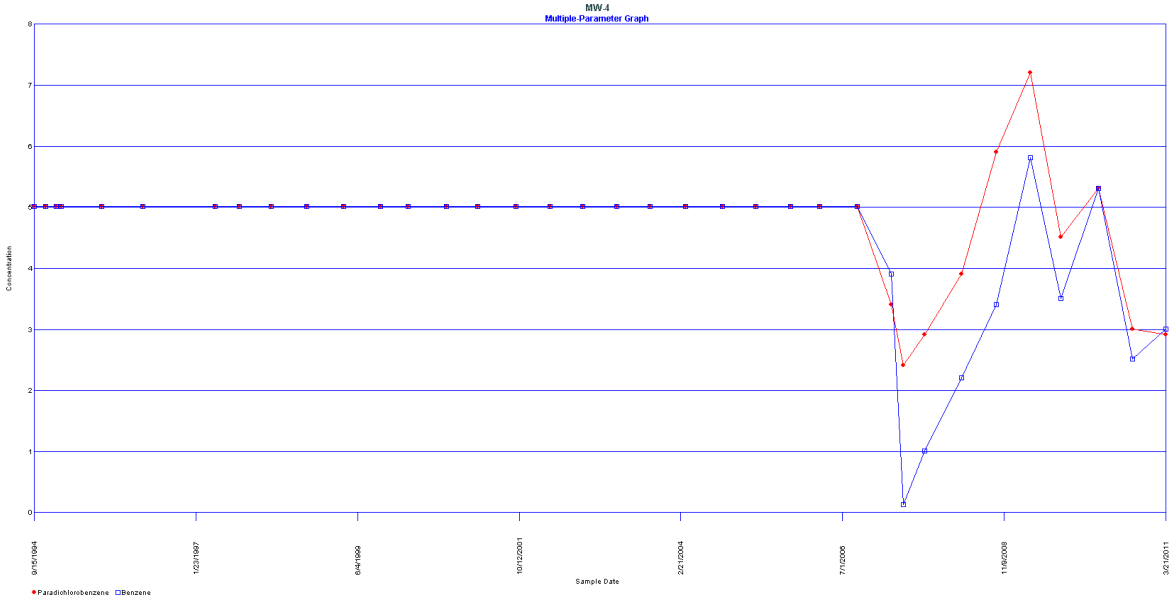
Concentrations in ug/L
"j" qualifiers omitted for statistical analysis purposes
Bold = Detected above 2L Standard
Shaded = Increasing concentration trend per Sen's Slope Indicator Analysis
Underlined = Concentration detected outside own historically identified range

Total number of sampling events [n] = 36
Total number of detections in background wells [y] = 0
Number of comparisons (downgradient wells) [k] = 5
One-sided value of Student's t-statistic (95% confidence) [t] = 2.44
Expected number of detections in a single future sample [y*] = 0.03

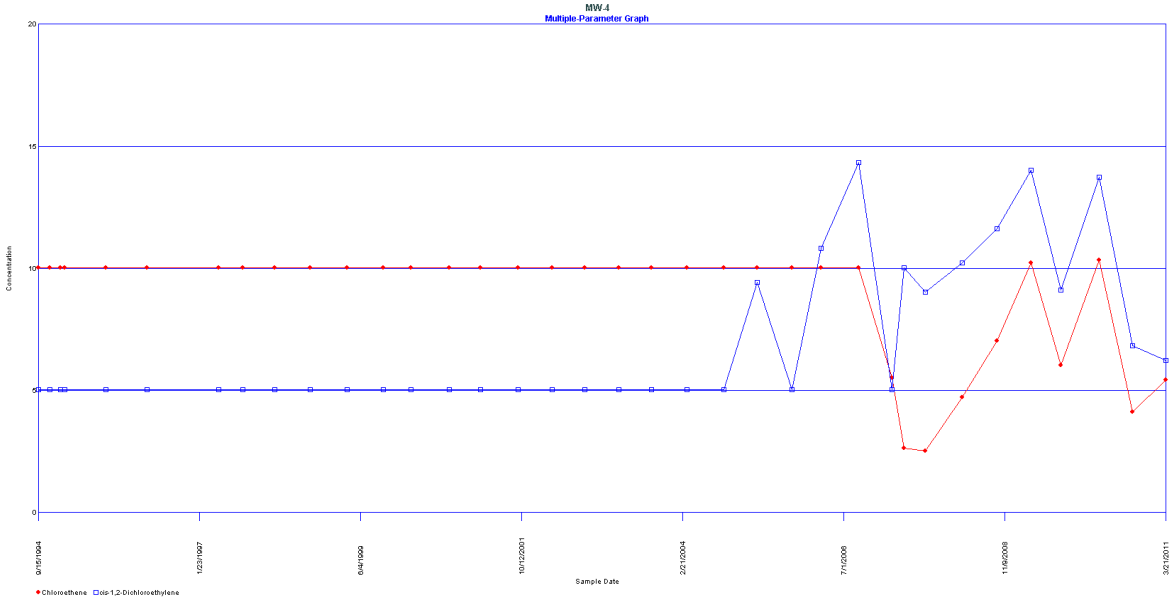
Statistically significant number of VOC detections within:
MW-4
Per the Poisson Tolerance Interval Method at a 95% Confidence Level
No VOCs have exhibited an increasing trend in concentration per Sen's Slope Indicator Analysis

Time Series Plots for Select Constituents
March 21, 2011

AROMATICS



CAH's



ND=Detection Limit

Statistical Analysis
Basic Statistics

Basic Statistics

Parameter: Lead, total

Original Data (Not Transformed)

Non-Detects Replaced with Detection Limit

Total Measurements	45
Total Non-Detects	35 (77.7778%)
Pooled Mean	11.8
Pooled Std Dev	4.8223
Compliance Meas.	9
Compliance Mean	12.5556
Compliance Std Dev	6.0231
Background Meas.	36
Background Mean	11.6111
Background Std Dev	4.55617

Background Locations

There is 1 background location

Location	Meas.	Non-Detects	% ND	Total
MW-1R	36	28	77.7778	418

Location	Mean	Std Dev	Std Err	Rank Sum	Rank Mean
MW-1R	11.6111	4.55617	0	823	22.8611

Compliance Locations

There is 1 compliance location

Location	Obs.	Non-Detects	% ND	Total
MW-8	9	7	77.7778	113

Location	Mean	Std Dev	Dif From Bkg	Std Err	Rank Sum	Rank Mean
MW-8	12.5556	6.0231	0.944444	1.81223	212	23.5556

Analysis of Variance Statistics

SS Wells	6.42222
SS Total	1023.2

Kruskal-Wallis Statistics

Non-Detect Rank	18
Background Rank Sum	823
Background Rank Mean	22.8611
H Statistic	0.0201288
H Adjusted for Ties	0.0380044

Statistical Analysis
Inter-well Analysis

Non-Parametric Tolerance Interval

Parameter: Lead, total

Original Data (Not Transformed)

Non-Detects Replaced with Detection Limit

Total Percent Non-Detects = 77.7778%
Background measurements (n) = 36
Maximum Background Concentration = 32
Minimum Coverage = 92%
Average Coverage = 97.2973%

Location	Date	Value	Significant
MW-8	6/22/2007	ND<10	FALSE
MW-8	9/13/2007	ND<10	FALSE
MW-8	3/28/2008	ND<10	FALSE
MW-8	9/29/2008	ND<10	FALSE
MW-8	3/30/2009	ND<10	FALSE
MW-8	9/8/2009	ND<10	FALSE
MW-8	3/30/2010	ND<10	FALSE
MW-8	9/27/2010	28	FALSE
MW-8	3/21/2011	15	FALSE