Corrective Action Evaluation Report

Prepared for

Wayne County Closed Landfill
Dudley, North Carolina
Permit No. 96-01

Prepared by

Municipal Engineering Services Company, P.A.
P.O. BOX 97
Garner, North Carolina
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MESCO Project Number: G11050.0

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Garner, Boone and Morehead City, North Carolina

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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 Co., PA

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

Name: Madeline German, PG Phone: (919)772-5393

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Facility name:	Facility Address:	Facility Permit #	NC Landfill Rule: (.0500 or .1600)	Actual sampling dates (e.g., October 20-24, 2006)
Wayne County Active C&D over Closed MSWLF	460-B South Landfill Road Dudley, NC 28333	96-01	.1600	August 2009, February 2010, August 2010, February 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 (MW-1, MW-2 and MW-8)
☐ 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

Madeline German — Digitally signed by Madeline German DN: cn=Madeline German, o=MESCO, ou, email=mgerman@mesco.com, c=US Date: 2011.03.21 15:34:52 -04'00' — 05/10/2011

Signature — Date

Affix NC Licensed/Professional Geologist Seal

NORTH CAROLINA LICENSED SEAL 2275 GEOLOGIST MADELINE GERMAN 5/10/2011

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1 INTRODUCTION

1.1 Site Background

1.1.1 Site History

The Wayne County landfill, located at 460 S. Landfill Road (SR 1129), Dudley, Wayne County, North Carolina, operates under permit #96-01. Prior to operation as a construction and demolition landfill (C&D) the site operated as a municipal solid waste (MSW) unlined sanitary landfill that consisted of two units. The first unit was closed prior to October 1991, with a 24-inch final soil cover. The second unit was closed by December 31, 1998, with an 18-inch thick cohesive soil cap having a permeability of 1 x 10^{-5} cm/sec, and 18 inches of erosive layer.[10] The C&D landfill was constructed and is operating on top of the second MSW unit. Adjacent to the C&D landfill is the existing Subtitle D MSW landfill, which operates under permit #96-06 and is monitored under 15A NCAC 13B.1630. A topographic map illustrating the facility location is included as **Plate 1**. A facility map is included as **Plate 6**.

Wayne County retained Municipal Engineering Services Company, P.A. (MESCO) to develop a *Corrective Action Plan* (CAP) for the closed C&D over an existing unlined MSW. In the CAP MESCO developed a site-specific remediation plan to address groundwater contamination possibly associated with the closed C&D/MSW landfill and constructed a timeline for implementation. The CAP was prepared in accordance with Rules 15A NCAC 13B.1636 & .1637 and submitted to the North Carolina Department of Environment and Natural Resources, Division of Waste Management (NCDENR), Solid Waste Section (SWS) on June 30, 2008. Final revisions to the CAP were submitted August 14, 2009 and approved on October 23, 2009.

1.1.2 Sampling History

Four monitoring wells (MW-1, MW-2, MW-3, and MW-4) were installed in August 1990. Initial sampling of these monitoring wells occurred on March 21, 1991; analysis included pH, biological oxygen demand (BOD), chemical oxygen demand (COD), nitrate nitrogen, total organic carbon (TOC), chloride, fluoride, total dissolved residue, arsenic, barium, cadmium, copper, total chromium, iron, lead, manganese, mercury, selenium, silver, zinc, total organic halides, sulfate, conductivity, temperature, and static water level. Additional sampling was reported for March 12, 1992, September 28, 1992, March 11, 1993 and September 20, 1993; results are available in the *Transition Plan*.

The Ground and Surface Water Monitoring System (SAP) was prepared in February 1994 and submitted as part of the *Transition Plan*.[10] As part of the SAP, monitoring wells MW-5, MW-6, MW-7 and MW-8

were installed in August 1994. Appendix I sampling was initiated in September 1994 with background sampling recorded on September 9, 1994, October 10, 1994, January 5, 1995, and March 23, 1995. Appendix II sampling was performed on monitoring wells MW-2, MW-3, MW-4, MW-5, MW-6, MW-7, and MW-8 on July 18, 1995. Naphthalene was detected in MW-6. Appendix I sampling was performed semi annually until March 1998. MW-6 was sampled for naphthalene in February 1996 and was recorded as a non-detect. Appendix II sampling was reported for monitoring wells MW-1, MW-2, MW-3, MW-4, MW-5, MW-6, MW-7, and MW-8 in March 1998. Bis(2-ethylhexyl)phthalate was detected in MW-1 and MW-3 and mercury was detected in MW-4.

Background sampling was initiated for Appendix II - mercury, naphthalene, and bis(2-ethylhexyl)phthalate in September 1998. Mercury, naphthalene, and bis(2-ethylhexyl)phthalate were reported as non-detects in the September 1998 sampling. Mercury, naphthalene, and bis(2-ethylhexyl)phthalate were sampled in October 1998, and Naphthalene was detected just above the PQL in MW-6. Mercury and bis(2-ethylhexyl)phthalate were not detected in the October 1998 sampling. Mercury was detected in MW-8 in December 1998. Naphthalene and bis(2-ethylhexyl)phthalate were non-detects in December 1998. Appendix II sampling was re-implemented during the August 12, 2010 sampling event. Appendix II exclusive parameters (defined in this report as parameters not included on the Appendix I list) were detected in wells MW-1, MW-2 MW-4 and MW-11. There were no Appendix II exclusive detections above the 2L Standard.

MW-9, MW-10 and MW-11 were installed July 9, 2009 at the request of NCDENR-SWS to more completely delineate the extent of groundwater impact. Samples for analysis of Appendix I and Appendix II constituents were collected. They have been included with the semi-annual water quality sampling reports.

Sampling is scheduled semi annually for Appendix I and Appendix II constituents on selected wells. Well information is included as **Table 1**. Well construction records are provided in **Appendix A**. Additional sampling procedures and information can be found in **Appendix B.**

1.2 Aquifer Characteristics

The site lies in the Atlantic Coastal Plain physiographic province, [1] a region characterized by flat or gently undulating topography dissected by drainage features with narrow to moderately sloped sides. The site is bounded by an intermittent drainage to the north and east, by SR 1129 to the south, and by another intermittent drainage to the west. The drainage features have been reported as dry during recent semi-annual sampling events. The northern drainage feature separates the site from the existing Subtitle D

MSW Landfill, and converges with the western drainage feature approximately 375 feet northwest of monitoring well MW-5. Both drainage features eventually converge with Edwards Branch approximately 600 feet west of the existing Subtitle D Leachate Lagoon. Edwards Branch appears to be a perennial stream, based on field observations made during surface water sampling from the existing Subtitle D MSW Landfill.

Regionally, Wayne County is located in the Coastal Plain groundwater region of the United States.[7] The unconfined aquifer at the site consists of unconsolidated sediments that are underlain by the Black Creek confining unit. South of Goldsboro, the Black Creek aquifer underlies the surficial aquifer and is confined by the clay/silty clay/sandy clay confining unit. Groundwater typically occurs at depths of less than 20 feet bgs, with the shallowest depths occurring in draws and near drainage features. Groundwater depths in the monitoring wells have been consistent over time, and generally occur in the following depth ranges:

- 0 to 5 ft. bgs: *MW-3, MW-5, MW-11*
- 5 to 10 ft. bgs: *MW-2, MW-4, MW-6, MW-7*
- 10 to 15 ft. bgs: *MW-1*
- > 15 ft. bgs: *MW-8, MW-9, MW-10*

Local groundwater flow dynamics are primarily controlled by the surrounding drainage features and ultimately Edwards Branch. Groundwater flow in the surficial aquifer is in a generally west-northwesterly direction. Historical groundwater elevations are provided in **Table 2**. A summary of slug test results is provided as **Table 3**. Other hydrologic properties and flow rate data is shown on **Table 4**. Hydraulic conductivity values ranged from a high of 6.40×10^{-3} cm/sec in MW-3, to a low of 3.16×10^{-5} cm/sec in MW-5, and an average of 1.10×10^{-3} cm/sec. A single-day potentiometric map depicting groundwater flow conditions on February 8, 2011 is provided as **Plate 3**.

Municipal water became available to the surrounding area around 1995-1996. The receptor survey, performed as part of the transition plan, identified two on-site water supply wells. The first water supply well, providing drinking water to the facility, was a 30-inch diameter bored well with a 1.5-inch dia. PVC inner casing set inside, and was located near the existing maintenance building. A total depth could not be located. This well was abandoned in 1996 when the facility was connected to municipal water. No well abandonment record is available. Site personnel confirmed that the well was abandoned with grout and a structure has been constructed on top of the well's former location. The second water supply well, also located near the maintenance building, was used to wash vehicles. According to the well construction record, this water supply well was installed on August 29, 1990 to a total depth of 80 feet below ground surface (bgs), and was constructed of 2-inch I.D. schedule 40 PVC casing and screen, with

a 5-foot screened interval from 75-80 feet bgs. Pump connections to this well were removed in May 2007. The well was properly abandoned in accordance with NCAC 2C well construction standards on July 9, 2009 by J&L Drilling, Inc. (Four Oaks, NC). The abandonment record is included in **Appendix A**.

The receptor survey performed during the *Transition Plan* identified nine properties within 2000 feet of the facility as having potable water supply wells. An updated receptor survey, performed in 2007, contacted these surrounding property owners/occupants regarding the status of their drinking water source. A number of wells remain but are not in use or are used for irrigation purposes. Three previously unidentified wells, located at the nearby hog farm, were also discovered in the 2007 receptor survey. The property owners were unavailable; however, verbal confirmation from the previous property owner indicated that the wells were installed in the Black Creek Formation and are used for agricultural purposes.

1.3 Contaminant Distribution

The constituents of concern (COC) identified in the Assessment of Corrective Measures (ACM) were chlorobenzene and p-dichlorobenzene. Mercury was incorrectly identified in the CAP as a COC.

The most recent water quality sampling results, collected in February 2011, detected chlorobenzene and p-dichlorobenzene in MW-2 and MW-8 at levels below the North Carolina Groundwater Standards (2L Standard). Benzene, in MW-2, was detected above the 2L limit. Additional VOCs were detected below the 2L Standard.

Historic water quality sampling results for VOCs are shown in **Table 5**. **Plate 4** illustrates the February 2011 detections above the 2L Standard. Isoconcentration maps for the constituents of concern are provided as **Plate 5A and Plate 5B**.

1.4 Description of Site Conceptual Model

Site conceptual and analytical models were created for the ACM, developed with Visual MODFLOW with MT3D[96] and presented as cross sections.

Physical Process

Estimated hydraulic properties for each lithology were obtained from *Wayne County - Design Hydrogeologic Study Phase 1*,[11] the on-going Phase 3 Design Study or the Simulation of Ground-Water Flow in the Coastal Plain Aquifer System of North Carolina.[6]

Hydraulic properties

	Hydraulic Conductivity cm/sec	**Total Porosity**	**Effective Porosity**
Layer 1: Clay Sand And Silty Clay	2.0×10^{-4}	37.6	9
Layer 2: Black Creek, Confining Layer	5.90×10^{-6}	37.6	9
Layer 3: Black Creek	5.29×10^{-3}	51.7	20

Precipitation data from the *Goldsboro 4 SE* station obtained from the State Climate Office of North Carolina web site [14] was reviewed. The *Goldsboro 4 SE* is located approximately 6.3 miles from the site. *Goldsboro 4 SE* receives an average of 49.8-inches of rainfall annually. There are no surface water inflows onto the site. The site drainage features are tributary "headwaters" for Edwards Branch. Evapotranspiration is estimated at 33 inches per year, which was derived in Simulation of Ground-Water Flow in the Coastal Plain Aquifer System of North Carolina.[6] Aquifer "storativity, *S,* [was] developed primarily for the analysis of well hydraulics in confined aquifers."[5][page 61] Change in aquifer storage in an unconfined aquifer system results in an increase/decrease in water level.[4] Due to the unconfined nature of the system and the assumption that the system is under steady state conditions the change in storage was considered negligible.[5][page 205] Overland run off towards drainage features is generally based on topography and was estimated at 5-inches per year.[6] Using these estimations, groundwater recharge was estimated at 12-inches per year. Limited recharge values were applied to areas with minimal impact due to landfill activities, including structures and roads.

Advection is the primary mechanism of physical plume movement. Advective flow with applied sorption (retardation) typically slows plume migration. The retardation coefficient (R), used to calculate the expected migration rates for the constituents, can be calculated from the following equation [7]:

$$R = 1 + \frac{\rho_d}{n} K_d$$

where

- R is the retardation coefficient
- ρ_d is the dry bulk density of the soil (g/cm^3)
- n is the porosity (unitless)
- K_d is the distribution coefficient (mL/g)

The average dry bulk density (ρ_d) presented in the *ACM* report, as calculated from laboratory dry weights determined during the *Phase 2 Design Hydrogeological Study*, was reported as 1.77 g/cm^3. The distribution coefficient (K_d) can be estimated as the constituent-specific soil–water partitioning coefficient (K_{oc}) times the fraction of organic carbon (f_{oc}) in the soil.[4] A conservative value of 1% was chosen for

soil organic carbon, based on boring logs and field observations. An average total porosity value of 36% was used based on the range of reported values in the *Transition Plan.*[10] Contaminant velocity in groundwater (v_c) is equal to the seepage velocity divided by the retardation coefficient [2]:

$$v_c = \frac{v_x}{R}$$

where

v_c is the velocity of the contaminant (ft/yr)
v_x is the average linear groundwater velocity, or *seepage velocity* (ft/yr)
R is the retardation coefficient (unitless)

The following table lists retardation coefficients for the relevant COCs. The contaminant velocities are given with respect to the *median* seepage velocity reported in the *ACM* (15.3 ft/yr).

Table of Retardation Coefficients & Contaminant Velocities

Constituent of Concern	**Distribution Coefficient (K_d)**	**Retardation Coefficient (R)**	**Contaminant Velocity (v_c)**
Chlorobenzene	0.83 – 3.89 (K_{oc} = 83 - 389) [8]	5.08 – 20.1	0.76 – 3.0 ft/yr
p-Dichlorobenzene (1,4-Dichlorobenzene)	2.73– 18.3 (K_{oc} = 273 – 1,833) [8]	14.4 – 91.0	0.17 – 1.1 ft/yr

Note – R values originally reported in the CAP. Contaminant velocities are based on a median seepage velocity of 15.3 feet/year.

The calculated values suggest that chlorobenzene has the potential to travel up to one-fifth of the seepage velocity calculated in the *ACM*. *p*-Dichlorobenzene is expected to have a similar, although generally slower, mobility.

Contaminant velocities for chlorobenzene and *p*-dichlorobenzene were calculated at the locations of monitoring wells MW-2 and MW-8, using seepage velocities calculated from individual slug test results. From their contaminant velocities, contaminant travel times to the compliance boundary were calculated. Well-specific contaminant velocities and travel times based on the above retardation factors are summarized in the following table.

Organic COC Contaminant Velocities and Estimated Travel Times to Compliance Boundary

Monitoring Well	**Seepage Velocity (v_x)**	**Contaminant Velocity (v_c)**		**Time to Relevant Point-of-Compliance (~50 ft. downgradient from MW-2) (~225 ft. crossgradient from MW-8)**	
		Chlorobenzene	***p*-Dichlorobenzene**	**Chlorobenzene**	***p*-Dichlorobenzene**
MW-2	30.9 ft/yr	1.5 – 6.1 ft/yr	0.34 - 2.1 ft/yr	8.2 - 33 yrs	24 – 150 yrs
MW-8	10.9 ft/yr	0.54 – 2.1 ft/yr	0.12 – 0.76 ft/yr	107 – 417 yrs	296 - 1,875 yrs

Please note the relevant point-of-compliance for monitoring well MW-8 is located cross-gradient and somewhat up-gradient to the well. Based on this information, contaminant transport would occur primarily as a result of diffusion as opposed to advection, which occurs primarily along down-gradient flowpaths. Therefore, contaminant travel times from MW-8 to the adjacent point-of-compliance are expected to be slower than those presented in the above table.

Chemical/Biochemical Process

The identified COCs consist of chlorinated aromatic hydrocarbons and metals dissolved in groundwater. Natural biodegradation of chlorinated hydrocarbons occurs primarily through the biochemical process of reductive dechlorination. Reductive dechlorination occurs as the result of microbial activity that progressively removes chlorine atoms from chlorinated hydrocarbons through various oxidation-reduction reactions. Under anaerobic conditions, reductive dechlorination occurs through electron acceptor reactions, with the chlorinated hydrocarbons acting as electron donors rather than as a carbon source for microbial activity. Under aerobic and some anaerobic conditions, reductive dechlorination can occur as a result of electron donor reactions, during which chlorinated hydrocarbons act as both carbon and energy sources for microbial activity. Breakdown of chlorinated aromatic hydrocarbons can also occur through chemical oxidation. [15]

1.5 Regulatory Status

The Wayne County Landfill operates as a C&D Landfill over a MSW Landfill under permit No. 96-01. Wayne County has been under a CAP for two years. Water quality monitoring is performed semi-annually.

2 CORRECTIVE ACTION SUMMARY

2.1 Aquifer Conditions

The groundwater contaminant source appears to be the former MSW landfill cell. The contamination mechanism is either precipitation that has percolated through the landfill waste, allowing VOCs to partition from solid/liquid phases into a dissolved phase, and subsequently migrated downwards to mix with groundwater or landfill gas. The ACM identified chlorobenzene and p-dichlorobenzene as constituents of concern.

2.1.1 Physical Changes

Wayne County has continued operation at the C&D landfill. As part of the CAP the on-site water supply well was abandoned on July 9, 2009. Additional monitoring wells MW-9, MW-10 and MW-11 were installed July 9 &10, 2009 to determine the extent of plume migration. MW-9 is located slightly southeast of MW-8. MW-10 is located slightly southwest of MW-8. MW-11 is located west of the site between MW-2 and MW-5. Well information is included in **Appendix A**.

The Gas Collection and Control System (GCCS) was installed in 2002 and went into operation February 4, 2003. The GCCS consists of two separate cells over 77 acres, with 44 vertical wellheads connecting to a single blower/flare system. The active system was expanded to generate power with additional landfill gas extraction wells, increasing its efficiency.

2.1.2 Chemical Changes

The ACM identified the contaminants of concern as chlorobenzene and p-dichlorobenzene. The CAP incorrectly added mercury which has not been detected since February 2008. The last mercury detection over the 2L Standard occurred in 2003. The most recent water quality sampling results, collected February 2011, included more sampling locations in addition to Appendix II parameters than collected in 2007. Benzene in MW-2 was the only VOC detected above 2L for this event.

Based on water quality laboratory results several trends can be observed. Aromatic hydrocarbons continue to be present at the site. The concentrations of chlorobenze and p-dichlorobenzene have decreased in MW-8. Chlorobenzene was detected at 3.2 ug/l in 2007 for the ACM, and was detected at 0.36 ug/l for the February 2011 sampling event. Chlorobenzene detections are well below the 2L Standard of 50 ug/l. P-dichlorobenze was detected at 9.2ug/l in 2007 for the ACM, and was detected at 1.6 ug/l from the February 2011 event. P-dichlorobenzene has a 2L Standard at 6 ug/l. Mercury was not detected in the August 2010 samples and in select samples from February 2011. A supplementary surface

water sample was collected downgradient of MW-2 during the February 2011 event. Laboratory results indicated no VOC detections, suggesting horizontal plume delineation.

2.2 Plume Characteristics

2.2.1 Physical Changes

Since the ACM submittal in August 2007 no noteworthy changes have been observed. If future conditions warrant additional monitoring or landfill gas wells, the SWS will be notified within a reasonable timeframe.

2.2.2 Chemical Changes

Naturally occurring metals continue to be detected in the groundwater and surface water samples across the facility. MW-2 continues to have low level detections. Benzene was detected in MW-2 above the 2L Standard. No other VOCs were detected above 2L in February 2011. Overall, VOC detections are decreasing with fewer 2L exceedances.

Bioscreen was run in the CAER for MW-2 to assess the continuing effectiveness of MNA. Bioscreen focused on benzene due to the half life of 2 years. Bioscreen results showed an 85% decrease in contamination in five years through 1st order decay and a 100% decrease in contamination through instantaneous reaction model. Results are provided in **Appendix C**. Biochlor modeling was unable to be used due to program limitations that did not correlate with the site-specific data. The USEPA Natural Attenuation Screening Protocol was used, and indicated “Limited evidence for anaerobic biodegradation of chlorinated organics” exists at the site; downgraded from “adequate evidence for aerobic biodegradation of chlorinated organics” determined in the ACM.

3 CORRECTIVE ACTION PLAN UPDATES

Multiple factors influenced the selection of remedy presented in the CAP, including:

- Anaerobic conditions exist in the natural wetland areas.
- Contaminant velocity is relatively slow.
- Contamination is below risk exposure levels.
- Contamination is limited to the surficial aquifer.
- The former on-site water supply well has been properly abandoned, thus eliminating a potential contaminant migration pathway to deeper aquifers.
- Contamination is within the relevant point of compliance.

The most cost effective and efficient remedial action was determined to be continued use of the gas extraction system supplemented with monitored natural attenuation (MNA).

3.1 Modifications to Selected Remedy

Groundwater contamination exists in the unconfined, shallow aquifer, inside the 250 foot compliance boundary. Natural attenuation mechanisms are actively controlling groundwater contaminant movement. Sampling was conducted for the SWS MNA parameter list to establish a baseline over four sampling events on MW-1, MW-2 and MW-8. Monitoring wells MW-1 through MW-11 were generally sampled for VOCs and metals.

Water quality monitoring will continue to be performed semi-annually. Baseline sampling for the MNA performance parameters list provided by the SWS was performed for two years. Based on the updated information regarding contaminant type and location, select MNA is proposed for MW-1, MW-2 and MW-8 in this AOC. Wells will be sampled annually, until the next CAER, for the following parameters from the list of MNA sampling parameters provided by the SWS.

- Alkalinity
- Sulfate
- Sulfide
- TOC
- COD
- Iron
- Chloride
- Nitrate
- Temperature
- ORP
- DO
- pH
- Specific Conductance
- Turbidity

Hydrogen is an indicator of a redox environment; however, hydrogen can be unstable in nature and is expensive to monitor. Measurement of ORP can substitute for hydrogen analysis.

Volatile Fatty Acids can provide insight into the types of microbial activities occurring in the subsurface sometimes serving as electron donors. As these are expensive to monitor and a baseline has been established, it is MESCO's belief it is no longer cost effective to continue sampling for these parameters.

Methane levels recorded above the background indicate methanogenic conditions in MW-2, representing the final stages of dechlorination. Methane is commonly associated with landfill gas that is monitored quarterly based on SWS guidance, providing coverage and data for this parameter.

Ethane and ethene also provide evidence of dechlorination's final stages. They are not cost effective to monitor in addition to multiple parameters providing similar information.

BOD is used to determine the amount of dissolved oxygen needed to break down organic material in the aquifer; however, it is not a precise quantitative test. Multiple analyses provide comparable data. BOD is a challenge to obtain, due to the short hold times, and the results are easier to obtain from other analysis.

Stream quality monitoring will be achieved through surface water sampling at sampling point SW-1, SW-2 and SW-3 (**Plate 2**). Supplementary sampling locations from the lined landfill, SW-2 and SW-3, may be included as necessary called SW-2 (shared) and SW-3 (shared). Surface water will be sampled for Appendix I parameters.

Sampling details are included in the Water Quality Sampling and Analysis Plan presented in **Appendix B** of this report.

3.2 Contingency Plan

The contingency plan presented in the CAP does not need to be implemented at this time. Wayne County is making progress under the current CAP. If future conditions warrant additional remedial action, these options may be re-evaluated at that time. The SWS will be notified in the event a contingency plan is implemented.

4 CONCLUSION

4.1 Evaluation of Effectiveness

Changes in the physical and chemical characteristics of the contaminant plumes should occur as remediation progresses. Contaminant concentrations are expected to decrease over the period of remediation, thus resulting in a decrease in the physical extent of the plume.

Since the ACM and CAP submittals, VOC 2L violations remain in the 250 foot compliance boundary. Contamination concentrations continue to decrease. Wayne County owns the majority of the property surrounding the facility and public water is available to the surrounding area. Laboratory analysis indicates new constituents are not emerging and existing concentrations have decreased. Modeling reiterates the slow moving nature of the plume and how natural attenuation degrades the contaminants.

4.2 Report Submittals

Brief updates regarding remediation status will continue to be submitted in the semi-annual groundwater sampling report. The purpose of these updates is to keep the SWS current on the remediation progress and apprised of situations that may require amendments to the current CAP. Text, tables, pictures, etc. may be used to illustrate the existing site conditions.

4.3 Completeness of Corrective Action

Reduction of low-level contamination at Wayne County Landfill may be achieved through natural attenuation. Institutional controls limit access to the site. The source area has been capped to limit infiltration. The on-site, non-potable water supple well, located near the scale house, was abandoned to eliminate a potential contaminant migration pathway.

The CAP will be deemed complete if contamination above 2L does not spread beyond the 250 foot compliance boundary. A reduction in MNA sampling and assessment monitoring may be warranted.

REFERENCES

[1] Brown, Philip M., et al, 1985, Geologic map of North Carolina: North Carolina Department of Natural Resources and Community Development, scale 1:500,000

[2] Environmental Protection Agency (EPA), 1998, Technical Protocol for Evaluating Natural Attenuation of Chlorinated Solvents in the Ground Water, EPA/600/R-98/128, September.

[3] EPA Technical Factsheets, http://www.epa.gov/OGWDW/contaminants/index.html

[4] Fetter, C.W., 1994, Applied Hydrogeology 3rd ed.: Prentice-Hall Inc., New Jersey, 691 pp.

[5] Freeze, R.A. and Cherry, J.A., 1979, Groundwater: Prentice Hall, Inc., Englewood Cliffs, New Jersey, 604 p.

[6] Giese, G. L., Eimers, J. L., Coble, R. W., 1997, Simulation of Ground-Water flow in the Coastal Plain Aquifer System of North Carolina. U.S Geological Survey Professional Paper 1404-M, 142p.

[7] Heath, R.C., 1984, Groundwater regions of the United States: U.S. Geological Survey Water Supply Paper 2242, 78 pp.

[8] Howard, P.H., Boethling, R.S., Jarvis, W.F., Myelan, W.M., and Michalenko, E.M., 1991, Handbook of Environmental Degradation Rates, Lewis Publishers, Inc, Chelsea, MI.

[9] McVay, K. A. and Rice, C. W., 2002. Soil Organic Carbon and the Global Carbon Cycle, Kansas State University.

[10] Municipal Engineering Services Company, P.A, April 1994. Wayne County Transition Plan.

[11] Municipal Engineering Services Company, P.A., 1997. Design Hydrogeologic Study Phase 1, Wayne County Subtitle D Lined Landfill, Wayne County, Dudley, North Carolina.

[12] Municipal Engineering Services Company, P.A, August 2007. Assessment of Corrective Measures, Wayne County Landfill – Permit #96-01.

[13] Municipal Engineering Services Company, PA, August 2009. Corrective Action Plan, Wayne County Landfill - Permit #96-01.

[14] State Climate Office of North Carolina. (SCONC), http://www.nc-climate.ncsu.edu/.

[15] United States Environmental Protection Agency (EPA), 2005, Partition Coefficients for Metals in Surface Water Soil, and Waste, EPA/600/R-05/074.

TABLES

Table 1: Well Construction Details

Monitoring Well	Date Installed	Ground Elevation	Top-of-Casing Elevation	Northing	Easting	Well Diameter	Boring Diameter	Screen Interval (BGS)	Confining Layer	Status
MW-1	08/28/1990	161.68	163.26	562296.5300	2279079.6200	2	8	20-25	-	Background Well
MW-2	08/28/1990	132.78	134.52	561999.8800	2275661.9500	2	8	10-15	-	Monitoring Well
MW-3	08/27/1990	133.03	134.81	562912.8422	2276867.5503	2	8	12-18	-	Monitoring Well
MW-4	08/28/1990	148.17	150.20	562860.4200	2278629.5700	2	8	10-15	-	Monitoring Well
MW-5	08/31/1994	120.56	124.78	562686.3000	2275741.6800	2	8	3-18	Y	Monitoring Well
MW-6	08/31/1994	143.62	145.53	563012.3600	2277910.6000	2	8	3.14-18.14	-	Monitoring Well
MW-7	08/31/1994	140.74	143.59	561293.3700	2276123.5500	2	8	4-19	-	Monitoring Well
MW-8	08/30/1994	160.88	161.88	561825.8000	2277906.8800	2	8	14-29	-	Monitoring Well
MW-9	07/09/2009	159.78	162.96	561770.8200	2278045.8300	2	8	10-25	-	Monitoring Well
MW-10	07/09/2009	160.01	162.90	561712.3300	2277770.5800	2	8	10-25	-	Monitoring Well
MW-11	07/09/2009	124.50	127.23	562410.7347	2275650.6952	2	8	5-15	-	Monitoring Well
Supply Well	08/29/1990	-	165.72	562039.2415	2277271.9898	2	8	75-80	-	Abandoned 07/09/2009

NOTE:
1. Ground and Top-of-Casing elevations are in feet above mean sea level (amsl), well and boring diameter are in units of inches.

Table 2: Historical Groundwater Elevation Data

WELL	9/8/1994	10/20/1994	1/1/1995	3/23/1995	7/18/1995	2/20/1996	8/29/1996	2/4/1997	8/27/1997	2/11/1998	3/12/1998	9/2/1998
MW-1	147.87	147.28	146.43	150.57	-	149.50	148.34	150.70	146.77	152.82	153.70	149.12
MW-2	129.50	129.30	129.24	130.27	130.26	130.21	129.25	130.10	128.58	-	130.50	130.11
MW-3	-	-	134.00	-	-	-	-	-	-	-	-	-
MW-4	143.55	143.44	-	143.90	143.89	144.09	143.69	144.37	143.14	144.26	144.35	144.18
MW-5	120.90	120.79	120.72	121.40	121.49	121.15	121.03	121.32	120.57	121.40	121.21	121.00
MW-6	139.96	139.91	139.48	140.26	140.63	140.59	139.72	140.47	138.94	140.71	140.75	140.49
MW-7	136.17	135.18	134.46	139.07	138.59	138.64	135.23	138.55	133.84	139.83	139.93	137.02
MW-8	143.89	-	142.17	144.87	144.90	144.91	143.87	145.84	142.77	145.00	145.63	144.71

WELL	10/29/1998	12/2/1998	2/22/1999	8/24/1999	2/10/2000	8/2/2000	2/8/2001	8/9/2001	2/14/2002	8/22/2002	2/5/2003	8/14/2003
MW-1	148.83	147.86	150.51	147.84	151.54	147.33	146.74	148.41	146.97	145.71	145.46	148.96
MW-2	129.44	129.34	130.15	129.41	130.34	129.54	129.29	129.33	130.08	128.23	129.05	130.11
MW-3	-	134.53	-	134.21	-	-	133.97	134.11	134.18	133.13	133.26	-
MW-4	143.84	143.65	144.13	143.51	144.49	143.51	143.38	143.39	143.54	142.25	142.43	143.65
MW-5	120.78	120.90	121.03	120.92	121.14	121.66	121.36	121.58	121.98	121.33	121.30	122.28
MW-6	139.62	-	140.44	140.06	140.62	139.98	139.64	138.92	140.50	138.56	139.07	140.91
MW-7	135.27	134.67	138.87	135.67	139.27	135.75	134.25	135.06	136.48	133.08	133.49	138.79
MW-8	144.09	143.20	144.74	142.97	145.64	142.90	141.92	142.67	141.95	140.86	140.28	143.24

WELL	2/19/2004	8/25/2004	2/21/2005	8/8/2005	2/23/2006	8/28/2006	2/6/2007	8/13/2007	2/11/2008	8/28/2008	2/17/2009	8/6/2009
MW-1	148.44	151.25	147.79	148.16	147.84	147.55	150.06	146.32	146.38	145.73	147.35	146.61
MW-2	130.29	130.21	129.68	128.99	129.80	128.72	130.36	128.92	129.54	128.40	129.62	129.08
MW-3	-	-	134.31	134.03	134.31	134.03	-	133.78	133.78	133.49	134.10	134.08
MW-4	147.30	146.22	143.59	143.28	145.48	145.24	144.31	142.92	143.00	142.39	143.14	142.95
MW-5	121.92	122.40	121.54	121.68	122.25	121.78	122.25	121.78	121.78	121.87	121.77	120.89
MW-6	141.29	141.09	140.02	139.88	140.13	138.88	140.95	138.99	140.12	138.47	139.78	138.96
MW-7	138.24	140.21	136.04	134.88	136.86	135.21	139.59	134.74	134.95	133.77	136.29	135.37
MW-8	143.19	143.90	142.96	142.45	142.67	142.50	144.76	141.98	141.25	141.11	142.51	141.93
MW-9	-	-	-	-	-	-	-	-	-	-	-	142.60
MW-10	-	-	-	-	-	-	-	-	-	-	-	143.09
MW-11	-	-	-	-	-	-	-	-	-	-	-	123.83

WELL	2/16/2010	8/12/2010	2/16/2011	Observed High	Observed Low	Difference	Average
MW-1	150.75	-	-	153.70	145.46	8.24	148.43
MW-2	130.45	127.67	129.77	130.50	127.67	2.83	129.56
MW-3	134.81	134.57	134.13	134.81	133.13	1.68	134.04
MW-4	144.37	142.22	143.1	147.30	142.22	5.08	143.79
MW-5	122.25	121.38	122.21	122.40	120.57	1.83	121.46
MW-6	141.33	137.93	140.16	141.33	137.93	3.40	139.95
MW-7	139.56	133.43	135.59	140.21	133.08	7.13	136.46
MW-8	143.93	141.73	141.69	145.84	140.28	5.56	143.20
MW-9	145.06	142.34	142.54	145.06	142.34	2.72	143.14
MW-10	146.29	142.55	143.53	146.29	142.55	3.74	143.87
MW-11	125.42	123.22	124.56	125.42	123.22	2.20	124.26

Table 3: Summary of Slug Test Results

Well	Screen Interval (BGS)	Initial DTW (BTOP)	Initial Head Change	K (cm/sec)	Lithology
MW-1	20-25	15.82	15.82	5.40E-04	Sand
MW-2	10-15	5.57	5.57	3.00E-04	Sand
MW-3	12-18	5.67	1.17	6.40E-03	Sand
MW-4	10-15	6.89	4.19	9.90E-04	Sand
MW-5	3-18	3.60	1.50	3.10E-05	Clayey Sand
MW-6	3.14-18.14	6.59	5.59	1.60E-04	Sand/Sandy Clay
MW-7	4-19	8.50	0.80	7.30E-05	Sandy Clay/Silty Sand
MW-8	14-29	19.73	2.43	3.40E-04	Clayey Sand

Summary Statistics			
Mean	1.10E-03	Maximum	6.40E-03
Median	3.20E-04	Minimum	3.10E-05
Sandard Deviation	2.16E-03	Count	8

Information obtained from Wayne County Transition Plan completed April 1994

Table 4: Flow Rate Calculations

Well	h_1 (ft)	h_2 (ft)	dh (ft)	dl (ft)	i	K (cm/sec)	n_e (%)	v (ft/yr)	Lithology
MW-1	148.66	146.00	2.66	379.36	0.0070	5.40E-4	20%	19.59	Sand
MW-2	129.66	128.00	1.66	83.49	0.0199	3.00E-4	20%	30.86	Sand
MW-3	133.97	132.00	1.97	100.23	0.0197	6.40E-3	20%	650.74	Sand
MW-4	143.82	142.00	1.82	343.20	0.0053	9.90E-4	20%	27.16	Sand
MW-5	121.31	124.00	2.69	136.84	0.0197	3.10E-5	20%	3.15	Clayey Sand
MW-6	140.09	138.00	2.09	307.96	0.0068	1.60E-4	20%	5.62	Sand/Sandy Clay
MW-7	136.64	136.00	0.64	71.21	0.0090	7.30E-5	20%	3.39	Sandy Clay/Silty Sand
MW-8	143.50	142.00	1.50	241.57	0.0062	3.40E-4	20%	10.92	Clayey Sand

NOTES:

1. Parameters *dh* and *dl* denote the difference in the hydraulic head and the horizontal distance, respectively, between two measurement points. A line is constructed from a piezometers to a perpendicular of the potentiometric contour on the average potentiometric map with flow directions. The hydraulic head is the absolute value of the difference in the groundwater elevation at the piezometer, h_1, and the elevation of the corresponding potentiometric contour, h_2. The horizontal distance, *dl,* is the length of the line.
2. Parameter *i* denotes the hydraulic gradient associate with the line, and is defined by the equation:

$$i = \frac{dh}{dl}$$

3. Parameter n_e denotes the effective porosity.
4. *K* denotes the hydraulic conductivity determined from field slug tests.
5. Parameter *v* denotes the average linear velocity. The average linear velocity, denoted by *v*, is defined by the equation:

$$v = -\frac{K}{n_e}\frac{dh}{dl}$$

Table 5: Historic Organic Groundwater Results

Well ID	CAS NO	Parameter Name	Sample Date	Result	Unit	NCGW2L[1]	SWSL[2]	Exceedance
MW-1	67-64-1	Acetone	08/12/2010	14.5	ug/l	6000	100	
MW-1	**75-27-4**	**Bromodichloromethane**	**08/12/2010**	**0.62**	**ug/l**	**0.6**	**1**	**0.02**
MW-1	67-66-3	Chloroform	08/06/2009	0.52	ug/l	70	5	
MW-1	67-66-3	Chloroform	02/17/2010	0.44	ug/l	70	5	
MW-1	67-66-3	Chloroform	08/12/2010	3.5	ug/l	70	5	
MW-1	67-66-3	Chloroform	02/08/2011	0.22	ug/l	70	5	
MW-1	74-87-3	Chloromethane	08/12/2010	0.49	ug/l	3	1	
MW-10	67-66-3	Chloroform	07/24/2009	0.57	ug/l	70	5	
MW-10	67-66-3	Chloroform	08/11/2010	0.6	ug/l	70	5	
MW-10	67-66-3	Chloroform	02/09/2011	0.58	ug/l	70	5	
MW-10	74-87-3	Chloromethane	08/11/2010	0.17	ug/l	3	1	
MW-11	67-64-1	Acetone	02/17/2010	3.1	ug/l	6000	100	
MW-11	67-64-1	Acetone	08/12/2010	4.2	ug/l	6000	100	
MW-11	75-15-0	Carbon disulfide	02/09/2011	1.6	ug/l	700	100	
MW-11	74-87-3	Chloromethane	08/12/2010	0.46	ug/l	3	1	
MW-11	74-87-3	Chloromethane	02/09/2011	1.2	ug/l	3	1	
MW-11	156-59-2	cis-1,2-Dichloroethene	07/23/2009	0.43	ug/l	70	5	
MW-11	156-59-2	cis-1,2-Dichloroethene	02/17/2010	0.32	ug/l	70	5	
MW-11	156-59-2	cis-1,2-Dichloroethene	08/12/2010	0.28	ug/l	70	5	
MW-11	156-59-2	cis-1,2-Dichloroethene	02/09/2011	0.32	ug/l	70	5	
MW-11	75-71-8	Dichlorodifluoromethane	08/12/2010	0.68	ug/l	1000	5	
MW-11	75-71-8	Dichlorodifluoromethane	02/09/2011	0.79	ug/l	1000	5	
MW-11	74-88-4	Iodomethane	02/09/2011	2.2	ug/l	NE	10	
MW-2	75-34-3	1,1-Dichloroethane	03/12/1998	5.5	ug/l	6	5	
MW-2	**75-34-3**	**1,1-Dichloroethane**	**08/24/1999**	**7.2**	**ug/l**	**6**	**5**	**1.2**
MW-2	75-34-3	1,1-Dichloroethane	02/11/2008	0.5	ug/l	6	5	
MW-2	75-34-3	1,1-Dichloroethane	08/28/2008	0.36	ug/l	6	5	
MW-2	95-50-1	1,2-Dichlorobenzene	02/11/2008	0.4	ug/l	20	5	
MW-2	95-50-1	1,2-Dichlorobenzene	08/28/2008	0.39	ug/l	20	5	
MW-2	95-50-1	1,2-Dichlorobenzene	02/17/2009	0.36	ug/l	20	5	
MW-2	95-50-1	1,2-Dichlorobenzene	08/06/2009	0.37	ug/l	20	5	
MW-2	95-50-1	1,2-Dichlorobenzene	02/16/2010	0.49	ug/l	20	5	
MW-2	95-50-1	1,2-Dichlorobenzene	08/12/2010	0.47	ug/l	20	5	
MW-2	95-50-1	1,2-Dichlorobenzene	02/08/2011	0.53	ug/l	20	5	
MW-2	541-73-1	1,3-Dichlorobenzene	02/11/2008	0.3	ug/l	200	5	
MW-2	541-73-1	1,3-Dichlorobenzene	08/12/2010	0.31	ug/l	200	5	
MW-2	541-73-1	1,3-Dichlorobenzene	02/08/2011	0.39	ug/l	200	5	
MW-2	**106-46-7**	**1,4-Dichlorobenzene**	**01/05/1995**	**8**	**ug/l**	**6**	**1**	**2**
MW-2	**106-46-7**	**1,4-Dichlorobenzene**	**07/18/1995**	**7**	**ug/l**	**6**	**1**	**1**
MW-2	106-46-7	1,4-Dichlorobenzene	02/11/2008	3.4	ug/l	6	1	
MW-2	106-46-7	1,4-Dichlorobenzene	02/17/2009	3.3	ug/l	6	1	
MW-2	106-46-7	1,4-Dichlorobenzene	08/06/2009	2.7	ug/l	6	1	
MW-2	106-46-7	1,4-Dichlorobenzene	02/16/2010	3.6	ug/l	6	1	
MW-2	106-46-7	1,4-Dichlorobenzene	08/12/2010	3.6	ug/l	6	1	
MW-2	106-46-7	1,4-Dichlorobenzene	02/08/2011	4.8	ug/l	6	1	
MW-2	67-64-1	Acetone	02/11/2008	2.9	ug/l	6000	100	
MW-2	67-64-1	Acetone	08/12/2010	2.3	ug/l	6000	100	
MW-2	67-64-1	Acetone	02/08/2011	4.3	ug/l	6000	100	
MW-2	**71-43-2**	**Benzene**	**07/18/1995**	**5**	**ug/l**	**1**	**1**	**4**
MW-2	**71-43-2**	**Benzene**	**02/11/2008**	**2.6**	**ug/l**	**1**	**1**	**1.6**
MW-2	**71-43-2**	**Benzene**	**08/28/2008**	**2.4**	**ug/l**	**1**	**1**	**1.4**
MW-2	**71-43-2**	**Benzene**	**02/17/2009**	**2.4**	**ug/l**	**1**	**1**	**1.4**

Table 5: Historic Organic Groundwater Results

Well ID	CAS NO	Parameter Name	Sample Date	Result	Unit	NCGW2L[1]	SWSL[2]	Exceedance
MW-2	**71-43-2**	**Benzene**	**08/06/2009**	**1.6**	**ug/l**	**1**	**1**	**0.6**
MW-2	**71-43-2**	**Benzene**	**02/16/2010**	**2**	**ug/l**	**1**	**1**	**1**
MW-2	**71-43-2**	**Benzene**	**08/12/2010**	**2**	**ug/l**	**1**	**1**	**1**
MW-2	**71-43-2**	**Benzene**	**02/08/2011**	**2.8**	**ug/l**	**1**	**1**	**1.8**
MW-2	108-74-1	Chlorobenzene	09/08/1994	36	ug/l	50	3	
MW-2	108-74-1	Chlorobenzene	10/20/1994	31	ug/l	50	3	
MW-2	108-74-1	Chlorobenzene	01/05/1995	22	ug/l	50	3	
MW-2	108-74-1	Chlorobenzene	03/23/1995	22	ug/l	50	3	
MW-2	108-74-1	Chlorobenzene	07/18/1995	32	ug/l	50	3	
MW-2	108-74-1	Chlorobenzene	02/20/1996	23	ug/l	50	3	
MW-2	108-74-1	Chlorobenzene	02/04/1997	24	ug/l	50	3	
MW-2	108-74-1	Chlorobenzene	02/11/1998	25	ug/l	50	3	
MW-2	108-74-1	Chlorobenzene	03/12/1998	28	ug/l	50	3	
MW-2	108-74-1	Chlorobenzene	09/02/1998	18	ug/l	50	3	
MW-2	108-74-1	Chlorobenzene	02/22/1999	21	ug/l	50	3	
MW-2	108-74-1	Chlorobenzene	08/24/1999	25	ug/l	50	3	
MW-2	108-74-1	Chlorobenzene	02/10/2000	16	ug/l	50	3	
MW-2	108-74-1	Chlorobenzene	08/02/2000	14	ug/l	50	3	
MW-2	108-74-1	Chlorobenzene	02/08/2001	30	ug/l	50	3	
MW-2	108-74-1	Chlorobenzene	08/09/2001	14	ug/l	50	3	
MW-2	108-74-1	Chlorobenzene	02/14/2002	11	ug/l	50	3	
MW-2	108-74-1	Chlorobenzene	09/19/2002	9	ug/l	50	3	
MW-2	108-74-1	Chlorobenzene	02/05/2003	10.5	ug/l	50	3	
MW-2	108-74-1	Chlorobenzene	08/14/2003	9.2	ug/l	50	3	
MW-2	108-74-1	Chlorobenzene	02/19/2004	7	ug/l	50	3	
MW-2	108-74-1	Chlorobenzene	08/25/2004	6.6	ug/l	50	3	
MW-2	108-74-1	Chlorobenzene	02/21/2005	8.4	ug/l	50	3	
MW-2	108-74-1	Chlorobenzene	08/08/2005	9	ug/l	50	3	
MW-2	108-74-1	Chlorobenzene	02/23/2006	10.8	ug/l	50	3	
MW-2	108-74-1	Chlorobenzene	08/28/2006	12.3	ug/l	50	3	
MW-2	108-74-1	Chlorobenzene	02/06/2007	11.4	ug/l	50	3	
MW-2	108-74-1	Chlorobenzene	02/11/2008	13.7	ug/l	50	3	
MW-2	108-74-1	Chlorobenzene	08/28/2008	13.2	ug/l	50	3	
MW-2	108-74-1	Chlorobenzene	02/17/2009	12.2	ug/l	50	3	
MW-2	108-74-1	Chlorobenzene	08/06/2009	11.4	ug/l	50	3	
MW-2	108-74-1	Chlorobenzene	02/16/2010	13.6	ug/l	50	3	
MW-2	108-74-1	Chlorobenzene	08/12/2010	15.6	ug/l	50	3	
MW-2	108-74-1	Chlorobenzene	02/08/2011	23.7	ug/l	50	3	
MW-2	74-87-3	Chloromethane	08/12/2010	0.38	ug/l	3	1	
MW-2	156-59-2	cis-1,2-Dichloroethene	02/11/2008	0.2	ug/l	70	5	
MW-2	156-59-2	cis-1,2-Dichloroethene	02/17/2009	0.29	ug/l	70	5	
MW-2	156-59-2	cis-1,2-Dichloroethene	08/06/2009	0.2	ug/l	70	5	
MW-2	**60-57-1**	**Dieldrin**	**02/08/2001**	**0.12**	**ug/l**	**0.002**	**0.075**	**0.118**
MW-2	78-83-1	Isobutanol	08/12/2010	216	ug/l	NE	100	
MW-2	78-83-1	Isobutanol	02/08/2011	143	ug/l	NE	100	
MW-2	108-88-3	Toluene	02/11/2008	0.2	ug/l	600	1	
MW-3	71-43-2	Benzene	08/04/2009	0.3	ug/l	1	1	
MW-3	**117-81-7**	**Bis(2-ethylhexyl)phthalate**	**03/12/1998**	**33**	**ug/l**	**3**	**15**	**30**
MW-3	**117-81-7**	**Bis(2-ethylhexyl)phthalate**	**02/22/1999**	**10**	**ug/l**	**3**	**15**	**7**
MW-3	74-87-3	Chloromethane	08/12/2010	0.37	ug/l	3	1	
MW-3	7439-97-6	Mercury	02/11/2008	0.05	ug/l	1	0.2	
MW-3	108-88-3	Toluene	08/04/2009	0.6	ug/l	600	1	

Table 5: Historic Organic Groundwater Results

Well ID	CAS NO	Parameter Name	Sample Date	Result	Unit	NCGW2L[1]	SWSL[2]	Exceedance
MW-4	75-34-3	1,1-Dichloroethane	01/05/1995	6	ug/l	6	5	
MW-4	75-34-3	1,1-Dichloroethane	07/18/1995	5	ug/l	6	5	
MW-4	**106-46-7**	**1,4-Dichlorobenzene**	**02/10/2000**	**9**	**ug/l**	**6**	**1**	**3**
MW-4	94-75-7	2,4-D Acid	02/08/2001	4	ug/l	70	2	
MW-4	67-64-1	Acetone	02/11/2008	2.2	ug/l	6000	100	
MW-4	67-64-1	Acetone	08/12/2010	3.7	ug/l	6000	100	
MW-4	75-15-0	Carbon disulfide	08/28/2008	1.4	ug/l	700	100	
MW-4	108-74-1	Chlorobenzene	02/10/2000	7.3	ug/l	50	3	
MW-4	67-66-3	Chloroform	02/11/2008	0.3	ug/l	70	5	
MW-4	67-66-3	Chloroform	02/17/2009	0.21	ug/l	70	5	
MW-4	67-66-3	Chloroform	02/17/2010	0.14	ug/l	70	5	
MW-4	67-66-3	Chloroform	08/12/2010	0.14	ug/l	70	5	
MW-4	67-66-3	Chloroform	02/08/2011	0.21	ug/l	70	5	
MW-4	74-87-3	Chloromethane	08/12/2010	0.73	ug/l	3	1	
MW-4	**60-57-1**	**Dieldrin**	**02/14/2002**	**0.45**	**ug/l**	**0.002**	**0.075**	**0.448**
MW-4	959-98-8	Endosulfan I	02/22/1999	0.11	ug/l	40	0.1	
MW-4	100-41-4	Ethylbenzene	02/10/2000	5.4	ug/l	600	1	
MW-5	67-64-1	Acetone	02/11/2008	5.3	ug/l	6000	100	
MW-5	67-64-1	Acetone	08/12/2010	3.7	ug/l	6000	100	
MW-5	74-87-3	Chloromethane	02/09/2011	0.14	ug/l	3	1	
MW-6	75-34-3	1,1-Dichloroethane	08/12/2010	0.55	ug/l	6	5	
MW-6	95-50-1	1,2-Dichlorobenzene	08/12/2010	0.37	ug/l	20	5	
MW-6	**106-46-7**	**1,4-Dichlorobenzene**	**09/08/1994**	**16**	**ug/l**	**6**	**1**	**10**
MW-6	**106-46-7**	**1,4-Dichlorobenzene**	**10/20/1994**	**11**	**ug/l**	**6**	**1**	**5**
MW-6	**106-46-7**	**1,4-Dichlorobenzene**	**01/05/1995**	**8**	**ug/l**	**6**	**1**	**2**
MW-6	**106-46-7**	**1,4-Dichlorobenzene**	**03/23/1995**	**10**	**ug/l**	**6**	**1**	**4**
MW-6	**106-46-7**	**1,4-Dichlorobenzene**	**07/18/1995**	**25**	**ug/l**	**6**	**1**	**19**
MW-6	**106-46-7**	**1,4-Dichlorobenzene**	**08/29/1996**	**8**	**ug/l**	**6**	**1**	**2**
MW-6	**106-46-7**	**1,4-Dichlorobenzene**	**08/27/1997**	**11**	**ug/l**	**6**	**1**	**5**
MW-6	**106-46-7**	**1,4-Dichlorobenzene**	**02/11/1998**	**6.2**	**ug/l**	**6**	**1**	**0.2**
MW-6	**106-46-7**	**1,4-Dichlorobenzene**	**03/12/1998**	**7.2**	**ug/l**	**6**	**1**	**1.2**
MW-6	**106-46-7**	**1,4-Dichlorobenzene**	**09/02/1998**	**7.2**	**ug/l**	**6**	**1**	**1.2**
MW-6	**106-46-7**	**1,4-Dichlorobenzene**	**02/22/1999**	**8.7**	**ug/l**	**6**	**1**	**2.7**
MW-6	**106-46-7**	**1,4-Dichlorobenzene**	**08/24/1999**	**12**	**ug/l**	**6**	**1**	**6**
MW-6	**106-46-7**	**1,4-Dichlorobenzene**	**08/02/2000**	**10**	**ug/l**	**6**	**1**	**4**
MW-6	**106-46-7**	**1,4-Dichlorobenzene**	**08/09/2001**	**10**	**ug/l**	**6**	**1**	**4**
MW-6	106-46-7	1,4-Dichlorobenzene	02/14/2002	5.1	ug/l	6	1	
MW-6	**106-46-7**	**1,4-Dichlorobenzene**	**08/22/2002**	**11**	**ug/l**	**6**	**1**	**5**
MW-6	106-46-7	1,4-Dichlorobenzene	02/05/2003	5.8	ug/l	6	1	
MW-6	106-46-7	1,4-Dichlorobenzene	08/12/2010	0.93	ug/l	6	1	
MW-6	67-64-1	Acetone	03/23/1995	145	ug/l	6000	100	
MW-6	67-64-1	Acetone	02/05/2003	107	ug/l	6000	100	
MW-6	67-64-1	Acetone	02/11/2008	3.5	ug/l	6000	100	
MW-6	71-43-2	Benzene	08/12/2010	0.46	ug/l	1	1	
MW-6	**319-84-6**	**BHC, alpha**	**02/05/2003**	**0.26**	**ug/l**	**NE**	**0.05**	
MW-6	**58-89-9**	**BHC, gamma**	**02/05/2003**	**0.67**	**ug/l**	**0.03**	**0.05**	**0.64**
MW-6	108-74-1	Chlorobenzene	03/23/1995	6	ug/l	50	3	
MW-6	108-74-1	Chlorobenzene	07/18/1995	10	ug/l	50	3	
MW-6	108-74-1	Chlorobenzene	02/20/1996	6	ug/l	50	3	
MW-6	108-74-1	Chlorobenzene	08/29/1996	8	ug/l	50	3	
MW-6	108-74-1	Chlorobenzene	02/04/1997	11	ug/l	50	3	
MW-6	108-74-1	Chlorobenzene	08/27/1997	9.9	ug/l	50	3	

Table 5: Historic Organic Groundwater Results

Well ID	CAS NO	Parameter Name	Sample Date	Result	Unit	NCGW2L[1]	SWSL[2]	Exceedance
MW-6	108-74-1	Chlorobenzene	03/12/1998	5.9	ug/l	50	3	
MW-6	108-74-1	Chlorobenzene	09/02/1998	6.5	ug/l	50	3	
MW-6	108-74-1	Chlorobenzene	08/24/1999	9.7	ug/l	50	3	
MW-6	108-74-1	Chlorobenzene	08/02/2000	11	ug/l	50	3	
MW-6	108-74-1	Chlorobenzene	02/08/2001	12	ug/l	50	3	
MW-6	108-74-1	Chlorobenzene	08/09/2001	9.7	ug/l	50	3	
MW-6	108-74-1	Chlorobenzene	08/22/2002	7.3	ug/l	50	3	
MW-6	108-74-1	Chlorobenzene	08/04/2009	0.45	ug/l	50	3	
MW-6	108-74-1	Chlorobenzene	08/12/2010	1.2	ug/l	50	3	
MW-6	74-87-3	Chloromethane	08/12/2010	1	ug/l	3	1	
MW-6	156-59-2	cis-1,2-Dichloroethene	08/04/2009	0.55	ug/l	70	5	
MW-6	156-59-2	cis-1,2-Dichloroethene	08/12/2010	0.57	ug/l	70	5	
MW-6	100-41-4	Ethylbenzene	09/08/1994	83	ug/l	600	1	
MW-6	100-41-4	Ethylbenzene	10/20/1994	61	ug/l	600	1	
MW-6	100-41-4	Ethylbenzene	01/05/1995	42	ug/l	600	1	
MW-6	100-41-4	Ethylbenzene	03/23/1995	104	ug/l	600	1	
MW-6	100-41-4	Ethylbenzene	07/18/1995	55	ug/l	600	1	
MW-6	100-41-4	Ethylbenzene	02/20/1996	31	ug/l	600	1	
MW-6	100-41-4	Ethylbenzene	02/04/1997	40	ug/l	600	1	
MW-6	100-41-4	Ethylbenzene	02/11/1998	10.6	ug/l	600	1	
MW-6	100-41-4	Ethylbenzene	03/12/1998	8.3	ug/l	600	1	
MW-6	100-41-4	Ethylbenzene	09/02/1998	7.1	ug/l	600	1	
MW-6	100-41-4	Ethylbenzene	02/22/1999	6.8	ug/l	600	1	
MW-6	**106-93-4**	**Ethylene dibromide**	**02/22/1999**	**6**	**ug/l**	**0.02**	**1**	**5.98**
MW-6	2037-26-5	Methylbenzene	03/23/1995	5	ug/l	NE	NE	
MW-6	**91-20-3**	**Naphthalene**	**07/18/1995**	**10**	**ug/l**	**6**	**10**	**4**
MW-6	91-20-3	Naphthalene	10/29/1998	5.4	ug/l	6	10	
MW-6	95-50-1	o-Dichlorobenzene	08/27/1997	5.1	ug/l	20	5	
MW-6	1330-20-7	Xylenes	09/08/1994	180	ug/l	500	5	
MW-6	1330-20-7	Xylenes	10/20/1994	104	ug/l	500	5	
MW-6	1330-20-7	Xylenes	01/05/1995	47	ug/l	500	5	
MW-6	1330-20-7	Xylenes	03/23/1995	141	ug/l	500	5	
MW-6	1330-20-7	Xylenes	07/18/1995	114	ug/l	500	5	
MW-6	1330-20-7	Xylenes	02/20/1996	52	ug/l	500	5	
MW-6	1330-20-7	Xylenes	08/29/1996	46	ug/l	500	5	
MW-6	1330-20-7	Xylenes	02/04/1997	133	ug/l	500	5	
MW-6	1330-20-7	Xylenes	08/27/1997	78	ug/l	500	5	
MW-6	1330-20-7	Xylenes	02/11/1998	66	ug/l	500	5	
MW-6	1330-20-7	Xylenes	03/12/1998	89	ug/l	500	5	
MW-6	1330-20-7	Xylenes	09/02/1998	43	ug/l	500	5	
MW-6	1330-20-7	Xylenes	02/22/1999	45	ug/l	500	5	
MW-6	1330-20-7	Xylenes	08/24/1999	96	ug/l	500	5	
MW-6	1330-20-7	Xylenes	08/02/2000	65	ug/l	500	5	
MW-6	1330-20-7	Xylenes	02/08/2001	48	ug/l	500	5	
MW-6	1330-20-7	Xylenes	08/09/2001	65	ug/l	500	5	
MW-6	1330-20-7	Xylenes	08/22/2002	21.5	ug/l	500	5	
MW-6	1330-20-7	Xylenes	02/05/2003	9.7	ug/l	500	5	
MW-7	67-64-1	Acetone	02/11/2008	6.5	ug/l	6000	100	
MW-7	74-87-3	Chloromethane	08/12/2010	0.29	ug/l	3	1	
MW-8	**75-34-3**	**1,1-Dichloroethane**	**09/08/1994**	**21**	**ug/l**	**6**	**5**	**15**
MW-8	**75-34-3**	**1,1-Dichloroethane**	**10/20/1994**	**12**	**ug/l**	**6**	**5**	**6**
MW-8	**75-34-3**	**1,1-Dichloroethane**	**01/05/1995**	**12**	**ug/l**	**6**	**5**	**6**

Table 5: Historic Organic Groundwater Results

Well ID	CAS NO	Parameter Name	Sample Date	Result	Unit	NCGW2L[1]	SWSL[2]	Exceedance
MW-8	**75-34-3**	**1,1-Dichloroethane**	**03/23/1995**	**14**	**ug/l**	**6**	**5**	**8**
MW-8	**75-34-3**	**1,1-Dichloroethane**	**07/18/1995**	**12**	**ug/l**	**6**	**5**	**6**
MW-8	**75-34-3**	**1,1-Dichloroethane**	**02/20/1996**	**10**	**ug/l**	**6**	**5**	**4**
MW-8	**75-34-3**	**1,1-Dichloroethane**	**08/29/1996**	**9**	**ug/l**	**6**	**5**	**3**
MW-8	75-34-3	1,1-Dichloroethane	02/04/1997	6	ug/l	6	5	
MW-8	75-34-3	1,1-Dichloroethane	02/11/1998	5.1	ug/l	6	5	
MW-8	75-34-3	1,1-Dichloroethane	02/11/2008	0.4	ug/l	6	5	
MW-8	**106-46-7**	**1,4-Dichlorobenzene**	**09/08/1994**	**24**	**ug/l**	**6**	**1**	**18**
MW-8	**106-46-7**	**1,4-Dichlorobenzene**	**01/05/1995**	**16**	**ug/l**	**6**	**1**	**10**
MW-8	**106-46-7**	**1,4-Dichlorobenzene**	**03/23/1995**	**29**	**ug/l**	**6**	**1**	**23**
MW-8	**106-46-7**	**1,4-Dichlorobenzene**	**07/18/1995**	**45**	**ug/l**	**6**	**1**	**39**
MW-8	**106-46-7**	**1,4-Dichlorobenzene**	**08/27/1997**	**32**	**ug/l**	**6**	**1**	**26**
MW-8	**106-46-7**	**1,4-Dichlorobenzene**	**02/11/1998**	**34**	**ug/l**	**6**	**1**	**28**
MW-8	**106-46-7**	**1,4-Dichlorobenzene**	**03/12/1998**	**32**	**ug/l**	**6**	**1**	**26**
MW-8	**106-46-7**	**1,4-Dichlorobenzene**	**09/02/1998**	**21**	**ug/l**	**6**	**1**	**15**
MW-8	**106-46-7**	**1,4-Dichlorobenzene**	**02/22/1999**	**29**	**ug/l**	**6**	**1**	**23**
MW-8	**106-46-7**	**1,4-Dichlorobenzene**	**08/24/1999**	**32**	**ug/l**	**6**	**1**	**26**
MW-8	**106-46-7**	**1,4-Dichlorobenzene**	**08/02/2000**	**28**	**ug/l**	**6**	**1**	**22**
MW-8	**106-46-7**	**1,4-Dichlorobenzene**	**08/09/2001**	**29**	**ug/l**	**6**	**1**	**23**
MW-8	**106-46-7**	**1,4-Dichlorobenzene**	**02/14/2002**	**28**	**ug/l**	**6**	**1**	**22**
MW-8	**106-46-7**	**1,4-Dichlorobenzene**	**08/22/2002**	**28.4**	**ug/l**	**6**	**1**	**22.4**
MW-8	**106-46-7**	**1,4-Dichlorobenzene**	**02/05/2003**	**22.7**	**ug/l**	**6**	**1**	**16.7**
MW-8	**106-46-7**	**1,4-Dichlorobenzene**	**08/14/2003**	**11.3**	**ug/l**	**6**	**1**	**5.3**
MW-8	**106-46-7**	**1,4-Dichlorobenzene**	**02/19/2004**	**31.4**	**ug/l**	**6**	**1**	**25.4**
MW-8	**106-46-7**	**1,4-Dichlorobenzene**	**08/25/2004**	**30.1**	**ug/l**	**6**	**1**	**24.1**
MW-8	**106-46-7**	**1,4-Dichlorobenzene**	**02/21/2005**	**24.7**	**ug/l**	**6**	**1**	**18.7**
MW-8	**106-46-7**	**1,4-Dichlorobenzene**	**08/08/2005**	**23.1**	**ug/l**	**6**	**1**	**17.1**
MW-8	**106-46-7**	**1,4-Dichlorobenzene**	**02/23/2006**	**14.4**	**ug/l**	**6**	**1**	**8.4**
MW-8	**106-46-7**	**1,4-Dichlorobenzene**	**08/28/2006**	**10.7**	**ug/l**	**6**	**1**	**4.7**
MW-8	**106-46-7**	**1,4-Dichlorobenzene**	**02/06/2007**	**9.2**	**ug/l**	**6**	**1**	**3.2**
MW-8	106-46-7	1,4-Dichlorobenzene	02/11/2008	5.4	ug/l	6	1	
MW-8	106-46-7	1,4-Dichlorobenzene	08/28/2008	3.1	ug/l	6	1	
MW-8	106-46-7	1,4-Dichlorobenzene	02/17/2009	2.5	ug/l	6	1	
MW-8	106-46-7	1,4-Dichlorobenzene	08/06/2009	3.6	ug/l	6	1	
MW-8	106-46-7	1,4-Dichlorobenzene	02/17/2010	0.64	ug/l	6	1	
MW-8	106-46-7	1,4-Dichlorobenzene	08/12/2010	0.67	ug/l	6	1	
MW-8	106-46-7	1,4-Dichlorobenzene	02/08/2011	1.6	ug/l	6	1	
MW-8	94-75-7	2,4-D Acid	02/19/2004	2.62	ug/l	70	2	
MW-8	67-64-1	Acetone	02/11/2008	4.6	ug/l	6000	100	
MW-8	**71-43-2**	**Benzene**	**07/18/1995**	**6**	**ug/l**	**1**	**1**	**5**
MW-8	71-43-2	Benzene	02/11/2008	0.2	ug/l	1	1	
MW-8	**117-81-7**	**Bis(2-ethylhexyl)phthalate**	**02/19/2004**	**37**	**ug/l**	**3**	**15**	**34**
MW-8	108-74-1	Chlorobenzene	09/08/1994	40	ug/l	50	3	
MW-8	108-74-1	Chlorobenzene	10/20/1994	15	ug/l	50	3	
MW-8	108-74-1	Chlorobenzene	01/05/1995	32	ug/l	50	3	
MW-8	108-74-1	Chlorobenzene	03/23/1995	40	ug/l	50	3	
MW-8	**108-74-1**	**Chlorobenzene**	**07/18/1995**	**56**	**ug/l**	**50**	**3**	**6**
MW-8	108-74-1	Chlorobenzene	02/20/1996	33	ug/l	50	3	
MW-8	108-74-1	Chlorobenzene	08/29/1996	24	ug/l	50	3	
MW-8	108-74-1	Chlorobenzene	02/04/1997	30	ug/l	50	3	
MW-8	108-74-1	Chlorobenzene	08/27/1997	29	ug/l	50	3	
MW-8	108-74-1	Chlorobenzene	02/11/1998	28	ug/l	50	3	

Table 5: Historic Organic Groundwater Results

Well ID	CAS NO	Parameter Name	Sample Date	Result	Unit	NCGW2L[1]	SWSL[2]	Exceedance
MW-8	108-74-1	Chlorobenzene	03/12/1998	26	ug/l	50	3	
MW-8	108-74-1	Chlorobenzene	09/02/1998	16	ug/l	50	3	
MW-8	108-74-1	Chlorobenzene	02/22/1999	19	ug/l	50	3	
MW-8	108-74-1	Chlorobenzene	08/24/1999	18	ug/l	50	3	
MW-8	108-74-1	Chlorobenzene	08/02/2000	14	ug/l	50	3	
MW-8	108-74-1	Chlorobenzene	02/08/2001	13	ug/l	50	3	
MW-8	108-74-1	Chlorobenzene	08/09/2001	15	ug/l	50	3	
MW-8	108-74-1	Chlorobenzene	02/14/2002	15	ug/l	50	3	
MW-8	108-74-1	Chlorobenzene	08/22/2002	12.9	ug/l	50	3	
MW-8	108-74-1	Chlorobenzene	02/05/2003	9.9	ug/l	50	3	
MW-8	108-74-1	Chlorobenzene	02/19/2004	11.9	ug/l	50	3	
MW-8	108-74-1	Chlorobenzene	08/25/2004	12	ug/l	50	3	
MW-8	108-74-1	Chlorobenzene	02/21/2005	9.6	ug/l	50	3	
MW-8	108-74-1	Chlorobenzene	08/08/2005	8.7	ug/l	50	3	
MW-8	108-74-1	Chlorobenzene	02/06/2007	3.2	ug/l	50	3	
MW-8	108-74-1	Chlorobenzene	02/11/2008	1.5	ug/l	50	3	
MW-8	108-74-1	Chlorobenzene	08/28/2008	0.91	ug/l	50	3	
MW-8	108-74-1	Chlorobenzene	02/17/2009	0.65	ug/l	50	3	
MW-8	108-74-1	Chlorobenzene	08/06/2009	0.94	ug/l	50	3	
MW-8	108-74-1	Chlorobenzene	02/08/2011	0.36	ug/l	50	3	
MW-8	**75-01-4**	**Chloroethene**	**09/08/1994**	**13**	**ug/l**	**0.03**	**1**	**12.97**
MW-8	**75-01-4**	**Chloroethene**	**10/20/1994**	**11**	**ug/l**	**0.03**	**1**	**10.97**
MW-8	**75-01-4**	**Chloroethene**	**07/18/1995**	**10**	**ug/l**	**0.03**	**1**	**9.97**
MW-8	**75-01-4**	**Chloroethene**	**02/20/1996**	**13**	**ug/l**	**0.03**	**1**	**12.97**
MW-8	74-87-3	Chloromethane	08/12/2010	0.45	ug/l	3	1	
MW-8	156-59-2	cis-1,2-Dichloroethylene	01/05/1995	6	ug/l	70	5	
MW-8	156-59-2	cis-1,2-Dichloroethylene	07/18/1995	5	ug/l	70	5	
MW-8	33213-65-9	Endosulfan II	02/08/2001	0.21	ug/l	42	0.1	
MW-8	7439-97-6	Mercury	02/11/2008	0.82	ug/l	1	0.2	
MW-8	156-60-5	trans-1,2-Dichloroethylene	08/27/1997	5.3	ug/l	100	5	
MW-9	67-64-1	Acetone	07/23/2009	4.8	ug/l	6000	100	
MW-9	74-87-3	Chloromethane	08/12/2010	0.59	ug/l	3	1	

NOTE:
[1] NCGW2L = North Carolina Ground Water 2L Standard
[2] SWSL = Solid Waste Section Limit

Table 6: MNA Parameter Summary

Parameters	Date	VFA – Acetic Acid (mg/l)	VFA – Butyric Acid (mg/l)	VFA – Lactic Acid (mg/l)	VFA – Propionic Acid (mg/l)	VFA – Pyruvic Acid (mg/l)	Hydrogen (nM)	Methane (ug/l)	Ethene (ug/l)	Ethane (ug/l)
MW-1	08/06/2009	<1	<1	<25	<100	<10	1.8*	0.045	0.011	<0.01
	02/17/2010	<0.070	<0.070	0.130	<0.070	<0.070	0.7*	0.063	<0.010	<0.010
	08/12/2010	0.110	<0.050	<0.100	<0.050	<0.150	13.0	0.036	0.025	0.006
	02/08/2011	0.053	<0.050	0.150	0.074	<0.150	7.7	0.023	0.029	0.003
MW-2	08/06/2009	<1	<1	<25	<100	<10	1400*	4700	0.013	0.8
	02/17/2010	0.064	<0.070	0.230	0.095	<0.070	1.700	2200	0.014	0.920
	08/12/2010	0.045	<0.050	0.130	<0.050	<150	3.4	5100	0.008	2.2
	02/08/2011	0.094	0.120	0.230	<0.050	0.100	8.5	4600	<0.010	6.2
MW-8	08/06/2009	<1	<1	<25	<100	<10	140*	3.9	0.007	0.003
	02/17/2010	<0.070	<0.070	0.086	<0.070	<0.070	0.580	0.200	<0.010	<0.010
	08/12/2010	0.019	<0.050	0.038	<0.050	<0.150	7.7	0.260	0.018	0.004
	02/08/2011	0.063	<0.050	0.340	<0.050	0.100	11	0.76	<0.010	<0.01

Parameters	Date	CO2-Dissolved (mg/l)	Alkalinity (ug/l)	Sulfate (ug/l)	Sulfide (ug/l)	Chloride (ug/l)	TOC (ug/l)	COD (ug/l)	BOD (ug/l)	Iron (ug/l)
MW-1	08/06/2009	20	<5000	6360	<100	<5000	1900	<25000	<2000	550
	02/17/2010	20	<5000	<5000	<100	<5000	2410	721000	<2000	527
	08/12/2010	30	8300	<5000	<100	6400	9950	<25000	<2000	2790
	02/08/11	20	5710	<5000	<100	<5000	18400	57000	<2000	3580
MW-2	08/06/2009	>100	652000	27100	<100	47000 π	44000	85900	12600	50100
	02/17/2010	>100	496000	12600	<100	62000 π	42100	71000	7020	45400
	08/12/2010	>100	579000	32100	<100	67100 π	51400¥	88000	17700	47600
	02/08/2011	>100	552000	85800	<100	82700 Ж	50100	123000	6150	53000
MW-8	08/06/2009	>100	<5000	<5000	<100	14700	5400	<25000	<2000	9680
	02/17/2010	<100	<5000	<5000	<100	14900	15400	<25000	<2000	2330
	08/12/2010	>100	<5000	<5000	<100	9510	18500	<25000	<2000	9680
	02/08/2011	>100	<5000	<5000	<100	9510	17500	<25000	<2000	1620

Table 6: MNA Parameter Summary

Parameters	Date	Nitrate (ug/l)	Temperature (Degrees C)	ORP (mV)	DO (mg/l)	pH (Std Units)	Specific Conductance (us/cm)	Turbidity (NTU)
MW-1	08/06/2009	447	21.7	270	6.9	5.13	30	11.9
	02/17/2010	777	13.5	281	6.9	5.15	31	17
	08/12/2010	123	20.9	167	6.5	5.9	53	14.6
	02/08/2011	<100	14.8	367	6.4	5	12	19.7
MW-2	08/06/2009	257	24.1	193	0.9	6.45	1890	13.8
	02/17/2010	126	8.9	-36	0.9	6.63	1215	14.6
	08/12/2010	164	21.9	-46	2.5	6.46	1192	15.2
	02/08/2011	<100	11.5	-38	0.7	6.57	1245	21.3
MW-8	08/06/2009	204	20.2	242	0.9	4.65	90	76.3
	02/17/2010	668	12.9	324	0.9	4.63	59	81.3
	08/12/2010	559	17.8	265	2.1	4.54	26	10.7
	02/08/2011	794	16.6	390	1.7	4.73	54	9.81

Notes:
VFA = Volatile Fatty Acids
Constituents Below Quantitation Limit are shown as < MDL value
>100 = CO2 Concentration Exceeds Maximum capability of Method Used
* Hydrogen artificially elevated due to use of steel washer on sampling device 8/6/09
П – Chloride in MW-2 used a 2x dilution (mdl = 10000)
¥ TOC in MW-2 used a 2x dilution (mdl=2000)
Ж– Chloride in MW-2 used a 10x dilution (mdl = 50000)

Table 7: Reductive Dechlorination Assessment

Well	Tetrachloroethene (Perchloroethene – PCE)				Trichloroethene (TCE)				1,1-Dichloroethene (1,1-DCE)				cis-1,2-Dichlorethene (cis-1,2 DCE)				Vinyl Chloride (VC)			
	Aug-09	Feb-10	Aug-10	Feb-11	Aug-09	Feb-10	Aug-10	Feb-11	Aug-09	Feb-10	Aug-10	Feb-11	Aug-09	Feb-10	Aug-10	Feb-11	Aug-09	Feb-10	Aug-10	Feb-11
MW-1	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL
MW-2	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	0.20	BQL	BQL	BQL	BQL	BQL	BQL	BQL
MW-11	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	0.43	0.32	0.28	0.32	BQL	BQL	BQL	BQL
MW-8	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL
MW-9	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL
MW-10	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL	BQL

Well	Ethene (ETH)				Ethane (ETH)			
	Aug-09	Feb-10	Aug-10	Feb-11	Aug-09	Feb-10	Aug-10	Feb-11
MW-1	0.011	BQL	0.025	0.029	BQL	BQL	0.006	0.003
MW-2	0.013	0.014	0.008	BQL	0.8	0.92	2.20	6.20
MW-11	NS	NS	NS	NS	NS	NS	NS	NS
MW-8	0.007	BQL	0.018	BQL	0.003	BQL	0.004	BQL
MW-9	NS	NS	NS	NS	NS	NS	NS	NS
MW-10	NS	NS	NS	NS	NS	NS	NS	NS

Notes:
1. The selected chlorinated solvents consist of the target parent compound and several target daughter compounds.
2. Analytes were analyzed per EPA Test Method 8260. Detections are presented in micrograms per liter (µg/L).
3. BQL = Below Quantitation Limit
4. Red Text identifies an increase in concentration when compared to the prior event.
5. Green Text identifies a decrease in concentrations when compared to the prior event.

Table 8: Natural Attenuation Properties

Well	Oxygen (DO)				Nitrate (NO3)				Ferrious Iron (Fe2+)				Sulfate (SO4)				Methane			
	Aug-09	Feb-10	Aug-10	Feb-11	Aug-09	Feb-10	Aug-10	Feb-11	Aug-09	Feb-10	Aug-10	Feb-11	Aug-09	Feb-10	Aug-10	Feb-11	Aug-09	Feb-10	Aug-10	Feb-11
MW-1	6.90	6.90	6.50	6.40	447	777	123	BQL	550	527	2790	3580	6360	BQL	BQL	BQL	0.045	0.063	0.036	0.023
MW-2	0.90	0.90	2.50	0.70	257	126	164	BQL	50100	45400	47600	53000	27100	12600	32100	85800	4700	2200	5100	4600
MW-11	2.53	1.90	1.80	1.60	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
MW-8	0.90	0.90	2.10	1.70	204	668	559	794	9680	2330	9680	1620	BQL	BQL	BQL	BQL	3.9	0.2	0.260	0.76
MW-9	3.81	4.80	4.70	4.50	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
MW-10	5.59	5.90	4.50	4.60	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

Note:
1. The selected parameters consist of target properties to help identify the attenuation environment.
2. Analytes were analyzed in accordance with the appropriate method, listed on Table 1.
3. DO detections are presented in milligrams per liter (mg/L); all others are presented in micrograms per liter (ug/L).
4. BQL = Below Quantitation Limit.
5. NS = Not Sampled.
6. Red Text identifies an increase in concentration when compared to the prior event.
7. Green Text identifies a decrease in concentrations when compared to the prior event.

Table 9: Timeline / Schedule of Corrective Action

Date	Description of Event
February 2011	Semi-Annual Assessment Sampling & Monitoring.
May 2011	Initial Summary Report.
August 2011	Semi-Annual Assessment Sampling & Monitoring.
February 2012	Semi-Annual Assessment Sampling & Monitoring.
August 2012	Semi-Annual Assessment Sampling & Monitoring.
February 2013	Semi-Annual Assessment Sampling & Monitoring.
August 2013	Semi-Annual Assessment Sampling & Monitoring.
February 2014	Semi-Annual Assessment Sampling & Monitoring.
May 2014	Summary Report.

PLATES

Topographic Map with Site Location

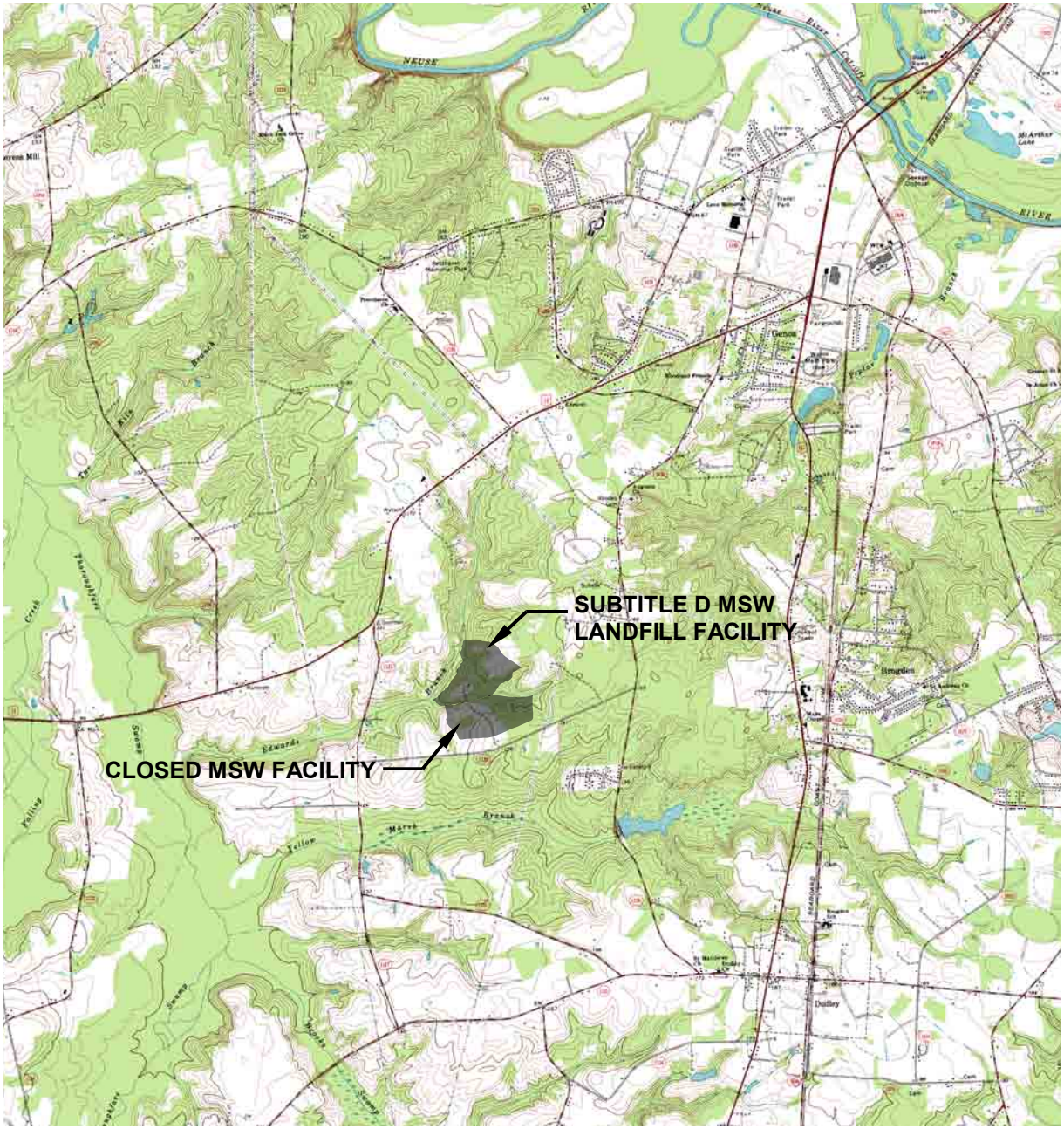
Corrective Action Evaluation Report

Wayne County Dudley

Date Completed	03/22/2011
Created By	M. German
Project Name	Corrective Action Evaluation Report
Site Name	Wayne County Dudley
Project Number	G11050.0

Municipal Engineering Services Company, PA

PLATE 1



QUADRANGLE LEGEND

1 0 1 MILE

N

ROAD CLASSIFICATION

Primary highway, hard surface

Light-duty road, hard or improved surface

Secondary highway, hard surface

Unimproved road

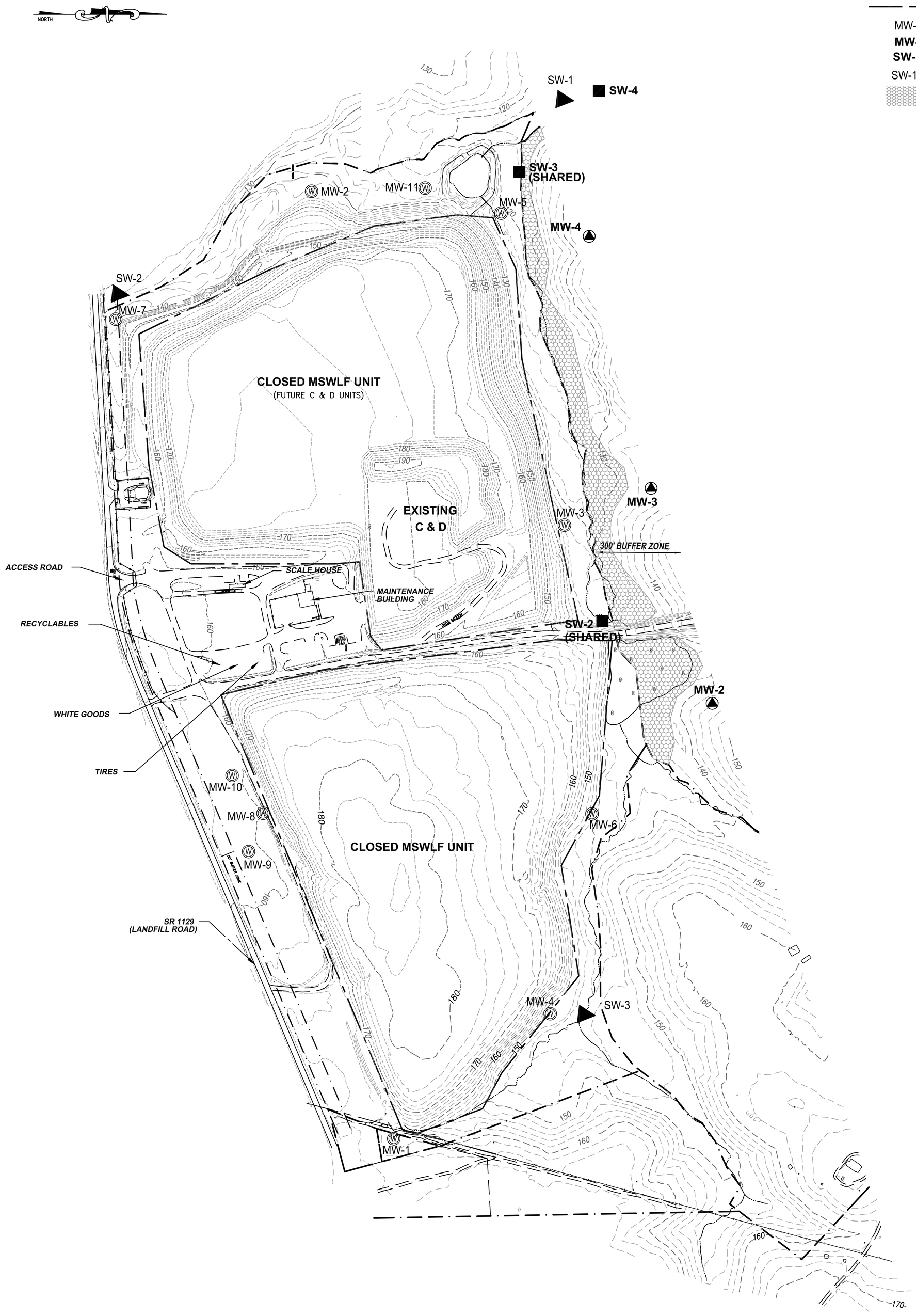
Interstate Route

U. S. Route

State Route

LEGEND

- EXISTING CONTOURS
- PROPERTY LINE
- EXISITING UNPAVED ROAD
- EXISTING CREEK, STREAM, ETC.
- EXISTING DIVERSION DITCHES
- CLOSED MSWLF SANITARY UNIT
- MW-7 — MONITORING WELLS C&D LANDFILL
- MW-1 — MONITORING WELLS SUBTITLE D
- SW-5 — SURFACE WATER SAMPLING SUBTITLE D
- SW-1 — SURFACE WATER SAMPLING C&D
- WETLANDS



GRAPHIC SCALE

200 0 100 200 400 800

(IN FEET)
1 inch = 200 ft.

PLATE 2

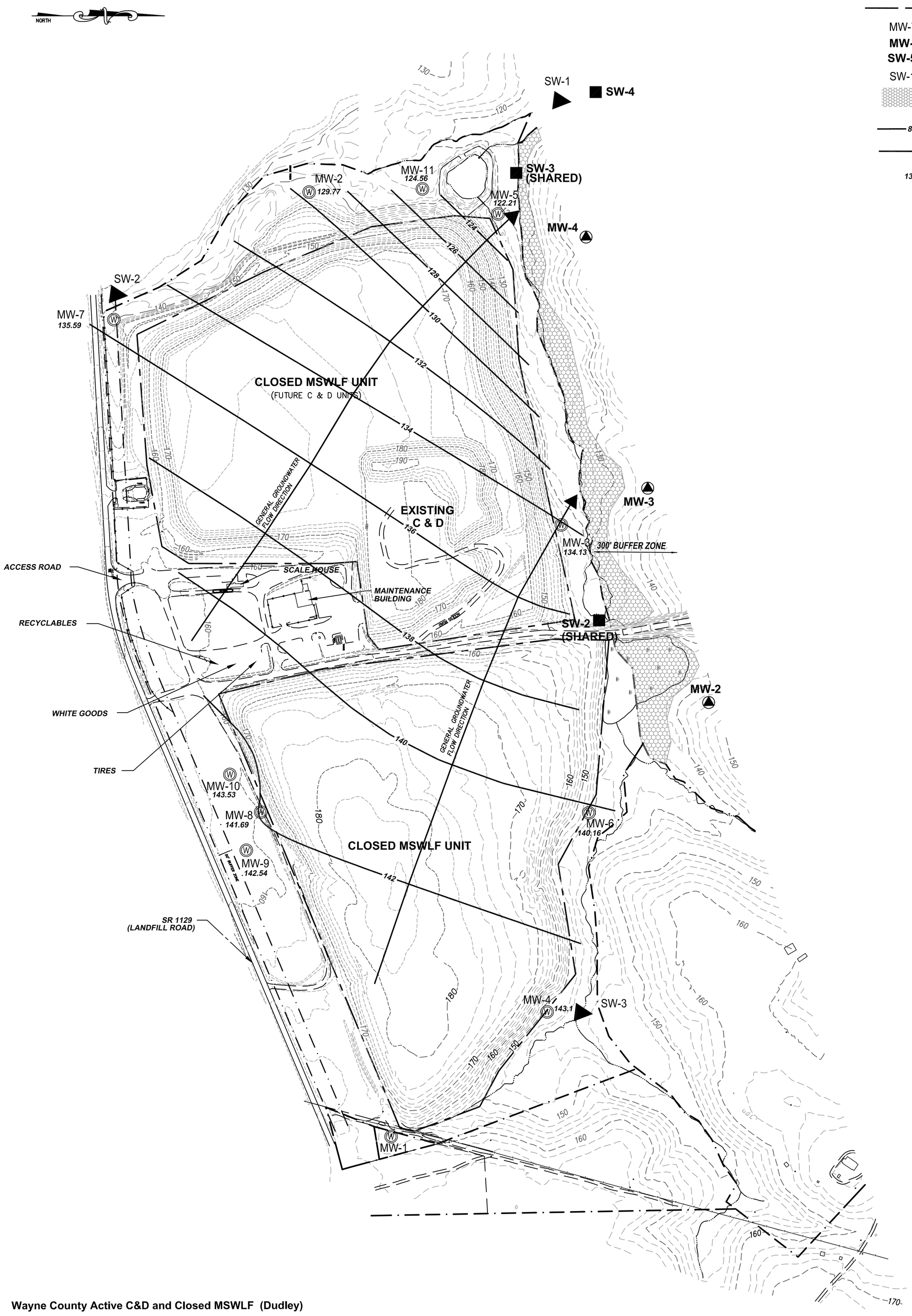
DRAWING NO.	PLATE 2
SHEET NO.	1 OF 1
PROJECT NUMBER	G11050.0
CHKD. BY:	M. GERMAN
DRWN. BY:	M. GERMAN
DATE:	04/25/2011
SCALE:	1" = 200'

DATE	BY	REV.	DESCRIPTION

SITE MAP
WITH SAMPLING LOCATIONS

MUNICIPAL SOLID WASTE LANDFILL FACILITY
WAYNE COUNTY NORTH CAROLINA

LICENSE NUMBER: C-0281
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
P.O. BOX 828 MOREHEAD CITY, N.C. 28557 (252) 726-9481



LEGEND

	EXISTING CONTOURS
	PROPERTY LINE
	EXISITING UNPAVED ROAD
	EXISTING CREEK, STREAM, ETC.
	EXISTING DIVERSION DITCHES
	CLOSED MSWLF SANITARY UNIT
MW-7	MONITORING WELLS C&D LANDFILL
MW-1	MONITORING WELLS SUBTITLE D
SW-5	SURFACE WATER SAMPLING SUBTITLE D
SW-1	SURFACE WATER SAMPLING C&D
	WETLANDS
80	GROUNDWATER CONTOUR
	GENERAL GROUNDWATER FLOW DIRECTION
135.59	GROUNDWATER ELEVATION

Wayne County Active C&D and Closed MSWLF (Dudley)

February 9, 2011

WELL #	TOP OF PIPE ELEVATION (FT AMSL)	DEPTH TO WATER (FT BTOC)	WATER ELEVATION (FT AMSL)
MW-1	-	19.64*	-
MW-2	134.52	4.75	129.77
MW-3	134.81	0.68	134.13
MW-4	150.20	7.10	143.10
MW-5	124.78	2.57	122.21
MW-6	145.53	5.37	140.16
MW-7	143.59	8.00	135.59
MW-8	161.88	20.19	141.69
MW-9	162.96	20.42	142.54
MW-10	162.90	19.37	143.53
MW-11	127.23	2.67	124.56

* MW-1: Needs re-survey due to repairs

GRAPHIC SCALE

200 0 100 200 400 800

(IN FEET)
1 inch = 200 ft.

PLATE 3

DRAWING NO.	PLATE 3
SHEET NO.	1 OF 1
PROJECT NUMBER	G11050.0
CHK'D. BY:	M. GERMAN
DRWN. BY:	M. GERMAN
DATE:	05/05/2011
SCALE:	1" = 200'

DATE	BY	REV.	DESCRIPTION

SINGLE DAY POTENTIOMETRIC SURFACE MAP (FEBRUARY 2011)

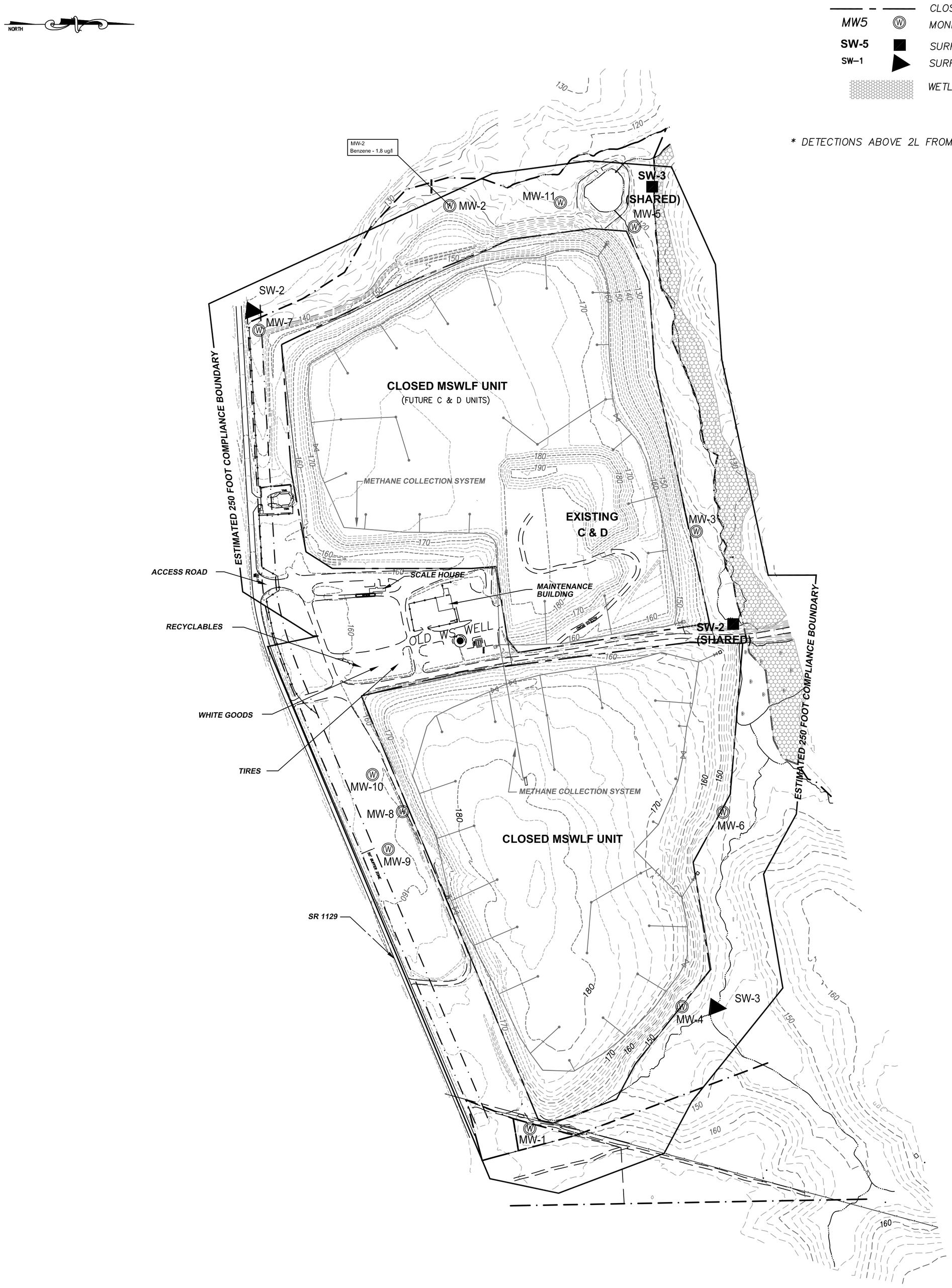
MUNICIPAL SOLID WASTE LANDFILL FACILITY
WAYNE COUNTY NORTH CAROLINA

LICENSE NUMBER: C-0281
Municipal Services
P.O. BOX 97 GARNER, N.C. 27529
(919) 772-5393
Engineering Company, P.A.
P.O. BOX 349 BOONE, N.C. 28607
(828) 262-1767
P.O. BOX 828 MOREHEAD CITY, N.C. 28557
(252) 726-9481

LEGEND

- EXISTING CONTOURS
- PROPERTY LINE
- EXISITING UNPAVED ROAD
- EXISTING CREEK, STREAM, ETC.
- EXISTING DIVERSION DITCHES
- CLOSED MSWLF SANITARY UNIT
- MW5 — MONITORING WELLS C&D LANDFILL
- SW-5 — SURFACE WATER SAMPLING SUBTITLE D
- SW–1 — SURFACE WATER SAMPLING C&D
- WETLANDS

* DETECTIONS ABOVE 2L FROM 02–08–11 SAMPLING EVENT



GRAPHIC SCALE

200 0 100 200 400 800

(IN FEET)
1 inch = 200 ft.

PLATE 4

DRAWING NO.	PLATE 4
SHEET NO.	1 OF 1
PROJECT NUMBER	G11050.0
CHKD. BY:	M. BROWN
DRWN. BY:	M. GERMAN
DATE:	4/10/2011
SCALE:	1" = 200'

DATE	BY	REV.	DESCRIPTION

VOC CONCENTRATIONS
ABOVE 2L – FEBRUARY 2011

MUNICIPAL SOLID WASTE LANDFILL FACILITY
WAYNE COUNTY NORTH CAROLINA

LICENSE NUMBER: C–0281
Municipal Services
P.O. BOX 97 GARNER, N.C. 27529
(919) 772-5393
Engineering Company, P.A.
P.O. BOX 349 BOONE, N.C. 28607
(828) 262-1767
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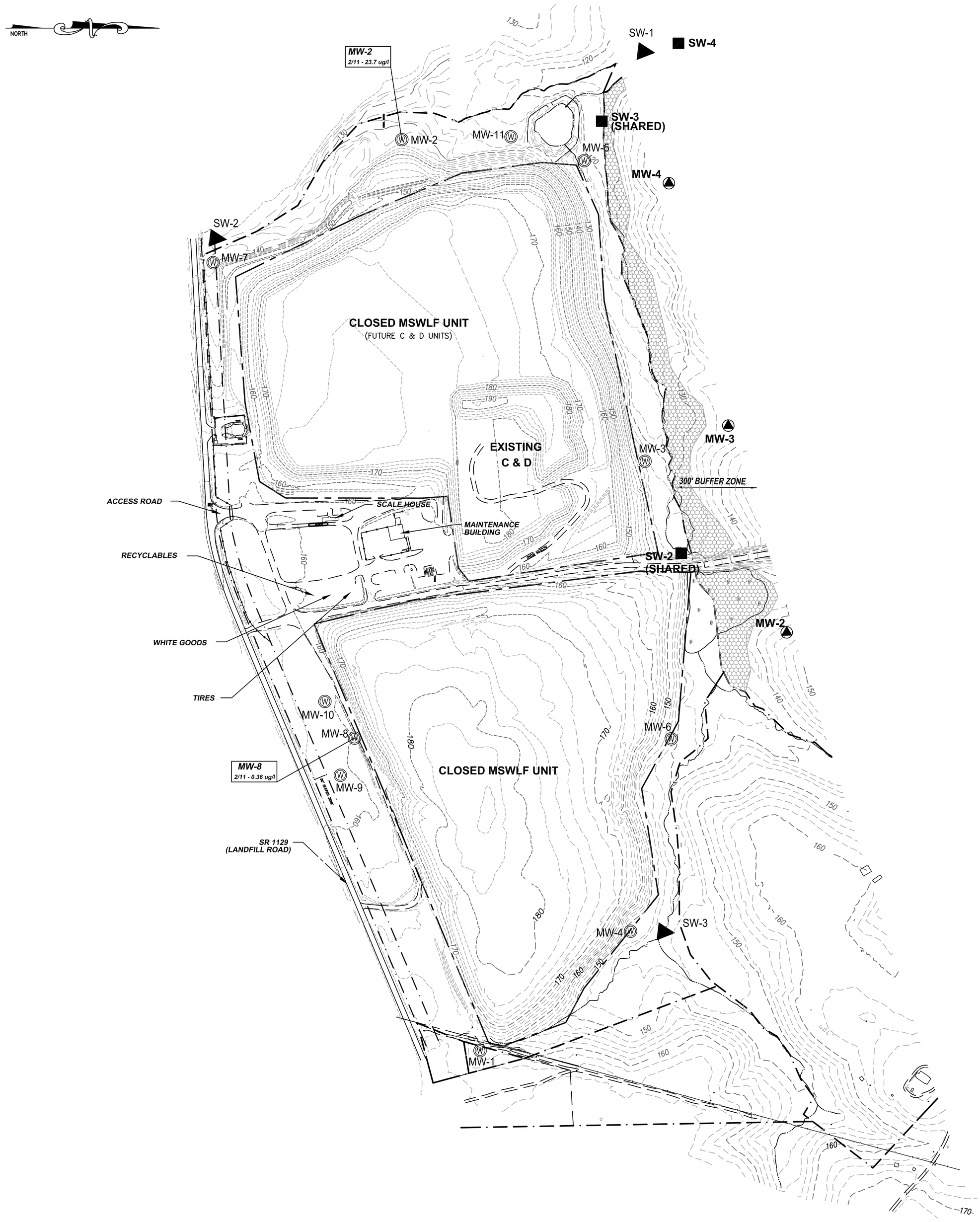
(252) 726-9481



LEGEND

- EXISTING CONTOURS
- PROPERTY LINE
- EXISITING UNPAVED ROAD
- EXISTING CREEK, STREAM, ETC.
- EXISTING DIVERSION DITCHES
- CLOSED MSWLF SANITARY UNIT
- MW-7 — MONITORING WELLS C&D LANDFILL
- MW-1 — MONITORING WELLS SUBTITLE D
- SW-5 — SURFACE WATER SAMPLING SUBTITLE D
- SW-1 — SURFACE WATER SAMPLING C&D
- WETLANDS
- 0.36 ug/l — CHLOROBENZENE CONCENTRATION
- APPROXIMATE CHLOROBENZENE INFLUENCE ABOVE 2L

** NOTE: 2L STANDARD FOR CHLOROBENZENE IS 50 ug/l

GRAPHIC SCALE

200 0 100 200 400 800

(IN FEET)
1 inch = 200 ft.

PLATE 5A

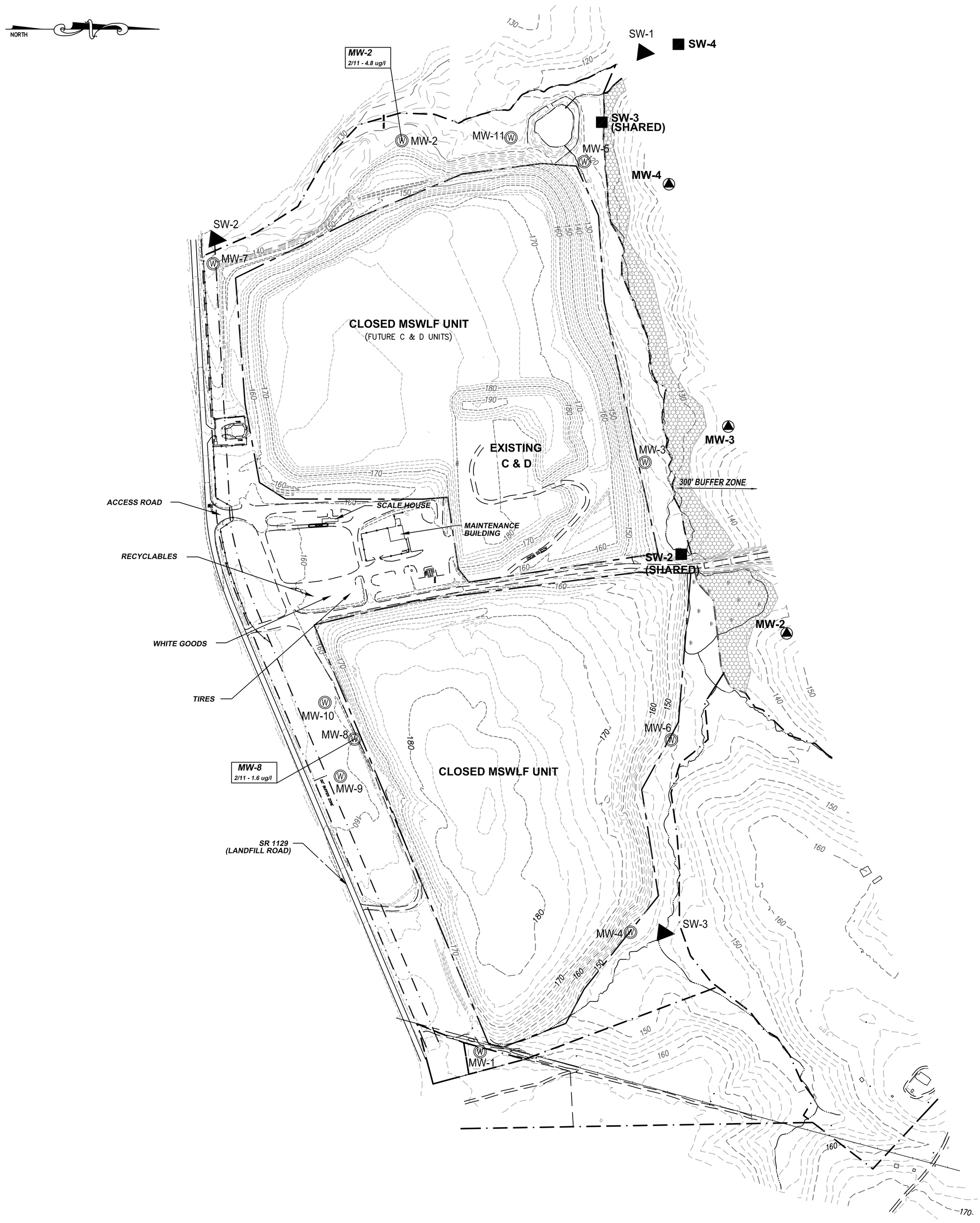
DRAWING NO.	PROJECT NUMBER	CHKD. BY:	DRWN. BY:	DATE:	SCALE:
PLATE 5A	G11050.0	M. GERMAN	M. GERMAN	04/26/2011	1" = 200'
SHEET NO. 1 OF 1					

DATE	BY	REV.	DESCRIPTION

ISOCONCENTRATION MAP
CHLOROBENZENE – FEBRUARY 2011

MUNICIPAL SOLID WASTE LANDFILL FACILITY
WAYNE COUNTY NORTH CAROLINA

LICENSE NUMBER: C-0281
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
P.O. BOX 828 MOREHEAD CITY, N.C. 28557 (252) 726-9481



LEGEND

- EXISTING CONTOURS
- PROPERTY LINE
- EXISITING UNPAVED ROAD
- EXISTING CREEK, STREAM, ETC.
- EXISTING DIVERSION DITCHES
- CLOSED MSWLF SANITARY UNIT
- MW-7 — MONITORING WELLS C&D LANDFILL
- MW-1 — MONITORING WELLS SUBTITLE D
- SW-5 — SURFACE WATER SAMPLING SUBTITLE D
- SW-1 — SURFACE WATER SAMPLING C&D
- WETLANDS
- 0.36 ug/l — p–DICHLOROBENZENE CONCENTRATION
- APPROXIMATE p–DICHLOROBENZENE INFLUENCE ABOVE 2L

** NOTE: 2L STANDARD FOR p–DICHLOROBENZENE IS 6 ug/l

GRAPHIC SCALE

200 0 100 200 400 800

(IN FEET)
1 inch = 200 ft.

PLATE 5B

DRAWING NO.	PROJECT NUMBER	CHKD. BY:	DRWN. BY:	DATE:	SCALE:
PLATE 5B	G11050.0	M. GERMAN	M. GERMAN	04/26/2011	1" = 200'
SHEET NO. 1 OF 1					

DATE	BY	REV.	DESCRIPTION

ISOCONCENTRATION MAP
p–DICHLOROBENZENE – FEB 2011

MUNICIPAL SOLID WASTE LANDFILL FACILITY
WAYNE COUNTY NORTH CAROLINA

LICENSE NUMBER: C-0281
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
P.O. BOX 828 MOREHEAD CITY, N.C. 28557 (252) 726-9481

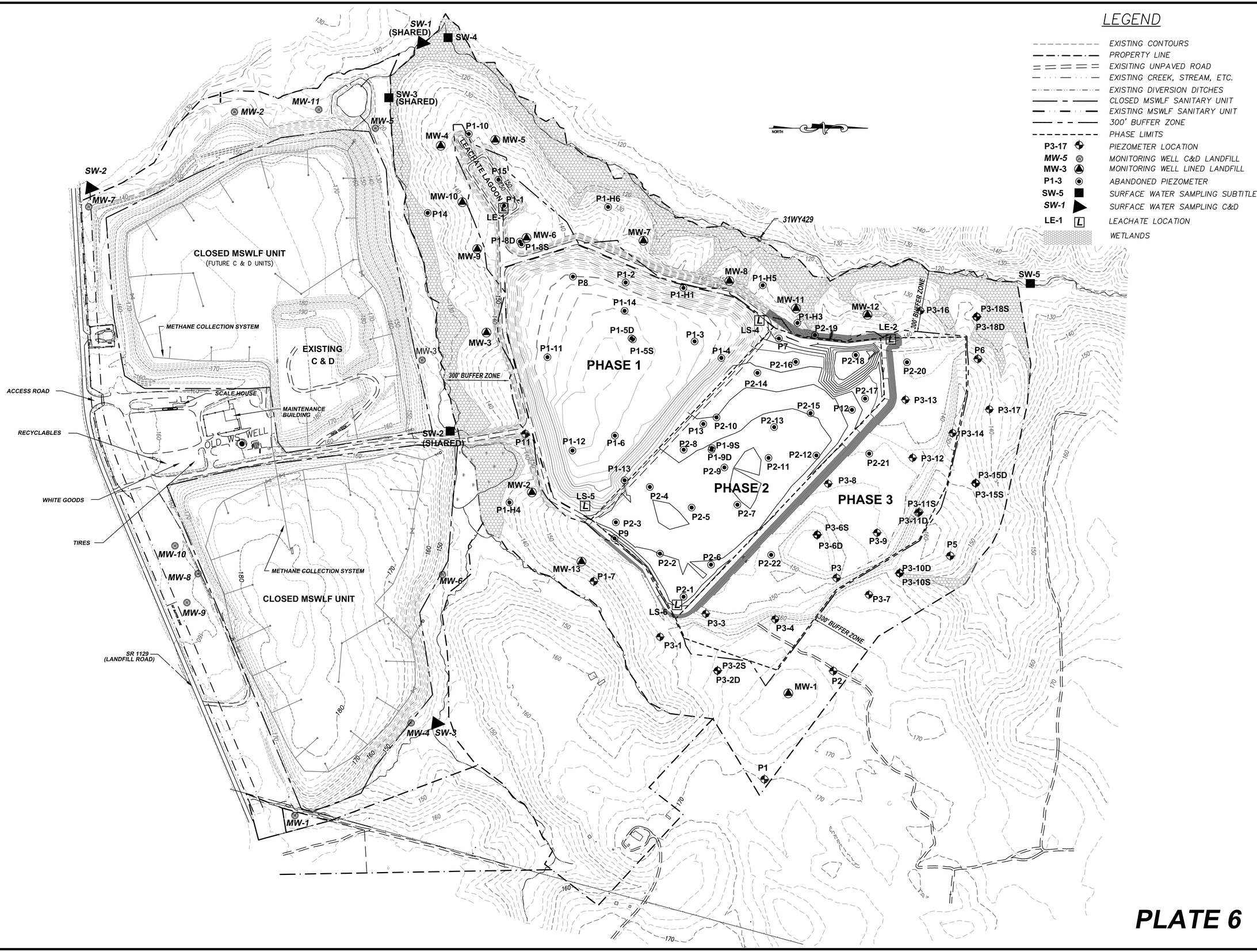


PLATE 6

Municipal Engineering Services 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
P.O. BOX 828 MOREHEAD CITY, N.C. 28557 (252) 726-9481
LICENSE NUMBER: C-0281

MUNICIPAL SOLID WASTE LANDFILL FACILITY
WAYNE COUNTY NORTH CAROLINA

DATE	BY	REV.	DESCRIPTION

FACILITY MAP

SCALE: 1" = 200'
DATE: 8/16/2007
DRWN. BY: M. CLEMENT
CHKD. BY: E. CALDWELL
PROJECT NUMBER G11050.0
DRAWING NO. PLATE 6
SHEET NO. 1 OF 1

APPENDIX A

NORTH CAROLINA DEPARTMENT OF NATURAL RESOURCES AND COMMUNITY DEVELOPMENT
DIVISION OF ENVIRONMENTAL MANAGEMENT – GROUNDWATER SECTION
P.O. BOX 27687 – RALEIGH, N.C. 27611, PHONE (919)733-3221

FOR OFFICE USE ONLY	
Quad. No.	Serial No.
Lat.	Long. / Pc
Minor Basin	
Basin Code	
Header Ent.	GW-1 Ent.

WELL CONSTRUCTION RECORD

DRILLING CONTRACTOR: Ralph Lawson

DRILLER REGISTRATION NUMBER: 720

STATE WELL CONSTRUCTION PERMIT NUMBER:

1. WELL LOCATION: (Show sketch of the location below)
   Nearest Town: Dudley
   (Road, Community, or Subdivision and Lot No.)
   County: Wayne
2. OWNER: Wayne Co Landfill
   ADDRESS: Rt #1 Box 200 (Street or Route No.)
   Dudley (City or Town) NC (State) 28333 (Zip Code)
3. DATE DRILLED: 8-28-90 USE OF WELL: Monitor
4. TOTAL DEPTH: 25' CUTTINGS COLLECTED: ☐ Yes ☑ No
5. DOES WELL REPLACE EXISTING WELL? ☐ Yes ☑ No
6. STATIC WATER LEVEL: 15' FT. ☐ above ☑ below TOP OF CASING.
   TOP OF CASING IS 2' FT. ABOVE LAND SURFACE.
7. YIELD (gpm): 2 METHOD OF TEST: air
   WATER ZONES (depth): 10'
9. CHLORINATION: Type 0 Amount 0
10. CASING:

	Depth From	Depth To	Diameter	Wall Thickness or Weight/Ft.	Material
	0	20'	2"	.40	PVC

11. GROUT:

	Depth From	Depth To	Material	Method
	0	19'	cuttings	Pouring

12. SCREEN:

	Depth From	Depth To	Diameter	Slot Size	Material
	20	25	2"	.16 in.	PVC

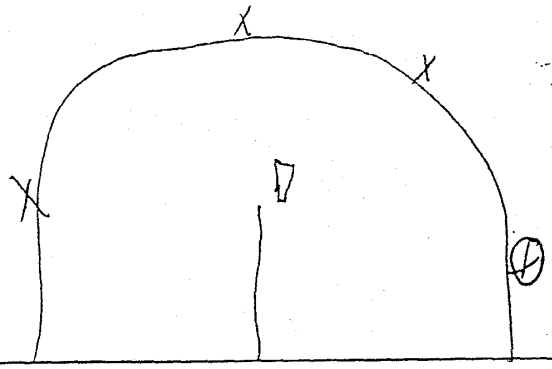
13. GRAVEL PACK:

	Depth From	Depth To	Size	Material
	19	25	sand	

Depth From	Depth To	DRILLING LOG Formation Description
0	5	sand
5	12	clay
15'	25'	sand & water

If additional space is needed use back of form.

LOCATION SKETCH
(Show direction and distance from at least two State Roads, or other map reference points)



REMARKS:

I DO HEREBY CERTIFY THAT THIS WELL WAS CONSTRUCTED IN ACCORDANCE WITH 15 NCAC 2C, WELL CONSTRUCTION STANDARDS, AND THAT A COPY OF THIS RECORD HAS BEEN PROVIDED TO THE WELL OWNER.

Ralph Lawson Jr. 9-10-90
SIGNATURE OF CONTRACTOR OR AGENT DATE

Submit original to Division of Environmental Management and copy to well owner.

GW-1 Revised 6/88

NORTH CAROLINA DEPARTMENT OF NATURAL RESOURCES AND COMMUNITY DEVELOPMENT
DIVISION OF ENVIRONMENTAL MANAGEMENT - GROUNDWATER SECTION
P.O. BOX 27687 - RALEIGH,N.C. 27611, PHONE (919)733-3221

FOR OFFICE USE ONLY
Quad. No. _____ Serial No. _____
Lat. _____ Long. _____ Pc _____
Minor Basin _____
Basin Code _____
Header Ent. _____ GW-1 Ent. _____

WELL CONSTRUCTION RECORD

DRILLING CONTRACTOR Ralph Lowlon G.
DRILLER REGISTRATION NUMBER 720

STATE WELL CONSTRUCTION PERMIT NUMBER: _____

1. WELL LOCATION: (Show sketch of the location below)
Nearest Town: _____ County: wayne
(Road, Community, or Subdivision and Lot No.)

2. OWNER wayne Co.
ADDRESS RT#1 Box 200 (Street or Route No.)
Dudley N C 28333
City or Town State Zip Code

3. DATE DRILLED 8-28-90 USE OF WELL monitor
4. TOTAL DEPTH 15' CUTTINGS COLLECTED ☐ Yes ☑ No
5. DOES WELL REPLACE EXISTING WELL? ☑ Yes ☐ No
6. STATIC WATER LEVEL: _____ FT. ☐ above ☐ below TOP OF CASING,
TOP OF CASING IS 2' FT. ABOVE LAND SURFACE.
7. YIELD (gpm): 5 METHOD OF TEST air
8. WATER ZONES (depth): 10'
9. CHLORINATION: Type 0 Amount 0
10. CASING:

	Depth From	Depth To	Diameter	Wall Thickness or Weight/Ft.	Material
	10'		2"	.40	PVC

11. GROUT:

	Depth From	Depth To	Material	Method
	0'	10'	portland	pouring

12. SCREEN:

	Depth From	Depth To	Diameter	Slot Size	Material
	10'	15'	2"	.16	PVC

13. GRAVEL PACK:

	Depth From	Depth To	Size	Material
	10'	15'	sand	sand

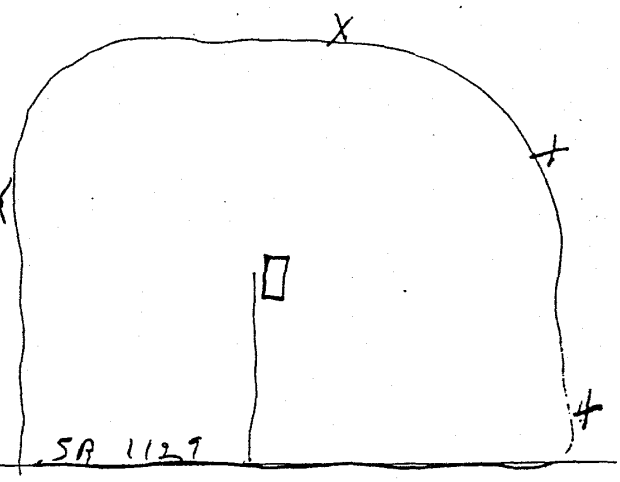
REMARKS: _____

DRILLING LOG

Depth From	Depth To	Formation Description
0	5'	sand
5	10	sand & clay
10	15'	sand & water

If additional space is needed use back of form.

LOCATION SKETCH
(Show direction and distance from at least two State Roads, or other map reference points)



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Ralph Lowlon G. 9-10-90
SIGNATURE OF CONTRACTOR OR AGENT DATE

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GW-1 Revised 6/88

NORTH CAROLINA DEPARTMENT OF NATURAL RESOURCES AND COMMUNITY DEVELOPMENT
DIVISION OF ENVIRONMENTAL MANAGEMENT - GROUNDWATER SECTION
P.O. BOX 27687 - RALEIGH, N.C. 27611, PHONE (919)733-3221

3

FOR OFFICE USE ONLY	
Quad. No.	Serial No.
Lat.	Long. / Pc
Minor Basin	
Basin Code	
Header Ent.	GW-1 Ent.

WELL CONSTRUCTION RECORD

DRILLING CONTRACTOR Ralph Lawson
DRILLER REGISTRATION NUMBER 720

STATE WELL CONSTRUCTION PERMIT NUMBER:

1. WELL LOCATION: (Show sketch of the location below)
Nearest Town: Dudley
(Road, Community, or Subdivision and Lot No.)
County: Wayne

2. OWNER Wayne Co Landfill
ADDRESS RT#1 Box 200 (Street or Route No.)
Dudley (City or Town) NC (State) 28333 (Zip Code)

3. DATE DRILLED 8-27-90 USE OF WELL Monitor
4. TOTAL DEPTH 18' CUTTINGS COLLECTED ☐ Yes ☑ No
5. DOES WELL REPLACE EXISTING WELL? ☑ Yes ☐ No
6. STATIC WATER LEVEL: 3' FT. ☐ above ☑ below TOP OF CASING,
TOP OF CASING IS 2" FT. ABOVE LAND SURFACE.
7. YIELD (gpm): 5 METHOD OF TEST air
8. WATER ZONES (depth): 15
9. CHLORINATION: Type 0 Amount 0

DRILLING LOG Depth From	To	Formation Description
0	5'	sand
5	10	sand & water
10'	18'	sand & water

If additional space is needed use back of form.

10. CASING:

	Depth From	To	Diameter	Wall Thickness or Weight/Ft.	Material
	0'	12	2"	.40	PVC

11. GROUT:

	Depth From	To	Material	Method
	0	12	portland	pouring

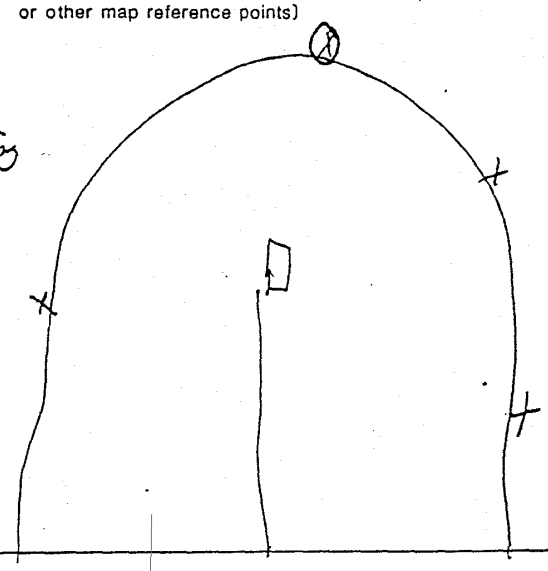
12. SCREEN:

	Depth From	To	Diameter	Slot Size	Material
	12'	18'	2"	.16 in.	PVC

13. GRAVEL PACK:

	Depth From	To	Size	Material
	11'	18'	sand	sand

LOCATION SKETCH
(Show direction and distance from at least two State Roads, or other map reference points)



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Ralph Lawson Jr. 9-10-90
SIGNATURE OF CONTRACTOR OR AGENT DATE

GW-1 Revised 6/88

Submit original to Division of Environmental Management and copy to well owner.

NORTH CAROLINA DEPARTMENT OF NATURAL RESOURCES AND COMMUNITY DEVELOPMENT
DIVISION OF ENVIRONMENTAL MANAGEMENT - GROUNDWATER SECTION
P.O. BOX 27687 - RALEIGH, N.C. 27611, PHONE (919)733-3221

FOR OFFICE USE ONLY	
Quad. No.	Serial No.
Lat.	Long. / Pc
Minor Basin	
Basin Code	
Header Ent.	GW-1 Ent.

WELL CONSTRUCTION RECORD

DRILLING CONTRACTOR Ralph Lawson g.

DRILLER REGISTRATION NUMBER

STATE WELL CONSTRUCTION PERMIT NUMBER:

1. WELL LOCATION: (Show sketch of the location below)
   Nearest Town: Dudley
   (Road, Community, or Subdivision and Lot No.)
   County: Wayne
2. OWNER Wayne Co Landfill
   ADDRESS Rt #1 Box 200 (Street or Route No.)
   Dudley NC 28333 (City or Town, State, Zip Code)
3. DATE DRILLED 5-28-90 USE OF WELL Monitor
4. TOTAL DEPTH 15' CUTTINGS COLLECTED ☐ Yes ☑ No
5. DOES WELL REPLACE EXISTING WELL? ☑ Yes ☐ No
6. STATIC WATER LEVEL: 4' FT. ☐ above ☑ below TOP OF CASING,
   TOP OF CASING IS 1' FT. ABOVE LAND SURFACE.
7. YIELD (gpm): 5 METHOD OF TEST air
8. WATER ZONES (depth): 10'
9. CHLORINATION: Type 0 Amount 0
10. CASING:

	Depth From	Depth To	Diameter	Wall Thickness or Weight/Ft.	Material
	0'	10'	2"	.140	PVC

11. GROUT:

	Depth From	Depth To	Material	Method
	0'	10'	portland	pouring

12. SCREEN:

	Depth From	Depth To	Diameter	Slot Size	Material
	10'	15'	2"	.16 in.	PVC

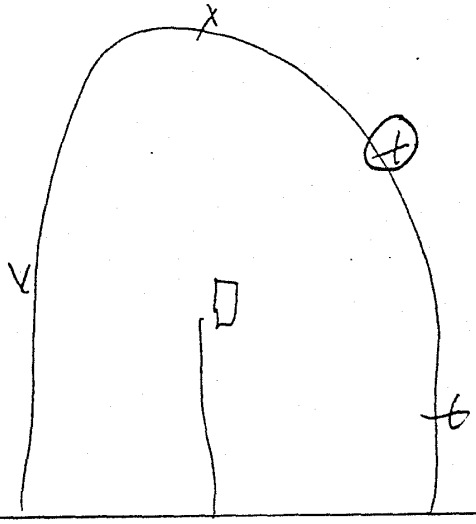
13. GRAVEL PACK:

	Depth From	Depth To	Size	Material
	10'	15'	sand	

Depth From	Depth To	DRILLING LOG Formation Description
0	5	sand
5	10	sand & water
10	15	sand & water

If additional space is needed use back of form.

LOCATION SKETCH
(Show direction and distance from at least two State Roads, or other map reference points)



REMARKS:

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Ralph Lawson g. 5-10-90
SIGNATURE OF CONTRACTOR OR AGENT DATE

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GW-1 Revised 6/88

North Carolina - Department of Environment, Health, and Natural Resources
Division of Environmental Management - Groundwater Section
P.O. Box 29535 - Raleigh, N.C. 27626-0535
Phone (919) 733-3221

FOR OFFICE USE ONLY	
QUAD. NO.	SERIAL NO.
Lat.	Long. RO
Minor Basin	
Basin Code	
Header Ent.	GW-1 Ent.

WELL CONSTRUCTION RECORD

DRILLING CONTRACTOR: GAI Consultants

DRILLER REGISTRATION NUMBER: 446

STATE WELL CONSTRUCTION PERMIT NUMBER: N/A

1. WELL LOCATION: (Show sketch of the location below)
   Nearest Town: Dudley County: Wayne
   NCSR 1129
   (Road, Community, or Subdivision and Lot No.)
2. OWNER Wayne County Attn: Lloyd Cook
   ADDRESS 460 B South Landfill Rd
   (Street or Route No.)
   Dudley NC 28333
   City or Town State Zip Code
3. DATE DRILLED 8-31-94 USE OF WELL Monitoring
4. TOTAL DEPTH 19.0
5. CUTTINGS COLLECTED YES [X] NO [ ]
6. DOES WELL REPLACE EXISTING WELL? YES [ ] NO [X]
7. STATIC WATER LEVEL Below Top of Casing: 6.45 FT.
   (Use "+" if Above Top of Casing)
8. TOP OF CASING IS 3.95 FT. Above Land Surface*
   * Casing Terminated at/or below land surface is illegal unless a variance is issued in accordance with 15A NCAC 2C .0118
9. YIELD (gpm): N/A METHOD OF TEST
10. WATER ZONES (depth):
11. CHLORINATION: Type N/A Amount
12. CASING:

	Depth From	Depth To	Ft.	Diameter	Wall Thickness or Weight/Ft.	Material
	+3.95	3		2"	Sch 40	PVC

13. GROUT:

	Depth From	Depth To	Ft.	Material	Method
	1	0		Cement	Grout
	2	1		Bentonite	Pellets

14. SCREEN:

	Depth From	Depth To	Ft	Diameter	in.	Slot Size	in.	Material
	3	18		2		.010		PVC

15. SAND/GRAVEL PACK:

	Depth From	Depth To	Ft.	Size	Material
	2	19		#2	Silica

16. REMARKS: MW-5 0.5' water level after 24 hours

DEPTH From	DEPTH To	DRILLING LOG Formation Description
3.5	5.5	Medium gray sandy silt with organics
8.5	10.5	Medium gray clayey sand with few gravel size grains
13.5	15.5	Dark gray clayey sand grades sand down dark gray clayey sand
15.5	19	Dark gray clayey sand

If additional space is needed use back of form

LOCATION SKETCH
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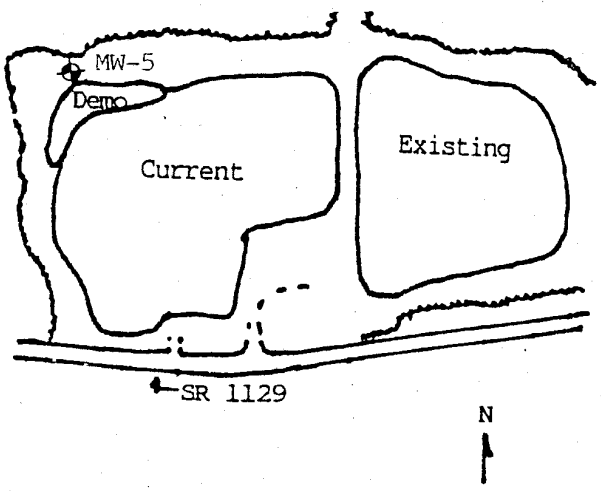

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8-31-94

SIGNATURE OF CONTRACTOR OR AGENT DATE

Submit original to Division of Environmental Management and copy to well owner

GW-1 REV. 3-91

North Carolina - Department of Environment, Health, and Natural Resources
Division of Environmental Management - Groundwater Section
P.O. Box 29535 - Raleigh, N.C. 27626-0535
Phone (919) 733-3221

FOR OFFICE USE ONLY
QUAD. NO. _____ SERIAL NO. _____
Lat. _____ Long. _____ RO _____
Minor Basin _____
Basin Code _____
Header Ent. _____ GW-1 Ent. _____

WELL CONSTRUCTION RECORD

RILLING CONTRACTOR: GAI Consultants

RILLER REGISTRATION NUMBER: 446

STATE WELL CONSTRUCTION PERMIT NUMBER: N/A

WELL LOCATION: (Show sketch of the location below)
Nearest Town: Dudley County: Wayne

NCSR 1129
(Road, Community, or Subdivision and Lot No.)

OWNER Wayne County Attn: Lloyd Cook
ADDRESS 460 B South Landfill Rd
(Street or Route No.)
Dudley NC 28333
City or Town State Zip Code

DATE DRILLED 8-31-94 USE OF WELL Monitoring
TOTAL DEPTH 19.0
CUTTINGS COLLECTED YES [X] NO [ ]
DOES WELL REPLACE EXISTING WELL? YES [ ] NO [X]
STATIC WATER LEVEL Below Top of Casing: 4.45 FT.
(Use "+" if Above Top of Casing)
TOP OF CASING IS 1.95 FT. Above Land Surface*
*asing Terminated at/or below land surface is illegal unless a variance is issued n accordance with 15A NCAC 2C .0118
YIELD (gpm): N/A METHOD OF TEST _____
). WATER ZONES (depth): _____
. CHLORINATION: Type N/A Amount _____
:. CASING:

	Depth From	Depth To	Diameter	Wall Thickness or Weight/Ft.	Material
	+1.95	3.14	2"	Sch 40	PVC

. GROUT:

	Depth From	Depth To	Material	Method
	.0	1.0	Cement Grout	
	1.0	2.0	Bentonite	Pellets

. SCREEN:

Depth From	Depth To	Diameter	Slot Size	Material
3.14	18.14	2"	.010	PVC

. SAND/GRAVEL PACK:

Depth From	Depth To	Size	Material
2.0	19.0	#2	Silica

. REMARKS: MW-6 4.2' water level after 24 hours

DEPTH From	DEPTH To	DRILLING LOG Formation Description
3.5	5.5	Gray sand
8.5	10.5	Gray sand down layer
		sandy clay
13.5	15.5	Gray mottled sandy
		clay with few coarse
		grains down clayey
		sand
15.5	19	Gray Clayey sand

If additional space is needed use back of form

LOCATION SKETCH
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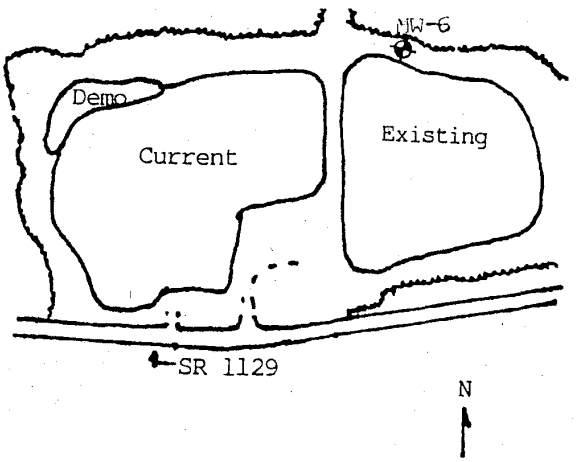

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8-31-94
SIGNATURE OF CONTRACTOR OR AGENT DATE

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/-1 REV 3-91

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Division of Environmental Management - Groundwater Section
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Phone (919) 733-3221

FOR OFFICE USE ONLY
QUAD. NO. _____ SERIAL NO. _____
Lat. _____ Long. _____ RO _____
Minor Basin _____
Basin Code _____
Header Ent. _____ GW-1 Ent. _____

WELL CONSTRUCTION RECORD

DRILLING CONTRACTOR: GAI Consultants

DRILLER REGISTRATION NUMBER: 446

STATE WELL CONSTRUCTION PERMIT NUMBER: N/A

1. WELL LOCATION: (Show sketch of the location below)
Nearest Town: Dudley County: Wayne
NCSR 1129
(Road, Community, or Subdivision and Lot No.)

2. OWNER Wayne County Attn: Lloyd Cook
ADDRESS 460 B South Landfill Rd
(Street or Route No.)
Dudley NC 28333
City or Town State Zip Code

3. DATE DRILLED 8-31-94 USE OF WELL Monitoring
4. TOTAL DEPTH 20.0
5. CUTTINGS COLLECTED YES [x] NO [ ]
6. DOES WELL REPLACE EXISTING WELL? YES [ ] NO [x]
7. STATIC WATER LEVEL Below Top of Casing: 8.85 FT.
(Use "+" if Above Top of Casing)
8. TOP OF CASING IS 2.85 FT. Above Land Surface*

* Casing Terminated at/or below land surface is illegal unless a variance is issued in accordance with 15A NCAC 2C .0118

9. YIELD (gpm): N/A METHOD OF TEST _____
10. WATER ZONES (depth): _____
11. CHLORINATION: Type N/A Amount _____
12. CASING:

	Depth From	Depth To	Ft.	Diameter	Wall Thickness or Weight/Ft.	Material
	+2.85	4.0		2"	Sch 40	PVC

13. GROUT:

	Depth From	Depth To	Ft.	Material	Method
	0	1.3		Cement Grout	
	1.3	2.5		Bentonite	Pellets

14. SCREEN:

	Depth From	Depth To	Ft	Diameter	in.	Slot Size	in.	Material
	4.0	19.0		2"		.010		PVC

15. SAND/GRAVEL PACK:

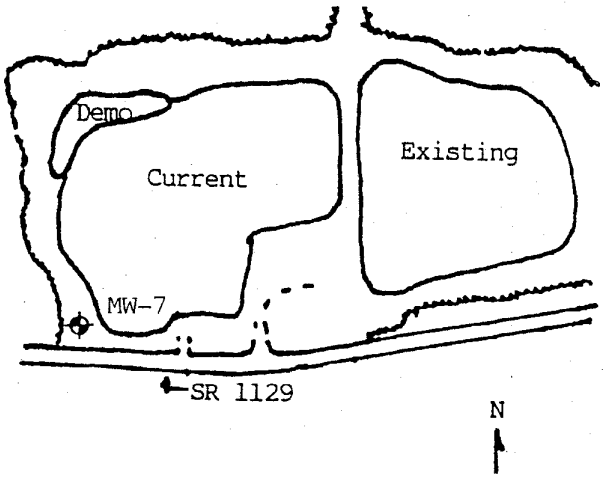
	Depth From	Depth To	Ft.	Size	Material
	2.5	20		#2	Silica

16. REMARKS: MW-7 4th attempt, 3 prior resulted inside waste limits 6.35' water after 24 hours

DEPTH From	DEPTH To	DRILLING LOG Formation Description
3.5	5.5	Orange mottled gray sandy clay
8.5	10.5	Light gray silty sand
13.5	15.5	Light gray sand
18.5	20	Tan sandy clay

If additional space is needed use back of form

LOCATION SKETCH
(Show direction and distance from at least two State Roads, or other map reference points)



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8-31-94
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Division of Environmental Management - Groundwater Section
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FOR OFFICE USE ONLY
QUAD. NO. _____ SERIAL NO. _____
Lat. _____ Long. _____ RO _____
Minor Basin _____
Basin Code _____
Header Ent. _____ GW-1 Ent. _____

WELL CONSTRUCTION RECORD

DRILLING CONTRACTOR: GAI Consultants

DRILLER REGISTRATION NUMBER: 446

STATE WELL CONSTRUCTION PERMIT NUMBER: N/A

. WELL LOCATION: (Show sketch of the location below)
Nearest Town: Dudley County: Wayne
NCSR 1129
(Road, Community, or Subdivision and Lot No.)

. OWNER Wayne County Attn: Lloyd Cook
ADDRESS 460 B South Landfill Rd
(Street or Route No.)
Dudley NC 28333
City or Town State Zip Code

. DATE DRILLED 8-30-94 USE OF WELL Monitoring
. TOTAL DEPTH 30
. CUTTINGS COLLECTED YES [x] NO [ ]
. DOES WELL REPLACE EXISTING WELL? YES [ ] NO [x]
. STATIC WATER LEVEL Below Top of Casing: 19.1 FT.
(Use "+" if Above Top of Casing)
. TOP OF CASING IS 1.1 FT. Above Land Surface*
Casing Terminated at/or below land surface is illegal unless a variance is issued in accordance with 15A NCAC 2C .0118
. YIELD (gpm): N/A METHOD OF TEST _____
0. WATER ZONES (depth): _____
1. CHLORINATION: Type N/A Amount _____

DEPTH From - To	DRILLING LOG Formation Description
3.5 - 5.5	Gray sand down orange gray clayey sand
8.5 - 10.5	Tan clayey sand down clay content increases
13.5 - 15.5	Orange mottled gray silty clay
18.5 - 20.5	Tan clayey sand some mottled
23.5 - 25.5	Tan Orange clayey sand
28.5 - 30	Orange mottled gray sand with seams of clay down sand clay with coarse grains

If additional space is needed use back of form

2. CASING:

Depth From	To	Ft.	Diameter	Wall Thickness or Weight/Ft.	Material
+1.1	14		2"	Sch 40	PVC

3. GROUT:

Depth From	To	Ft.	Material	Method
0	10		Cement	Grout
10	12		Bentonite	Pellets

4. SCREEN:

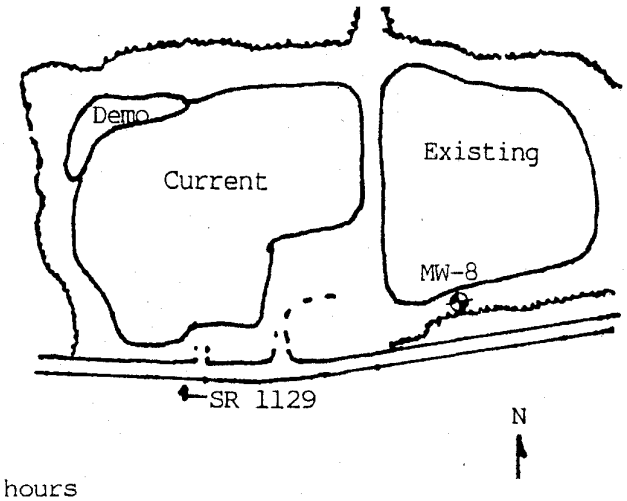
Depth From	To	Ft	Diameter	Slot Size	Material
14	29.0		2 in.	.010 in.	PVC
			in.	in.	
			in.	in.	

5. SAND/GRAVEL PACK:

Depth From	To	Ft.	Size	Material
12	30			Silica

6. REMARKS: MW-8 17.82' water level after 24 hours

LOCATION SKETCH
(Show direction and distance from at least two State Roads, or other map reference points)



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8-30-94
SIGNATURE OF CONTRACTOR OR AGENT DATE

Submit original to Division of Environmental Management and copy to well owner

W-1 REV. 9-91

MONITORING WELL 5

PROJECT: Wayne County Landfill
Dudley, North Carolina
LOCATION: see Landfill Plans

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION	SPT VALUE
			Gray medium sandy silt with organics	
5		X		4
			Gray clayey medium sand	
10		X		28
15		X	-grades dark gray with sand layers	36
20			End of Boring	
25				
30				
35				
40				
45				

COMPLETION DEPTH: 19.0 ft DATE: 8-31-94
DEPTH TO WATER: 2.5 ft while drilling, 0.5 ft after 24 hrs

MONITORING WELL 6

PROJECT: Wayne County Landfill
Dudley, North Carolina
LOCATION: see Landfill Plans

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION	SPT VALUE
			Gray sand	
5		X		15
10		X	-with sandy clay layers	1
			Gray sandy clay	
15			Gray clayey sand	
20			End of Boring	
25				
30				
35				
40				
45				

COMPLETION DEPTH: 19.0 ft DATE: 8-31-94
DEPTH TO WATER: 2.5 ft while drilling, 4.2 ft after 24 hrs

MONITORING WELL 7

PROJECT: Wayne County Landfill
Dudley, North Carolina
LOCATION: see Landfill Plans

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION	SPT VALUE
			Orange mottled gray sandy clay	
5		X		6
			Light gray silty sand	
10		X		2
			Light gray sand	
15		X		6
			Tan sandy clay	
20		X		1
			End of Boring	
25				
30				
35				
40				
45				

COMPLETION DEPTH: 20.0 ft DATE: 8-31-94
DEPTH TO WATER: 6 ft while drilling, 6.35 ft after 24 hours

MONITORING WELL 8

PROJECT: Wayne County Landfill
Dudley, North Carolina
LOCATION: see Landfill Plans

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION	SPT VALUE
			Tan gray clayey sand	
5		X		5
10		X		30
			Orange mottled gray silty clay	
15		X		7
			Tan orange clayey sand	
20		X		5
25		X		4
30		X	-with clay layers	2
			End of Boring	
35				
40				
45				

COMPLETION DEPTH: 30.0 ft DATE: 8-30-94
DEPTH TO WATER: 18.9 ft while drilling, 17.82 after 24 hours

NON RESIDENTIAL WELL CONSTRUCTION RECORD

North Carolina Department of Environment and Natural Resources- Division of Water Quality

WELL CONTRACTOR CERTIFICATION # 28665

1. WELL CONTRACTOR:

Leo H. Charbonneau
Well Contractor (Individual) Name

J+L Drilling Inc.
Well Contractor Company Name

STREET ADDRESS 109 Greg St.

Four Oaks NC 27524
City or Town State Zip Code

(919) 989-8856
Area code- Phone number

2. WELL INFORMATION:

SITE WELL ID #(if applicable)

STATE WELL PERMIT#(if applicable)

DWQ or OTHER PERMIT #(if applicable)

WELL USE (Check Applicable Box) Monitoring ☒ Municipal/Public ☐

Industrial/Commercial ☐ Agricultural ☐ Recovery ☐ Injection ☐

Irrigation ☐ Other ☐ (list use) MW-9

DATE DRILLED 7/9/09

TIME COMPLETED 11:00 AM ☒ AM ☒ PM ☐

3. WELL LOCATION:

CITY: Dudley COUNTY Wayne

460 S. Landfill Rd. #B
(Street Name, Numbers, Community, Subdivision, Lot No., Parcel, Zip Code)

TOPOGRAPHIC / LAND SETTING:

☐ Slope ☐ Valley ☒ Flat ☐ Ridge ☐ Other
(check appropriate box)

LATITUDE N 35° 17.400'

LONGITUDE W 078° 04.084'

May be in degrees, minutes, seconds or, in a decimal format

Latitude/longitude source: ☒ GPS ☐ Topographic map

(location of well must be shown on a USGS topo map and attached to this form if not using GPS)

4. FACILITY- is the name of the business where the well is located.

FACILITY ID #(if applicable)

NAME OF FACILITY Wayne Co. Landfill

STREET ADDRESS 460 S. Landfill Rd #B

Dudley NC
City or Town State Zip Code

CONTACT PERSON

MAILING ADDRESS

City or Town State Zip Code

( )-
Area code - Phone number

5. WELL DETAILS:

a. **TOTAL DEPTH:** 25.0'

b. **DOES WELL REPLACE EXISTING WELL?** YES ☐ NO ☒

c. **WATER LEVEL** Below Top of Casing: 16.5 FT.
(Use "+" if Above Top of Casing)

d. **TOP OF CASING IS** +2.5 FT. Above Land Surface*
*Top of casing terminated at/or below land surface may require a variance in accordance with 15A NCAC 2C .0118.

e. **YIELD (gpm):** METHOD OF TEST

f. **DISINFECTION: Type** Amount

g. **WATER ZONES** (depth):

From To From To
From To From To
From To From To

6. CASING:

From	To	Depth Ft.	Diameter	Thickness/ Weight	Material
+2.5	10.0		2	Sch 40	PVC

7. GROUT:

From	To	Depth Ft.	Material	Method
7.0	9.0		Bentonite	Poured
0	7.0		Cement	Poured

8. SCREEN:

From	To	Depth Ft.	Diameter in.	Slot Size in.	Material
10.0	25.0				

9. SAND/GRAVEL PACK:

From	To	Depth Ft.	Size	Material
9.0	25.0		#2	SAND

10. DRILLING LOG

From - To	Formation Description
0 - 9.0	Clayey SAND
9.0 - 25.0	SAND

11. REMARKS:

I DO HEREBY CERTIFY THAT THIS WELL WAS CONSTRUCTED IN ACCORDANCE WITH 15A NCAC 2C, WELL CONSTRUCTION STANDARDS, AND THAT A COPY OF THIS RECORD HAS BEEN PROVIDED TO THE WELL OWNER.

SIGNATURE OF CERTIFIED WELL CONTRACTOR 7/23/09 DATE

Leo H. Charbonneau
PRINTED NAME OF PERSON CONSTRUCTING THE WELL

Submit the original to the Division of Water Quality within 30 days. Attn: Information Mgt., 1617 Mail Service Center – Raleigh, NC 27699-1617 Phone No. (919) 733-7015 ext 568.

Form GW-1b
Rev. 7/05

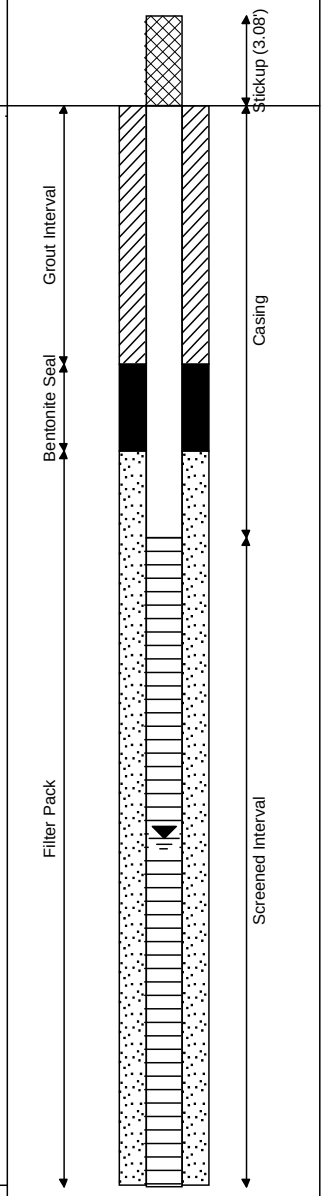
LOG OF BORING: MW-9

Wayne Co. Closed C&D/MSW Landfill **Project No. G07058.0**

Drilling contractor:	J&L Drilling	Date started:	7/9/2009	Surface elevation:	159.78 ft (MSL)
Drill rig & method:	4.25" ID HSA	Date ended:	7/9/2009	Top of pipe elevation:	162.96 ft (MSL)
Logged by:	Sean K. Patrick, L.G.	Completion depth:	25.00 ft	Depth to water (TOB):	16.99 ft
		Stickup height:	3.18 ft	Depth to water (24hrs):	16.96 ft

Depth (ft)	SPT (bpf)	Soil Type Symbol	Sample	Description of Material & Remarks
				TOPSOIL / Grey, med.-grained SAND (SP)
				Brown, moist, loose, med.-grained SAND (SP), w/ few clay. SPT: 4-7-8-11
5				
				Grey & red-brown, mottled, soft, plastic CLAY (CH), w/ trace-few v. fine to fine-grained sand. SPT: 4-5-8-11
10				
				Lt. grey & orange-brown mottled, moist, fine to med.-grained CLAYEY SAND (SC), w/ some clay. SPT: 2-3-6-7
15				
				Lt. brown, loose, saturated, fine to med.-grained SAND (SP). SPT: WOR-1-2-2
20				
				Lt. brown, loose, saturated, med. to coarse-grained, CLAYEY SAND (SC), w/ some clay. SPT: 1-1-2-2
25				Boring terminated at 25.0 feet
30				

Well Diagram



Municipal Engineering Services Company, P.A.
Operation/Construction Managers Civil/Sanitary Engineers Environmental Studies
PO Box 97, Garner, North Carolina 27529 (919) 772-5393 PO Box 349, Boone, North Carolina 28607 (828) 262-1767

NON RESIDENTIAL WELL CONSTRUCTION RECORD

North Carolina Department of Environment and Natural Resources- Division of Water Quality

WELL CONTRACTOR CERTIFICATION # 28665

1. WELL CONTRACTOR:

Leo H. Charbonneau
Well Contractor (Individual) Name

J+L Drilling Inc.
Well Contractor Company Name

STREET ADDRESS 109 Greg St.

Four Oaks NC 27524
City or Town State Zip Code

(919) 989-8856
Area code- Phone number

2. WELL INFORMATION:

SITE WELL ID #(if applicable)

STATE WELL PERMIT#(if applicable)

DWQ or OTHER PERMIT #(if applicable)

WELL USE (Check Applicable Box) Monitoring ☒ Municipal/Public ☐

Industrial/Commercial ☐ Agricultural ☐ Recovery ☐ Injection ☐

Irrigation ☐ Other ☐ (list use) MW-10

DATE DRILLED 7/9/09

TIME COMPLETED 3:00 AM ☐ PM ☒

3. WELL LOCATION:

CITY: Dudley COUNTY WAYNE

460 S. LANDFILL Rd #B

(Street Name, Numbers, Community, Subdivision, Lot No., Parcel, Zip Code)

TOPOGRAPHIC / LAND SETTING:

☐ Slope ☐ Valley ☒ Flat ☐ Ridge ☐ Other

(check appropriate box)

LATITUDE N 35° 17.389'

LONGITUDE W 078° 04.148'

May be in degrees, minutes, seconds or in a decimal format

Latitude/longitude source: ☒ GPS ☐ Topographic map

(location of well must be shown on a USGS topo map and attached to this form if not using GPS)

4. FACILITY- is the name of the business where the well is located.

FACILITY ID #(if applicable)

NAME OF FACILITY WAYNE Co. LANDFILL

STREET ADDRESS 460 S. LANDFILL Rd #B

Dudley NC
City or Town State Zip Code

CONTACT PERSON

MAILING ADDRESS

City or Town State Zip Code

( )-
Area code - Phone number

5. WELL DETAILS:

a. **TOTAL DEPTH:** 25.0'

b. **DOES WELL REPLACE EXISTING WELL?** YES ☐ NO ☒

c. **WATER LEVEL** Below Top of Casing: 17.0' FT.
(Use "+" if Above Top of Casing)

d. **TOP OF CASING IS** +2.5 FT. Above Land Surface*
*Top of casing terminated at/or below land surface may require a variance in accordance with 15A NCAC 2C .0118.

e. **YIELD (gpm):** METHOD OF TEST

f. **DISINFECTION:** Type Amount

g. **WATER ZONES** (depth):

From To From To
From To From To
From To From To

6. CASING:

	Depth		Diameter	Thickness/ Weight	Material
From +2.5	To 10.0	Ft.	2"	Sch-40	PVC
From	To	Ft.			
From	To	Ft.			

7. GROUT:

	Depth		Material	Method
From 7.0	To 9.0	Ft.	Bentonite	Poured
From 0	To 7.0	Ft.	Cement	Poured
From	To	Ft.		

8. SCREEN:

	Depth		Diameter	Slot Size	Material
From 10.0	To 25.0	Ft.	2 in.	.10 in.	PVC
From	To	Ft.	in.	in.	
From	To	Ft.	in.	in.	

9. SAND/GRAVEL PACK:

	Depth		Size	Material
From 9.0	To 25.0	Ft.	#2	SAND
From	To	Ft.		
From	To	Ft.		

10. DRILLING LOG

From - To	Formation Description
0 - 8.5	Clayey SAND
8.5 - 25	SAND

11. REMARKS:

I DO HEREBY CERTIFY THAT THIS WELL WAS CONSTRUCTED IN ACCORDANCE WITH 15A NCAC 2C, WELL CONSTRUCTION STANDARDS, AND THAT A COPY OF THIS RECORD HAS BEEN PROVIDED TO THE WELL OWNER.

SIGNATURE OF CERTIFIED WELL CONTRACTOR 7/23/09 DATE

Leo H. Charbonneau
PRINTED NAME OF PERSON CONSTRUCTING THE WELL

Submit the original to the Division of Water Quality within 30 days. Attn: Information Mgt., 1617 Mail Service Center – Raleigh, NC 27699-1617 Phone No. (919) 733-7015 ext 568.

Form GW-1b
Rev. 7/05

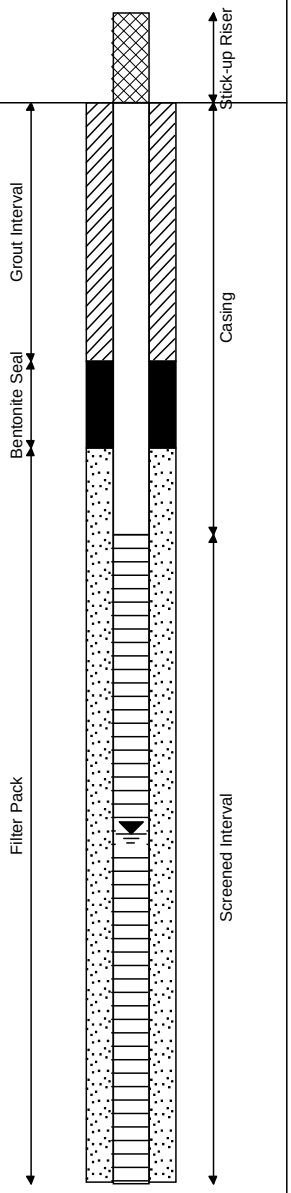
LOG OF BORING: MW-10

Wayne Co. Closed C&D/MSW Landfill **Project No. G07058.0**

Drilling contractor:	J&L Drilling	Date started:	7/9/2009	Surface elevation:	160.01 ft (MSL)
Drill rig & method:	HSA	Date ended:	7/9/2009	Top of pipe elevation:	162.90 ft (MSL)
Logged by:	Sean K. Patrick, L.G.	Completion depth:	25.00 ft	Depth to water (TOB):	16.89 ft
		Stickup height:	2.89 ft	Depth to water (24hrs):	16.90 ft

Depth (ft)	SPT (bpf)	Soil Type Symbol	Sample	Description of Material & Remarks
				TOPSOIL / Lt. brown, fine to med.-grained SILTY SAND (SM)
				Lt. grey to lt. brown, dry, loose, fine-grained quartz SAND (SP), w/ trace silt. SPT: 5-5-6-7
5				
				Lt. grey & brown, moist, soft, plastic CLAY (CH), w/ few fine-grained quartz sand. SPT: 3-4-6-8
10				
				Lt. grey & red-brown mottled, v. moist, v. soft, plastic CLAY (CH), w/ trace v. fine to fine-grained sand. SPT: 2-3-5-6
15				
				Lt. grey & brown, v. soft, saturated, plastic CLAY (CH). SPT: 1-1-2-2
20				
				Lt. grey, loose, saturated, med. to coarse-grained, SAND (SP-SW), w/ few clay in top 3". SPT: 3-6-7-7
25				Boring terminated at 25.0 feet
30				

Well Diagram



Municipal Engineering Services Company, P.A.
Operation/Construction Managers Civil/Sanitary Engineers Environmental Studies
PO Box 97, Garner, North Carolina 27529 (919) 772-5393 PO Box 349, Boone, North Carolina 28607 (828) 262-1767

NON RESIDENTIAL WELL CONSTRUCTION RECORD

North Carolina Department of Environment and Natural Resources- Division of Water Quality

WELL CONTRACTOR CERTIFICATION # 28665

1. WELL CONTRACTOR:

Leo H. Charbonneau
Well Contractor (Individual) Name

J+L Drilling Inc.
Well Contractor Company Name

STREET ADDRESS 109 Greg St.

Four Oaks NC 27524
City or Town State Zip Code

(919) 989-8856
Area code- Phone number

2. WELL INFORMATION:

SITE WELL ID #(if applicable) ____

STATE WELL PERMIT#(if applicable) ____

DWQ or OTHER PERMIT #(if applicable) ____

WELL USE (Check Applicable Box) Monitoring ☒ Municipal/Public ☐

Industrial/Commercial ☐ Agricultural ☐ Recovery ☐ Injection ☐

Irrigation ☐ Other ☐ (list use) MW-21

DATE DRILLED 7/10/09

TIME COMPLETED 10:30 AM ☒ PM ☐

3. WELL LOCATION:

CITY: Dudley COUNTY Wayne

460 S. Landfill Rd. #B

(Street Name, Numbers, Community, Subdivision, Lot No., Parcel, Zip Code)

TOPOGRAPHIC / LAND SETTING:

☐ Slope ☐ Valley ☐ Flat ☐ Ridge ☐ Other ____

(check appropriate box)

LATITUDE N 35° 17.507'

LONGITUDE W 78° 04.572'

May be in degrees, minutes, seconds or in a decimal format

Latitude/longitude source: ☒ GPS ☐ Topographic map

(location of well must be shown on a USGS topo map and attached to this form if not using GPS)

4. FACILITY- is the name of the business where the well is located.

FACILITY ID #(if applicable) ____

NAME OF FACILITY Wayne Co. Landfill

STREET ADDRESS 460 S. Landfill Rd. #B

Dudley NC
City or Town State Zip Code

CONTACT PERSON ____

MAILING ADDRESS ____

City or Town State Zip Code

(____)- ____
Area code - Phone number

5. WELL DETAILS:

a. **TOTAL DEPTH:** 15.0'

b. **DOES WELL REPLACE EXISTING WELL?** YES ☐ NO ☒

c. **WATER LEVEL** Below Top of Casing: 8.0' FT.
(Use "+" if Above Top of Casing)

d. **TOP OF CASING IS** +2.5 FT: Above Land Surface*
*Top of casing terminated at/or below land surface may require a variance in accordance with 15A NCAC 2C .0118.

e. **YIELD (gpm):** ____ **METHOD OF TEST** ____

f. **DISINFECTION: Type** ____ **Amount** ____

g. **WATER ZONES** (depth):

From ____ To ____ From ____ To ____
From ____ To ____ From ____ To ____
From ____ To ____ From ____ To ____

6. CASING:

Depth From	To	Ft.	Diameter	Thickness/ Weight	Material
+2.5	5.0		2	SCH-40	PVC

7. GROUT:

Depth From	To	Ft.	Material	Method
2.0	4.0		Bentonite	Poured
0	2.0		Cement	Poured

8. SCREEN:

Depth From	To	Ft.	Diameter	Slot Size	Material
			in.	in.	
			in.	in.	
			in.	in.	

9. SAND/GRAVEL PACK:

Depth From	To	Ft.	Size	Material
4.0	15.0		#2	SAND

10. DRILLING LOG

From	To	Formation Description
0	6.0	Clayey SAND
6.0	15.0	SAND

11. REMARKS:

I DO HEREBY CERTIFY THAT THIS WELL WAS CONSTRUCTED IN ACCORDANCE WITH 15A NCAC 2C, WELL CONSTRUCTION STANDARDS, AND THAT A COPY OF THIS RECORD HAS BEEN PROVIDED TO THE WELL OWNER.

SIGNATURE OF CERTIFIED WELL CONTRACTOR — DATE 7/23/09

Leo H. Charbonneau
PRINTED NAME OF PERSON CONSTRUCTING THE WELL

Submit the original to the Division of Water Quality within 30 days. Attn: Information Mgt., 1617 Mail Service Center – Raleigh, NC 27699-1617 Phone No. (919) 733-7015 ext 568.

Form GW-1b
Rev. 7/05

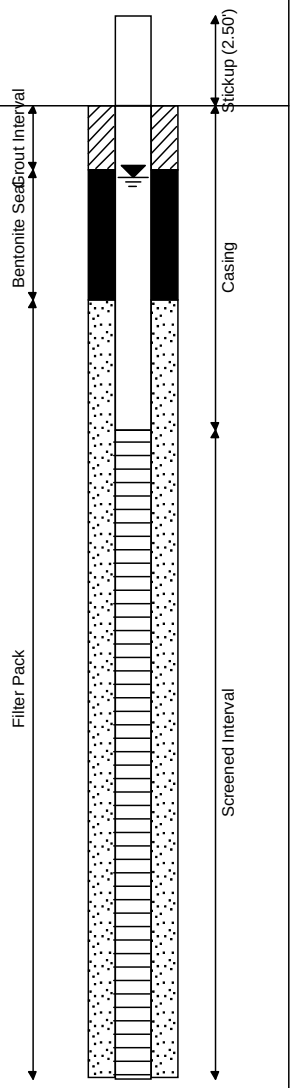
LOG OF BORING: MW-11

Wayne Co. Closed C&D/MSW Landfill **Project No. G07058.0**

Drilling contractor:	J&L Drilling	Date started:	7/9/2009	Surface elevation:	124.50 ft (MSL)
Drill rig & method:	4.25" ID HSA	Date ended:	7/9/2009	Top of pipe elevation:	127.23 ft (MSL)
Logged by:	Sean K. Patrick, L.G.	Completion depth:	15.00 ft	Depth to water (TOB):	
		Stickup height:	2.73 ft	Depth to water (24hrs):	1.10 ft

Depth (ft)	SPT (bpf)	Soil Type Symbol	Sample	Description of Material & Remarks
				TOPSOIL / Grey, med.-grained SAND (SP)
				Lt. grey & brown, wet, soft, med.-grained CLAYEY SAND (SC), w/ some clay. SPT: 3-2-1-2
5				
				Dk. grey, wet, med. dense, med. to coarse-grained, SILTY-CLAYEY SAND (SP-SW), w/ trace-few silt & little clay. SPT: 5-10-18-15
10				
				Dk. grey, saturated, dense, fine to med.-grained quartz SAND (SP-SW), w/ trace silt, thin carbonaceous laminae. SPT: 4-11-31-50/6"
15				Boring terminated at 15.0 feet
20				

Well Diagram



Municipal Engineering Services Company, P.A.
Operation/Construction Managers Civil/Sanitary Engineers Environmental Studies
PO Box 97, Garner, North Carolina 27529 (919) 772-5393 PO Box 349, Boone, North Carolina 28607 (828) 262-1767

Supply well

NATURE SAVER™ FAX MEMO 01616	Date 6-30-97	#of pages ▶ 1
To TOM ROSSBACH	From LLOYD COOK	
Co./Dept. M. E.	Co. WCSW	
Phone #	Phone #	
	Fax #	

DEVELOPMENT
TION

FOR OFFICE USE ONLY

Quad. No. _____ Serial No. _____
Lat. _____ Long. _____ Pc _____
Minor Basin _____
Basin Code _____
Header Ent. _____ GW-1 Ent. _____

DRILLING CONTRACTOR Ralph Lowlong.
DRILLER REGISTRATION NUMBER 720

STATE WELL CONSTRUCTION PERMIT NUMBER: _____

1. WELL LOCATION: (Show sketch of the location below)
Nearest Town: Dudley
(Road, Community, or Subdivision and Lot No.)

County: Wayne

2. OWNER _____
ADDRESS _____
(Street or Route No.)
City or Town State Zip Code

3. DATE DRILLED 8-29-90 USE OF WELL Irrigation
4. TOTAL DEPTH 80' CUTTINGS COLLECTED ☐ Yes ☑ No
5. DOES WELL REPLACE EXISTING WELL? ☐ Yes ☑ No
6. STATIC WATER LEVEL: 20' FT. ☐ above ☐ below TOP OF CASING,
TOP OF CASING IS 18" FT. ABOVE LAND SURFACE.
7. YIELD (gpm): 10 METHOD OF TEST pump
WATER ZONES (depth): _____

9. CHLORINATION: Type pill Amount 6

10. CASING:

	Depth From	To	Diameter	Wall Thickness or Weight/Ft.	Material
	75'		2"	160	PVC

11. GROUT:

	Depth From	To	Material	Method
	0	20'	portland	pouring

12. SCREEN:

	Depth From	To	Diameter	Slot Size	Material
	75'	80'	2"	.16 in.	PVC

13. GRAVEL PACK:

	Depth From	To	Size	Material
	75	80	gravel	Rock

DRILLING LOG

Depth From	To	Formation Description
0	5'	sand
5	20	sand & clay
20	40'	clay
40	80'	sand & water

If additional space is needed use back of form.

LOCATION SKETCH
(Show direction and distance from at least two State Roads, or other map reference points)

SR 1127

REMARKS: _____

I DO HEREBY CERTIFY THAT THIS WELL WAS CONSTRUCTED IN ACCORDANCE WITH 15 NCAC 2C, WELL CONSTRUCTION STANDARDS, AND THAT A COPY OF THIS RECORD HAS BEEN PROVIDED TO THE WELL OWNER.

Ralph Lowlong. 9-10-90
SIGNATURE OF CONTRACTOR OR AGENT DATE

GW-1 Revised 6/88

Submit original to Division of Environmental Management and copy to well owner

WELL ABANDONMENT RECORD

North Carolina Department of Environment and Natural Resources- Division of Water Quality

WELL CONTRACTOR CERTIFICATION # 2865

1. WELL CONTRACTOR:

Leo H. Charbonneau
Well Contractor (Individual) Name

J & L DRILLING, INC.
Well Contractor Company Name

STREET ADDRESS 109 Greg Street

Four Oaks, NC 27524
City or Town State Zip Code

(919) - 989-8856
Area code - Phone number

2. WELL INFORMATION:

SITE WELL ID # (if applicable)

STATE WELL PERMIT # (if applicable)

COUNTY WELL PERMIT # (if applicable)

DWQ or OTHER PERMIT # (if applicable)

WELL USE (Circle applicable use): Monitoring Residential Municipal/Public Industrial/Commercial Agricultural Recovery Injection Irrigation

Other (list use) Water Supply Well

3. WELL LOCATION:

COUNTY Wayne QUADRANGLE NAME

NEAREST TOWN: Dudley

460 S. Landfill Rd #B

(Street/Road Name, Number, Community, Subdivision, Lot No., Parcel, Zip Code)

TOPOGRAPHIC / LAND SETTING:
Slope Valley (Flat) Ridge Other
(Circle appropriate setting)

LATITUDE N 35° 17.497
LONGITUDE W 078° 04.374

May be in degrees, minutes, seconds, or in a decimal format

Latitude/longitude source: (GPS) Topographic map

(Location of well must be shown on a USGS topo map and attached to this form if not using GPS.)

4a. FACILITY- The name of the business where the well is located. Complete 4a and4b. (If a residential well, skip 4a; complete 4b, well owner information only.)

FACILITY ID #(if applicable)

NAME OF FACILITY Wayne County Landfill

STREET ADDRESS 460 S. Landfill Rd. #B

Dudley NC
City or Town State Zip Code

4b. CONTACT PERSON/WELL OWNER:

NAME

STREET ADDRESS

City or Town State Zip Code

( ) -
Area code - Phone number

5. WELL DETAILS:

a. Total Depth: 80.0 ft. Diameter: 2 in.

b. Water Level (Below Measuring Point): 24.0 ft.

Measuring point is 0 ft. above land surface.

6. CASING: Length Diameter

a. Casing Depth (if known): ft. in.

b. Casing Removed: None ft. in.

7. DISINFECTION: 2 LBS.

(Amount of 65%-75% calcium hypochlorite used)

8. SEALING MATERIAL:

Neat Cement

Cement 75 lb.
Water 30 gal.

Sand Cement

Cement lb.
Water gal.

Bentonite

Bentonite 10 lb.
Type: Slurry Pellets
Water gal.

Other

Type material

Amount

9. EXPLAIN METHOD OF EMPLACEMENT OF MATERIAL:

Material was mixed and tremied from bottom of well to land surface

10. WELL DIAGRAM: Draw a detailed sketch of the well on the back of this form showing total depth, depth and diameter of screens (if any) remaining in the well, gravel interval, intervals of casing perforations, and depths and types of fill materials used.

11. DATE WELL ABANDONED 7/9/09

I DO HEREBY CERTIFY THAT THIS WELL WAS ABANDONED IN ACCORDANCE WITH 15A NCAC 2C, WELL CONSTRUCTION STANDARDS, AND THAT A COPY OF THIS RECORD HAS BEEN PROVIDED TO THE WELL OWNER.

Leo H. Charbonneau 7/28/09
SIGNATURE OF CERTIFIED WELL CONTRACTOR DATE

SIGNATURE OF PRIVATE WELL OWNER ABANDONING THE WELL DATE
(The private well owner must be an individual who personally abandons his/her residential well in accordance with 15A NCAC 2C .0113.)

LEO H. CHARBONNEAU
PRINTED NAME OF PERSON ABANDONING THE WELL

Submit a copy to the owner and the original to the Division of Water Quality within 30 days.
Attn: Information Management, 1617 Mail Service Center – Raleigh, NC 27699-1617, Phone No. (919) 733-7015 ext 568.

Form GW-30
Rev. 5/06

APPENDIX B

Groundwater and Surface Water Sampling and Analysis Plan

Prepared for

Wayne County Closed Landfill
Dudley, North Carolina

MESCO Project Number: G11050.0

This report is included in Appendix B, part of the Corrective Action Evaluation Report

Submitted: May 10, 2011

NORTH CAROLINA LICENSED SEAL 2275 5/10/2011 GEOLOGIST MADELINE GERMAN

Madeline German, PG
Geologist

LICENSE NUMBER: C-0281
Municipal Services
P.O. BOX 97 GARNER, N.C. 27529
(919) 772-5393
Engineering Company, P.A.
P.O. BOX 348 BOONE, N.C. 28607
(828) 262-1791
P.O. BOX 828 MOREHEAD CITY, N.C. 28557 (252) 726-9481

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TABLES

Table B-1 Summary of Ground and Surface Water Monitoring Points

PLATES

Plate A Monitoring Location Map
Plate B Typical Monitoring Well
Plate C Graphical Plot of Standing Volumes of Water

1 INTRODUCTION AND OBJECTIVE

The Ground and Surface Water Sampling and Analysis Plan (SAP) objective is to provide clear guidelines and procedures for field and laboratory personnel when obtaining and analyzing groundwater and surface water samples. This plan applies to the Wayne County C&D Landfill over Closed MSW Landfill. This plan is an update and supersedes the Ground and Surface Water Sampling and Analysis Plan included in the Corrective Action Plan (CAP), approved October 2009. The sampling procedures outlined in this analysis plan are guidelines by which sampling will be performed. Deviation from the procedures may be warranted depending on facility conditions or unforeseen sampling variables. Alternative sampling procedures must conform to the Solid Waste Section Guidelines for Groundwater, Soil and Surface Water Sampling (Guidance Document).

Groundwater and surface water monitoring points shall be sampled semi-annually for the constituents listed in 40 CFR 258, Appendix I [and or select Appendix II listed constituents as promulgated in 15A NCAC 13B]. Additionally, monitoring wells MW-1, MW-2 and MW-8 will be sampled for select parameters from the following suite of Monitored Natural Attenuation (MNA) parameters, based on independent well conditions and NCDENR SWS approval. MW-1 will serve as the background MNA well.

MNA Performance Parameters		
Parameter	**Analysis Type**	**Analytical Method**
Dissolved Oxygen (DO)	Field Reading	Multi-parameter Field Instrument w/ flow-through cell
pH	Field Reading	
Oxidation-Reduction Potential (ORP)	Field Reading	
Turbidity	Field Reading	
Conductivity	Field Reading	
Temperature	Field Reading	
Dissolved CO_2	Field Reading	Field Instrument / Hach Kit
Alkalinity (Total as $CaCO_3$)*	Laboratory/Field*	SM2320B or EPA 310.2
Chloride*	Laboratory/Field*	SM 4500-CL-E or EPA 300.0
Iron	Laboratory	EPA 6010
Nitrate*	Laboratory/Field*	EPA 353.2 / SM 2320B
Sulfate*	Laboratory/Field*	ASTM D516-90 or EPA 300.0
Sulfide*	Laboratory/Field*	SM18 4500-S D or SM 4500-S2D
TOC/BOD/COD	Laboratory	SM 5310B / SM 5210B / SM 5220D
Methane	Laboratory	AM20GAX
Ethane, Ethene	Laboratory	AM20GAX
Hydrogen	Laboratory	AM20GAX
Volatile Fatty Acids	Laboratory	AM23G
*For budgetary considerations these analyses may be performed in the field using Hach® brand color wheel test kits. Historical iron concentrations have exceeded Hach kit quantitation limits.		

2 GROUNDWATER AND SURFACE WATER

2.1 ON LOCATION

2.1.1 Existing Conditions

The monitoring plan consists of eleven monitoring wells (MW-1, MW-2, MW-3, MW-4, MW-5, MW-6, MW-7, MW-8, MW-9, MW-10 and MW-11), and three surfacewater monitoring points (SW-1, SW-2 and SW-3). Monitoring points included in this plan are summarized in **Table B-1**. Locations of monitoring points are shown on **Plate A**.

Monitoring well MW-1 is the background well located upgradient of the landfill. MW-2 is a downgradient monitoring well for the western portion; designed to intersect groundwater flow from the eastern portion prior to reaching the western tributary of Edwards Branch. MW-3 is a downgradient monitoring well in the northeastern portion of the western landfill. MW-4 is installed on the eastern half of the landfill to detect a potential release from the southeastern area via advection. MW-5 is a downgradient well utilized for the detection of a release from the middle of the landfill. MW-6 is a downgradient monitoring well located on the northeastern side of the landfill, positioned to detect a release from the landfill center. MW-7 is a downgradient monitoring well for the southernmost route of contamination. MW-8 is an upgradient monitoring well for the eastern unit. MW-9 is an upgradient monitoring well located approximately 150 feet southeast of MW-8. MW-10 is a crossgradient monitoring well located approximately 180 feet southwest of MW-8. MW-11 is a down gradient monitoring well for the western portion, designed to intersect groundwater flowing between MW-2 and MW-5.

Surfacewater sampling point SW-1 is located downstream of the landfill below the confluence of the two forks of Edwards Branch. Surfacewater sampling points SW-2 and SW-3 are located upstream of the landfill on the two separate forks of Edwards Branch. Surfacewater samples from the lined landfill, SW-2 and SW-3, are commonly included due to their locations downgradient of the closed landfill. They will be included as supplementary samples, as necessary, called SW-2(shared) and SW-3(shared).

2.1.2 Potential Additions with further Corrective Action

Providing for potential contaminant plume migration is a dynamic situation. Additional wells may be added if the plume migrates or site conditions change; however, at this time no new wells are scheduled to be installed.

2.1.3 Water Quality Monitoring

Water quality monitoring will involve groundwater collection for analysis for the 40 CFR 258, Appendix I constituents [and/or select Appendix II listed constituents as promulgated in 15A NCAC 13B]. Field parameters including dissolved oxygen (DO), oxidation-reduction potential (ORP), pH, temperature, turbidity,

and conductivity will also be collected. Water quality monitoring will be performed on MW-1, MW-2, MW-3, MW-4, MW-5, MW-6, MW-7, MW-8, MW-9, MW-10 and MW-11.

2.1.4 Natural Attenuation Monitoring

Natural attenuation monitoring (MNA) will be performed on monitoring wells MW-1, MW-2 and MW-8 in addition to traditional water quality monitoring.

2.2 SAMPLING

Wells will be sampled in order from least to greatest contamination unless no information is available; then they will be sampled in order working down gradient. In both cases, background well samples will be collected prior to collecting monitoring well samples.

2.2.1 Set-Up

A clean sheet of plastic shall be placed around the well to provide a clean surface for sampling equipment. The total well depth (read from the well tag) and the measured depth to water (determined using the water level indicator) will be used to compute the depth of water in the well. The total well depth will be measured and compared to the depth indicated on the well tag as a check for siltation or blockage at depth, using the chart on **Plate C**. For example, if a two-inch well is 29 feet deep and has a measured depth to water of 10 feet, there are 19 feet of standing water or 3.3 gallons in the well.

The EPA recommends the indicator parameters: pH, specific conductance and temperature are measured on purged and recovered monitoring wells before collecting samples. When three consecutive measurements are within a 10% range, temperature and specific conductance are considered stable; pH is considered stable when three consecutive measurements are within a range of 0.2 units. Collected information, including the depth to water, pH, temperature and specific conductivity of the sample measured in the field at each well sampled will be recorded on a field data sheet or in a field logbook with copies submitted to the Division of Waste Management (DWM) with the analytical results.

Meters will be calibrated immediately prior to purging and sampling and those readings will be recorded in a field logbook or sampling data sheet. The meters will be recalibrated at the end of each sampling event and those readings will be recorded in the log also. Entries will include pre- and post- calibration readings as well as the model and serial number of the equipment and the date, time, and person performing the calibration(s). Two standards, which bracket the average or suspected measurements for pH and specific conductance, will be used at the site. Additionally, if an equipment blank needs to be run, it will be done before any sampling is started.

2.2.2 Equipment

Groundwater purging and sampling will be performed using a submersible pump and disposable polyethylene bailers. Each location will be sampled with a new bailer to prevent cross-contamination issues. The following procedure will be used to decontaminate the submersible pump:

1. Phosphate-free detergent & de-ionized or distilled water rinse.
2. De-ionized or distilled water rinse.
3. Isopropyl alcohol (isopropanol) rinse.
4. De-ionized or distilled water rinse.

Alternative sampling equipment may be warranted, depending on variable field conditions; any alternative equipment and procedures must conform to the Guidance Document. The standard equipment necessary to conduct sampling for each well consists of sample containers (including trip blanks and equipment blanks), one wide-mouth container, at least two 600-ft spools of 1/4-inch nylon rope, at least two boxes of un-powdered disposable gloves, one box of large plastic bags, temperature indicator, pH indicator, conductivity indicator, water level indicator, storage coolers and ice. If the total depth of wells to be sampled exceeds 1,200 feet, additional spools of rope will be required to complete the sampling. If the number of wells to be sampled exceeds one third of the number of pairs of gloves in stock, additional boxes of gloves will be necessary. Equipment subject to damage and contamination will be transported in sealed, plastic bags or storage containers.

Each sample container will be clearly labeled providing the site name, county location, well identification number, parameters to be analyzed, preservative added, date and time of sampling and sampler initials. Samples to be analyzed for organic content will be collected in four 40-ml glass vials with Teflon caps. The sample vials will be filled with no air left in the vials. Samples to be analyzed for inorganic contamination will be collected in a -quart/1-liter polyethylene container with ½ inch space for air permitted.

Sample containers will be obtained from an independent North Carolina certified laboratory in a sterilized condition. Some of the containers will have a pre-measured amount of preservative in them as necessary. In this event, care will be taken not to rinse the container or allow the preservative to wash out during sampling.

2.2.3 Purging

Purging is done prior to sampling to remove stagnant water from the well and to introduce fresh groundwater for sampling. Each well will be purged approximately three to five well volumes (quantity of water in the well), or until dry. In the previous example, 10 gallons would be adequate.

After determining the amount of water to be purged from a well, the equipment necessary will be assembled including rope, a 5-gallon bucket, bailer and gloves. Pull the top portion of wrapping away exposing the eyelet, keeping the bailer in a stable upright position. Using gloved hands: secure rope to the bailer via the eyelet hole and suspend to remove the remaining wrapping. These gloves are now contaminated and cannot touch the bailer or the rope. Clean, gloved hands will slowly lower the suspended bailer into the well until the bailer contacts groundwater. Cut the rope to length and secure it, to prevent loss of the bailer, again replace contaminated gloves. During purging, the rope cannot touch the ground or contaminated surfaces including, dirtied plastics, gloves, boots, etc. Many methods are available and it is to the sampler's discretion which method they prefer. The wind-mill method, looping the rope between thumbs, bucket method, where rope is lowered into a clean plastic bag lining a bucket, or simply placing plastic onto the ground near the well covering shoes, are commonly used.

If purging and sampling of a well are performed at separate times, the bailer will be left suspended in the well, above the water table, with the rope secured. The remaining rope will be removed, in order to prevent contamination issues. The rope may be doubled and grasped in a tight loop in one hand then covered by pulling the corresponding hand's glove on top, inside out. The procedure can be repeated using the other hand if necessary. The glove-encased rope will be set on top of the well head until time to sample. Alternatively, the rope remaining after securing may be gathered in a tight loop and pushed into the 2-inch PVC well pipe and left. Even when sampling immediately follows purging, new gloves will be necessary.

Based on the number of wells to be sampled and their proximity to each other, the wells may be purged one after another with sampling to follow. In this manner, if a well is purged dry, it may be allowed to recharge prior to sampling.

2.2.4 Groundwater

Samples will be collected for the various analyses in laboratory-supplied containers. Each sample container will be clearly labeled providing the following information: site name, county location, sample identification number, parameters to be analyzed, preservative added, date and time of sampling, and sampler initials.

Sample containers will be obtained from an independent laboratory in a sterilized condition and with the appropriate, method-specific preservative. Care will be taken by the field technician to not allow the preservative to wash out of the sample containers during sampling.

Bottles should be filled in the following order, in accordance with the Guidance Document:

1. Organics and Volatile Inorganics

2. Organics, Petroleum Hydrocarbons, Aggregate Organics and Oil and Grease
3. Total Metals
4. Inorganic Nonmetallics, Physical and Aggregate Properties and Biologicals
5. Micobiological

To collect a sample, lower the bailer into the well slowly, with gloved hands, to avoid releasing any volatiles from the groundwater; the bailer should not splash or smack the water surface. Once full, the bailer will be retrieved and containers filled by emptying the water through the hole at the bottom of the bailer. To top off the VOC's, collect some of the groundwater in the cap and pour it onto the sample's contents to acquire the needed meniscus to eliminate air bubbles. The polyethylene containers will be filled and sealed with the cap, leaving about 1/2 inch of airspace at the top. In addition to collecting the samples, water will be collected in the wide-mouth container for pH, temperature, and conductivity measurements. Upon completion of sampling, sample containers will be placed in labeled and sealed plastic bags, including equipment and trip blanks, and stored on ice in coolers. The used gloves and rope will be properly discarded.

Water Quality Sampling Containers

Samples to be analyzed for VOC concentrations will be collected in three 40-ml glass vials with Teflon septa caps. The sample vials will be filled with zero headspace in the vials. Samples to be analyzed for inorganic compound concentrations will be collected into various polyethylene containers, with ½ inch space for air permitted. Sample containers will be obtained from an independent laboratory in a sterilized condition. Some containers may contain a pre-measured amount of preservative, as necessary. Care will be taken not to rinse the container or to allow the preservative to wash out during sampling.

MNA Sampling Containers

Groundwater samples analyzed for select MNA performance parameters will be collected in the corresponding container types from the table below.

MNA Parameter	Volume	Bottle Type	Preservative
Alkalinity	250 mL	Plastic	none; cool to 4°C
Chloride	125 mL	Plastic	none; cool to 4°C
TOC/COD	250 mL	Glass	Sulfuric acid (H_2SO_4)
BOD	500 mL	Polyethylene	none; cool to 4°C
Iron	125 mL	Plastic	Nitric acid (HNO_3)
Nitrate	125 mL	Plastic	Sulfuric acid (H_2SO_4)
Sulfate	125 mL	Plastic	none; cool to 4°C
Sulfide	250 mL	Glass	Sodium hydroxide (NaOH)
Methane/Ethane/Ethene	125 mL	Plastic	Trisodium phosphate
Hydrogen	-	-	proprietary lab sampler
Volatile Fatty Acids	40 mL	Glass	Benzalkonium chloride

2.2.5 Surface Water

Surface water samples will be collected with consideration to minimize turbulence and aeration. Surface water samples will be collected by a field technician wearing disposable, non-powdered gloves. Surface water sample containers will be handled with gloves on, keeping one hand near the base. Containers will be dipped at location points with extreme caution in order to avoid contamination at the mouth of the container, pushing rapidly at an angle into the water, mouth up and tilted towards the stream current to fill, so as not to lose any of the preservative into the surrounding water. If there is little current movement, the container will be moved slowly through the water laterally. During times of drought, if the water is not deep enough to allow filling of the container, a pool may be scooped out of the bottom of the stream to obtain a sample. The pool will be allowed to clear before sampling. Containers will be filled in the same manner and treated as the ground water samples, sealed in labeled, plastic bags, stored in an ice-filled cooler to chill the samples to $4^{o}C$ pending transport to a NCDENR-certified analytical laboratory. In addition to collecting the samples, water will be collected in the wide-mouth container for pH, temperature and conductivity measurements.

2.2.6 Investigation Derived Waste

Any investigation derived waste (IDW) will be properly managed and disposed of to prevent contamination of previously uncontaminated areas. Water, soil, drilling mud, decontamination waste, discarded personal protective equipment and any other substance possibly contaminated during site investigations, drilling activities or daily operation procedures will be properly discarded. IDW that is determined to be RCRA-hazardous will be managed according to local, state and federal regulation. Containers for storage of IDW will be periodically inspected to ensure they are properly labeled and in good condition.

2.2.7 Chain of Custody

Chain-of-custody (C-O-C) forms will be used to document the handling of collected samples and list individuals who have taken possession of a sample set, including field personnel, laboratory couriers, and laboratory personnel. Trip blanks, equipment blanks and sample containers will travel and be stored on ice in coolers for transport to a North Carolina-certified laboratory. Trip blanks will remain in the condition they are received from the laboratory and will not be opened or tampered with during the sampling. Samples will be carefully packed to protect the integrity of the sample and maintain a temperature of approximately 4 degrees Celsius. A chain-of-custody record will be completed for each day's samples, describing each sample (including QA/QC samples), the number of containers, the sample location, the date and time, the sample matrix (soil, water, etc.), the laboratory analyses to be conducted, the signature of the sampler, the regulatory agency and the signatures of everyone through whom the samples change hands and the dates and times of the transfers.

3 ANALYSIS

When the water samples reach the laboratory, they will be transferred to a sample custodian who will sign the C-O-C documentation as receipt of the samples. Internal control of the water samples in the laboratory will be in accordance with QA/QC procedures for the laboratory. Copies of QA/QC manuals for approved laboratories are on file at the Division of Solid Waste.

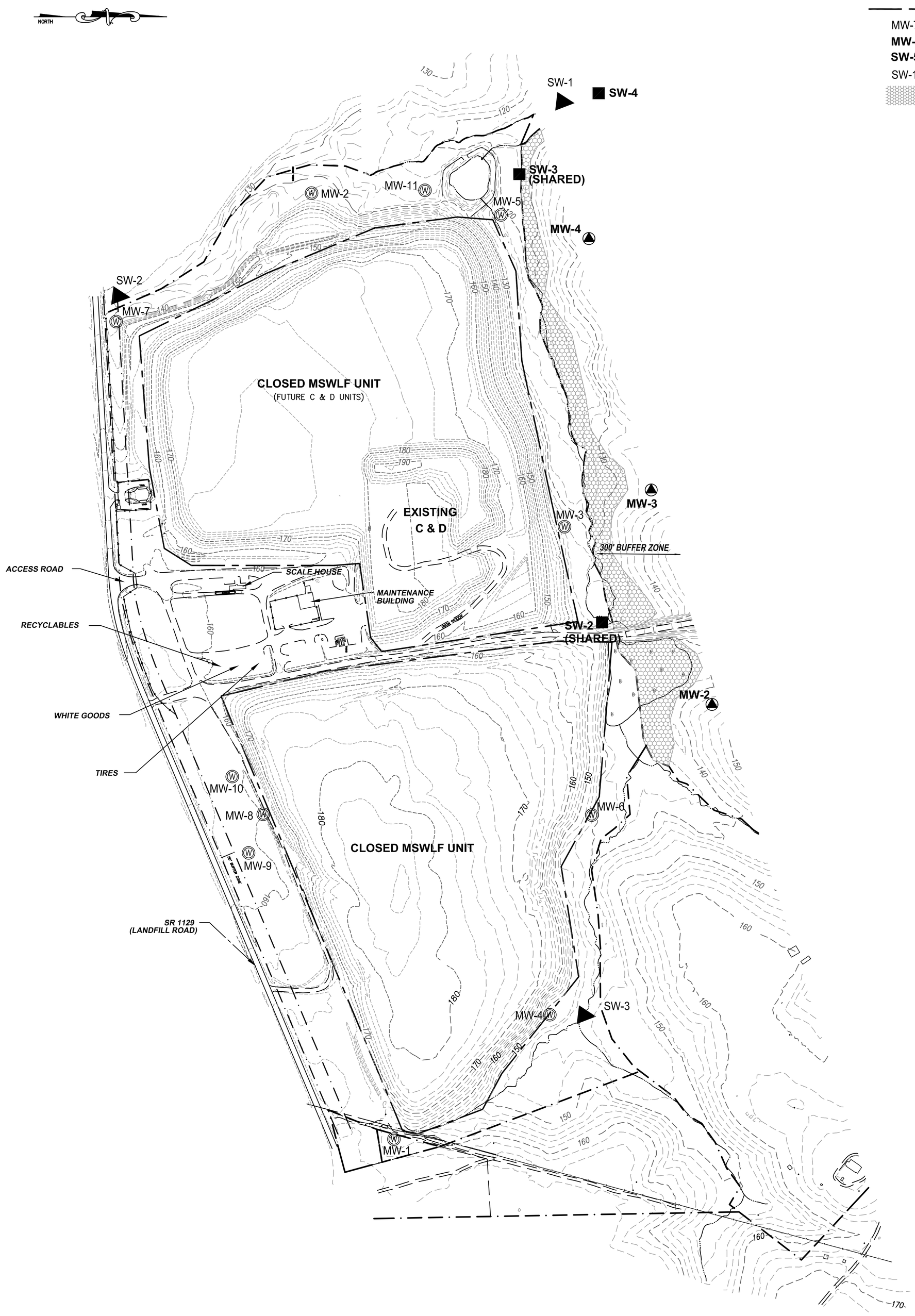
Groundwater and surface water samples will be analyzed for the Appendix I list of constituents [and/or select Appendix II listed constituents as promulgated in 15A NCAC 13B]. QA/QC procedures utilized during the testing will be in conformance with the laboratory QA/QC manual. Samples from monitoring wells MW-1, MW-2 and MW-8, will also be analyzed for the appropriate MNA performance parameters.

4 CONCLUSION

The ground and surface water monitoring plan for the Wayne County Closed Landfill is designed to be effective in the early detection of a possible release of hazardous constituents to the unconfined aquifer, and to provide indicator parameters for the natural degradation processes.

Table B-1: Existing Ground and Surface Water Monitoring Points

Sampling Point	Type	Gradient	Total Depth (ft)	Designation
MW-1	Monitoring Well	Up	25	Monitoring Well
MW-2	Monitoring Well	Down	15	Monitoring Well
MW-3	Monitoring Well	Down	18	Monitoring Well
MW-4	Monitoring Well	Down	15	Monitoring Well
MW-5	Monitoring Well	Down	18	Monitoring Well
MW-6	Monitoring Well	Down	18.14	Monitoring Well
MW-7	Monitoring Well	Down	19	Monitoring Well
MW-8	Monitoring Well	Up	29	Monitoring Well
MW-9	Monitoring Well	Up	25	Monitoring Well
MW-10	Monitoring Well	Cross	25	Monitoring Well
MW-11	Monitoring Well	Down	15	Monitoring Well
SW-1	Surface Water	Down Stream		Edwards Branch Confluence
SW-2	Surface Water	Up Stream		Western Tributary
SW-3	Surface Water	UpStream		Eastern Tributary
SW-2 (shared)	Surface Water	Down Stream		Lined – Edwards Branch
SW-3 (shared)	Surface Water	Down Stream		Lined- Edwards Branch



LEGEND

- EXISTING CONTOURS
- PROPERTY LINE
- EXISITING UNPAVED ROAD
- EXISTING CREEK, STREAM, ETC.
- EXISTING DIVERSION DITCHES
- CLOSED MSWLF SANITARY UNIT
- MW-7 MONITORING WELLS C&D LANDFILL
- **MW-1** MONITORING WELLS SUBTITLE D
- **SW-5** SURFACE WATER SAMPLING SUBTITLE D
- SW-1 SURFACE WATER SAMPLING C&D
- WETLANDS

GRAPHIC SCALE

200 0 100 200 400 800

(IN FEET)
1 inch = 200 ft.

PLATE A

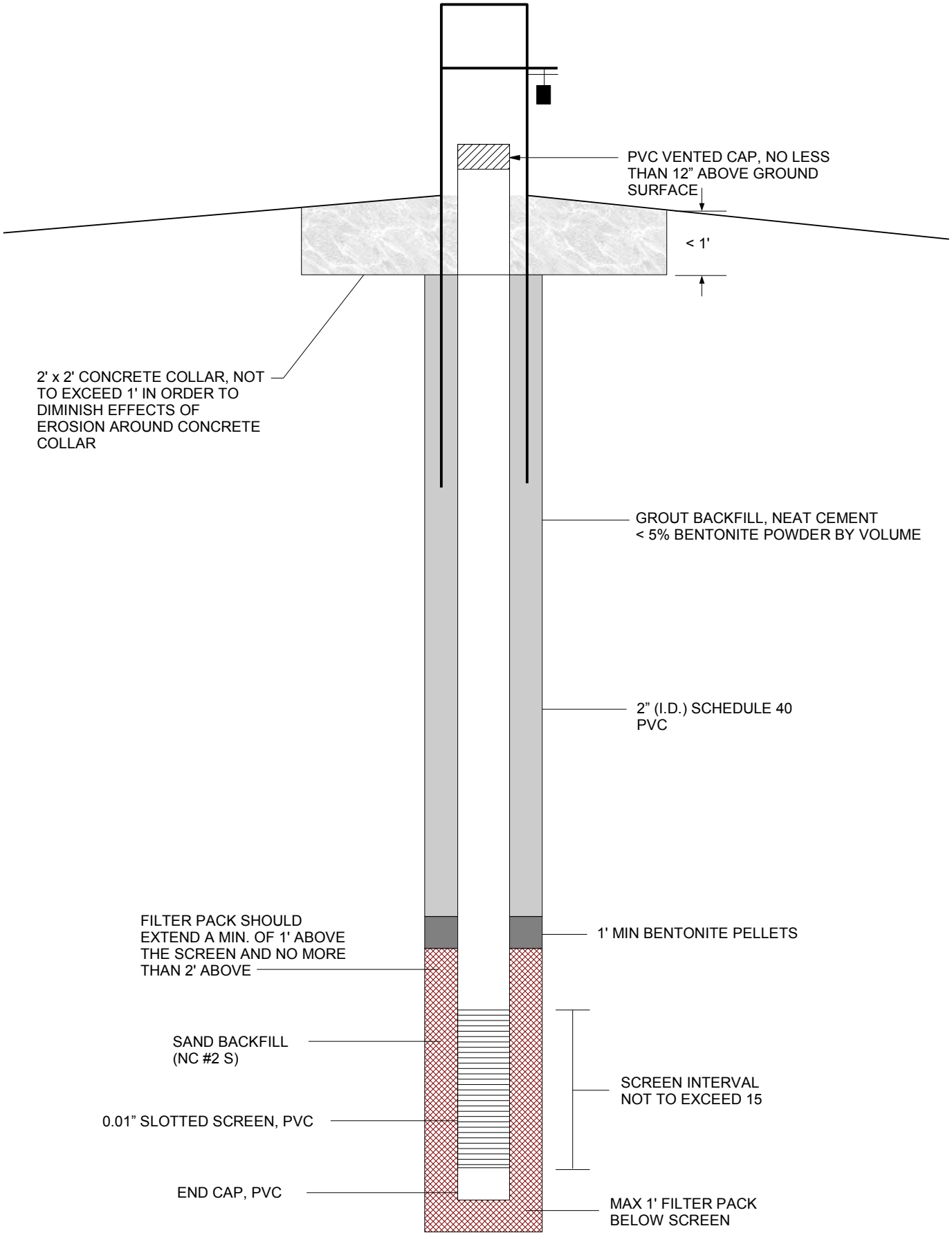
DRAWING NO.	PLATE A
SHEET NO.	1 OF 1
PROJECT NUMBER	G11050.0
CHKD. BY:	M. GERMAN
DRWN. BY:	M. GERMAN
DATE:	04/25/2011
SCALE:	1" = 200'

DATE	BY	REV.	DESCRIPTION

MONITORING LOCATION MAP

MUNICIPAL SOLID WASTE LANDFILL FACILITY
WAYNE COUNTY NORTH CAROLINA

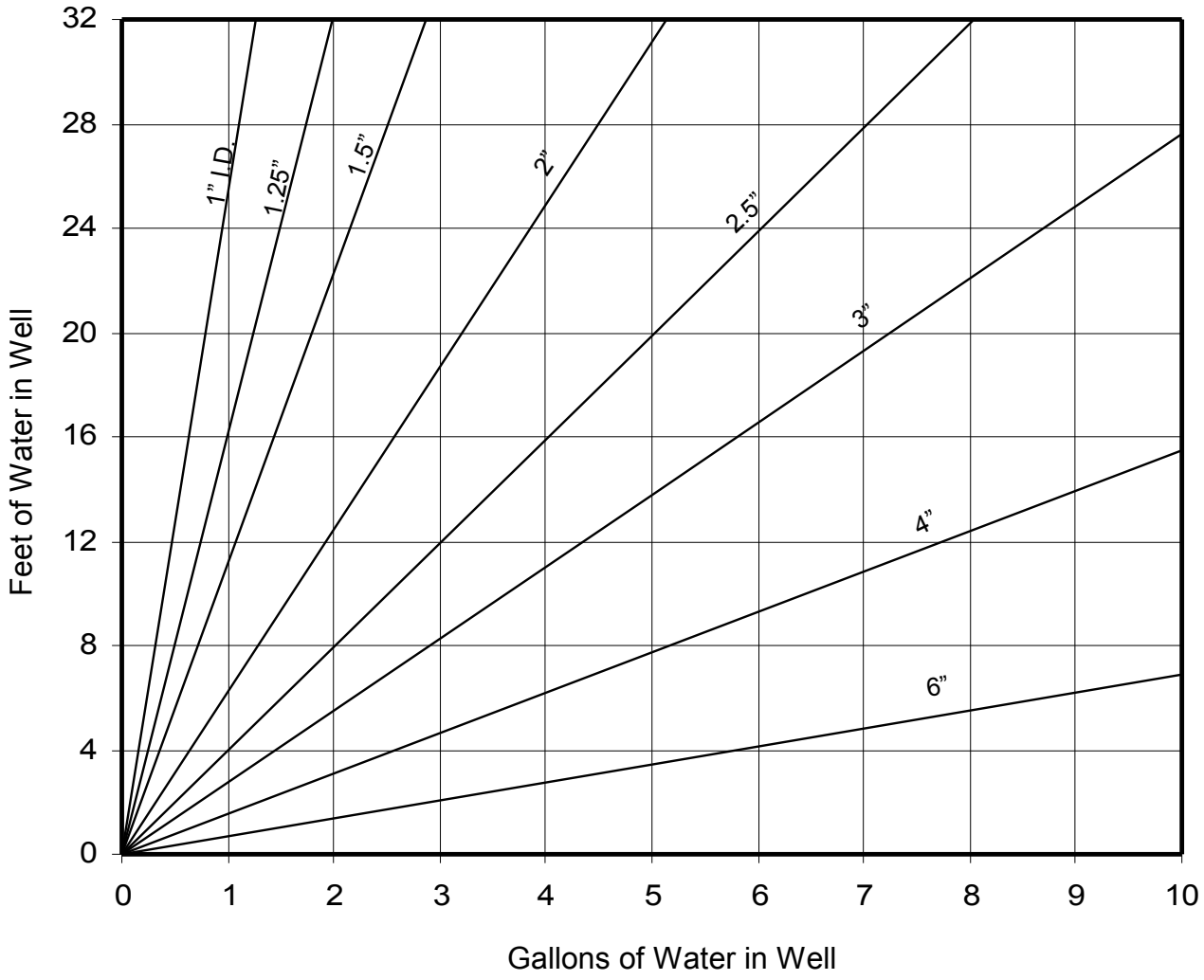
LICENSE NUMBER: C-0281
Municipal Services Engineering Company, P.A.
P.O. BOX 97 GARNER, N.C. 27529 (919) 772-5393
P.O. BOX 349 BOONE, N.C. 28607 (828) 262-1767
P.O. BOX 828 MOREHEAD CITY, N.C. 28557 (252) 726-9481



NOTE: SHALLOW WELLS REQUIRE A MINIMUM OF 5' COMBINED THICKNESS OF GROUT AND BENTONITE.

TYPICAL MONITORING WELL

PLATE B



GRAPHICAL PLOT OF STANDING VOLUMES OF WATER

PLATE C

APPENDIX C

BIOSCREEN Natural Attenuation Decision Support System

Air Force Center for Environmental Excellence — *Version 1.4*

Wayne County
MW-2 (benzene)
Run Name

Data Input Instructions:

115 → *1. Enter value directly....or*
↑ *or*
0.02 → *2. Calculate by filling in grey cells below. (To restore formulas, hit button below).*

Variable* → *Data used directly in model.*
20 → *Value calculated by model. (Don't enter any data).*

1. HYDROGEOLOGY

Seepage Velocity*	*Vs*	30.9	*(ft/yr)*
or		↑ *or*	
Hydraulic Conductivity	*K*	3.0E-04	*(cm/sec)*
Hydraulic Gradient	*i*	0.0199	*(ft/ft)*
Porosity	*n*	0.2	*(-)*

2. DISPERSION

Longitudinal Dispersivity*	*alpha x*	12.5	*(ft)*
Transverse Dispersivity*	*alpha y*	1.3	*(ft)*
Vertical Dispersivity*	*alpha z*	0	*(ft)*
or		↑ *or*	
Estimated Plume Length	*Lp*	250	*(ft)*

3. ADSORPTION

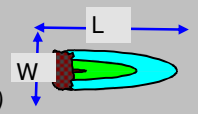
Retardation Factor*	*R*	4.8	*(-)*
or		↑ *or*	
Soil Bulk Density	*rho*		*(kg/l)*
Partition Coefficient	*Koc*		*(L/kg)*
FractionOrganicCarbon	*foc*		*(-)*

4. BIODEGRADATION

1st Order Decay Coeff*	*lambda*	0.35	*(per yr)*
or		↑ *or*	
Solute Half-Life	*t-half*	2.00	*(year)*
or Instantaneous Reaction Model			
Delta Oxygen*	*DO*	0.7	*(mg/L)*
Delta Nitrate*	*NO3*	0.04	*(mg/L)*
Observed Ferrous Iron*	*Fe2+*	53	*(mg/L)*
Delta Sulfate*	*SO4*	85.8	*(mg/L)*
Observed Methane*	*CH4*	4.6	*(mg/L)*

5. GENERAL

Modeled Area Length*	340	*(ft)*
Modeled Area Width*	365	*(ft)*
Simulation Time*	5	*(yr)*



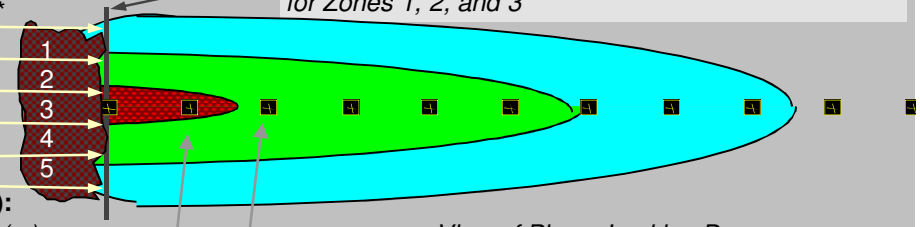
6. SOURCE DATA

Source Thickness in Sat.Zone* 10 *(ft)*

Source Zones:

Width* (ft)	Conc. (mg/L)*
150	0.011
20	0.02
150	0.011
0	0

Vertical Plane Source: Look at Plume Cross-Section and Input Concentrations & Widths for Zones 1, 2, and 3



View of Plume Looking Down

Source Halflife (see Help): <1 | 500 *(yr)*

Inst. React. ↑ ↑ 1st Order

Soluble Mass 5 *(Kg)*
In Source NAPL, Soil

Observed Centerline Concentrations at Monitoring Wells If No Data Leave Blank or Enter "0"

7. FIELD DATA FOR COMPARISON

Concentration (mg/L)							.003				
Dist. from Source (ft)	0	34	68	102	136	170	204	238	272	306	340

8. CHOOSE TYPE OF OUTPUT TO SEE:

RUN CENTERLINE — **View Output**

RUN ARRAY — **View Output**

Help

Recalculate This Sheet

Paste Example Dataset

Restore Formulas for Vs, Dispersivities, R, lambda, other

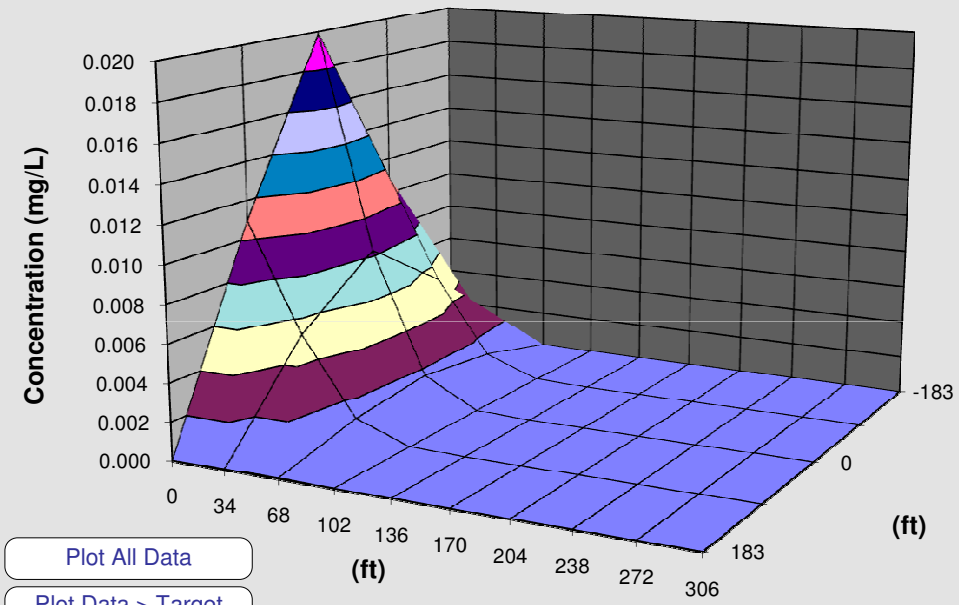
DISSOLVED HYDROCARBON CONCENTRATIONS IN PLUME (mg/L at Z=0)

Transverse Distance (ft) ↓	Distance from Source (ft) 0	34	68	102	136	170	204	238	272	306	340
183	0.000	0.000	0.000	6.097E-06	1.565E-07	9.155E-10	1.259E-12	4.110E-16	0.00E+00	0.00E+00	0.00E+00
91	0.011	0.005	0.001	7.654E-05	1.404E-06	6.640E-09	7.867E-12	2.298E-15	0.00E+00	0.00E+00	0.00E+00
0	0.020	0.008	0.002	1.059E-04	1.877E-06	8.664E-09	1.008E-11	2.902E-15	0.00E+00	0.00E+00	0.00E+00
-91	0.011	0.005	0.001	7.654E-05	1.404E-06	6.640E-09	7.867E-12	2.298E-15	0.00E+00	0.00E+00	0.00E+00
-183	0.000	0.000	0.000	6.097E-06	1.565E-07	9.155E-10	1.259E-12	4.110E-16	0.00E+00	0.00E+00	0.00E+00
MASS FLUX (mg/day)	1.8E+1	8.2E+0	1.8E+0	1.2E-1	2.2E-3	1.0E-5	1.2E-8	3.6E-12	0.0E+0	0.0E+0	0.0E+0

Time: **5 Years** Target Level: **0.001** mg/L Displayed Model: **No Degradation**

Model to Display:

- *No Degradation Model*
- *1st Order Decay Model*
- *Instantaneous Reaction Model*



Plot All Data

Plot Data > Target

Plume and Source Masses (Order-of-Magnitude Accuracy)

Plume Mass if No Biodegradation	3.2E-02	*(Kg)*
- Actual Plume Mass	3.2E-02	*(Kg)*
= Plume Mass Removed by Biodeg	**0.0E+00**	*(Kg)*
	0 %	

Change in Electron Acceptor/Byproduct Masses:

Oxygen	*Nitrate*	*Iron II*	*Sulfate*	*Methane*	
na	na	na	na	na	*(Kg)*

Contam. Mass in Source (t=0 Years)	5.0	*(Kg)*
Contam. Mass in Source Now (t=5Years)	5.0	*(Kg)*
Current Volume of Groundwater in Plume	0.9	*(ac-ft)*
Flowrate of Water Through Source Zone	0.454	*(ac-ft/yr)*

Mass HELP

Recalculate

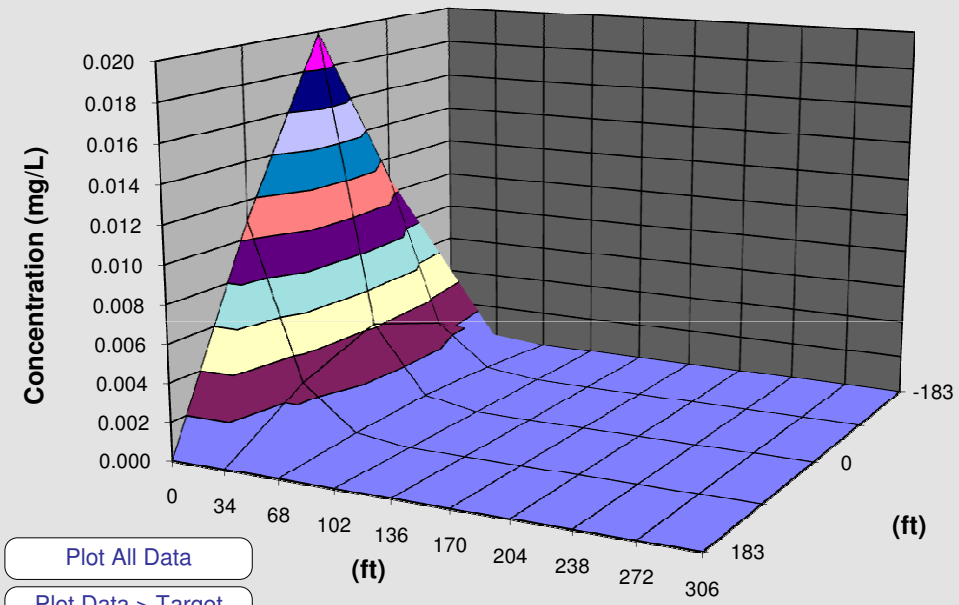
DISSOLVED HYDROCARBON CONCENTRATIONS IN PLUME (mg/L at Z=0)

Transverse Distance (ft) ↓	Distance from Source (ft) 0	34	68	102	136	170	204	238	272	306	340
183	0.000	0.000	0.000	1.610E-06	3.691E-08	2.020E-10	2.662E-13	8.441E-17	0.00E+00	0.00E+00	0.00E+00
91	0.011	0.003	0.000	2.022E-05	3.311E-07	1.465E-09	1.664E-12	4.720E-16	0.00E+00	0.00E+00	0.00E+00
0	0.020	0.004	0.001	2.796E-05	4.428E-07	1.912E-09	2.131E-12	5.960E-16	0.00E+00	0.00E+00	0.00E+00
-91	0.011	0.003	0.000	2.022E-05	3.311E-07	1.465E-09	1.664E-12	4.720E-16	0.00E+00	0.00E+00	0.00E+00
-183	0.000	0.000	0.000	1.610E-06	3.691E-08	2.020E-10	2.662E-13	8.441E-17	0.00E+00	0.00E+00	0.00E+00
MASS FLUX (mg/day)	1.8E+1	4.1E+0	5.8E-1	3.1E-2	5.2E-4	2.3E-6	2.6E-9	7.5E-13	0.0E+0	0.0E+0	0.0E+0

Model to Display:

- *No Degradation Model*
- *1st Order Decay Model*
- *Instantaneous Reaction Model*

Time: **5 Years** Target Level: **0.001** mg/L Displayed Model: **1st Order Decay**



Plot All Data

Plot Data > Target

Plume and Source Masses (Order-of-Magnitude Accuracy)

Plume Mass if No Biodegradation	3.2E-02	*(Kg)*
- Actual Plume Mass	4.8E-03	*(Kg)*
= Plume Mass Removed by Biodeg	**2.7E-02**	*(Kg)* (85 %)

Change in Electron Acceptor/Byproduct Masses:

Oxygen	*Nitrate*	*Iron II*	*Sulfate*	*Methane*	
na	na	na	na	na	*(Kg)*

Contam. Mass in Source (t=0 Years)	5.0	*(Kg)*
Contam. Mass in Source Now (t=5Years)	5.0	*(Kg)*
Current Volume of Groundwater in Plume	0.4	*(ac-ft)*
Flowrate of Water Through Source Zone	0.454	*(ac-ft/yr)*

Mass HELP

Recalculate

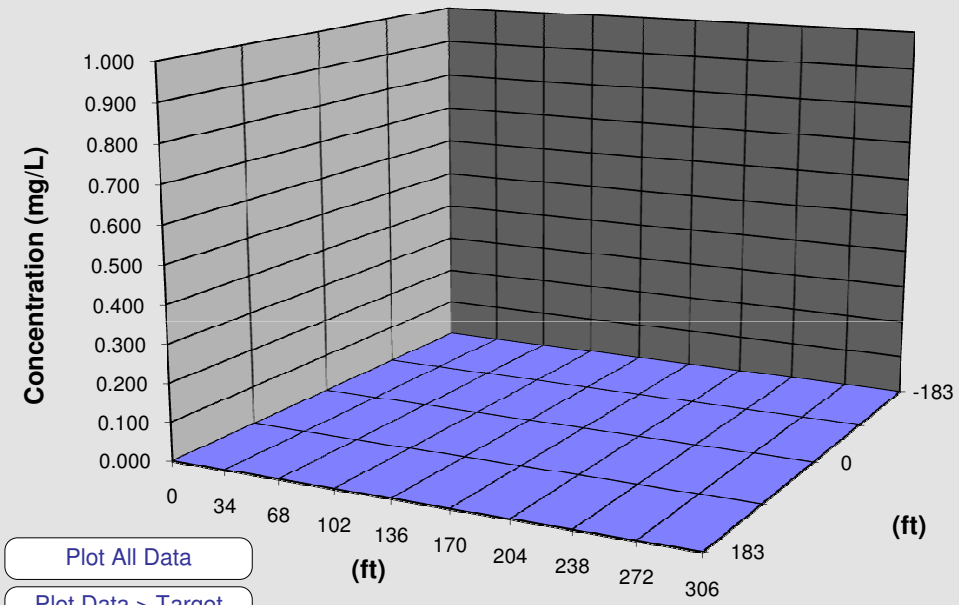
DISSOLVED HYDROCARBON CONCENTRATIONS IN PLUME (mg/L at Z=0)

Transverse Distance (ft) ↓	Distance from Source (ft) 0	34	68	102	136	170	204	238	272	306	340
183	0.000	0.000	0.000	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.00E+00	0.00E+00	0.00E+00
91	0.000	0.000	0.000	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.00E+00	0.00E+00	0.00E+00
0	0.000	0.000	0.000	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.00E+00	0.00E+00	0.00E+00
-91	0.000	0.000	0.000	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.00E+00	0.00E+00	0.00E+00
-183	0.000	0.000	0.000	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.00E+00	0.00E+00	0.00E+00
MASS FLUX (mg/day)	1.8E+1	0.0E+0	0.0E+0	0.0E+0	0.0E+0	0.0E+0	0.0E+0	0.0E+0	0.0E+0	0.0E+0	0.0E+0

Time: **5 Years** Target Level: **0.001** mg/L Displayed Model: **Inst. Reaction**

Model to Display:

- *No Degradation Model*
- *1st Order Decay Model*
- *Instantaneous Reaction Model*



Plot All Data

Plot Data > Target

Plume and Source Masses (Order-of-Magnitude Accuracy)

Plume Mass if No Biodegradation	5.0E+00	*(Kg)*
- Actual Plume Mass	0.0E+00	*(Kg)*
= Plume Mass Removed by Biodeg	**5.0E+00**	*(Kg)* (100 %)

Change in Electron Acceptor/Byproduct Masses:

Oxygen	*Nitrate*	*Iron II*	*Sulfate*	*Methane*	
-0.1	-0.0	+9.9	-16.0	+0.9	*(Kg)*

Contam. Mass in Source (t=0 Years)	5.0	*(Kg)*
Contam. Mass in Source Now (t=5Years)	0.0	*(Kg)*
Current Volume of Groundwater in Plume	0.0	*(ac-ft)*
Flowrate of Water Through Source Zone	0.454	*(ac-ft/yr)*

Mass HELP

Recalculate

Natural Attenuation Screening Protocol

The following is taken from the USEPA protocol (USEPA, 1998). The results of this scoring process have no regulatory significance.

Interpretation	Score
Inadequate evidence for anaerobic biodegradation* of chlorinated organics	0 to 5
Limited evidence for anaerobic biodegradation* of chlorinated organics	6 to 14
Adequate evidence for anaerobic biodegradation* of chlorinated organics	15 to 20
Strong evidence for anaerobic biodegradation* of chlorinated organics	>20

* reductive dechlorination

Score: 11

Scroll to End of Table

Analysis	Concentration in Most Contam. Zone	Interpretation	Yes	No	Points Awarded
Oxygen*	<0.5 mg/L	Tolerated, suppresses the reductive pathway at higher concentrations	○	◉	0
	> 5mg/L	Not tolerated; however, VC may be oxidized aerobically	◉	○	-3
Nitrate*	<1 mg/L	At higher concentrations may compete with reductive pathway	○	◉	0
Iron II*	>1 mg/L	Reductive pathway possible; VC may be oxidized under Fe(III)-reducing conditions	◉	○	3
Sulfate*	<20 mg/L	At higher concentrations may compete with reductive pathway	○	◉	0
Sulfide*	>1 mg/L	Reductive pathway possible	○	◉	0
Methane*	>0.5 mg/L	Ultimate reductive daughter product, VC Accumulates	◉	○	3
Oxidation Reduction Potential* (ORP)	<50 millivolts (mV)	Reductive pathway possible	○	○	
	<-100mV	Reductive pathway likely	○	○	
pH*	5 < pH < 9	Optimal range for reductive pathway	◉	○	0
TOC	>20 mg/L	Carbon and energy source; drives dechlorination; can be natural or anthropogenic	◉	○	2
Temperature*	>20°C	At T >20°C biochemical process is accelerated	○	◉	0
Carbon Dioxide	>2x background	Ultimate oxidative daughter product	○	○	
Alkalinity	>2x background	Results from interaction of carbon dioxide with aquifer minerals	◉	○	1
Chloride*	>2x background	Daughter product of organic chlorine	◉	○	2
Hydrogen	>1 nM	Reductive pathway possible, VC may accumulate	◉	○	3
Volatile Fatty Acids	>0.1 mg/L	Intermediates resulting from biodegradation of aromatic compounds; carbon and energy source	○	◉	0
BTEX*	>0.1 mg/L	Carbon and energy source; drives dechlorination	○	◉	0
PCE*		Material released	○	◉	0
TCE*		Daughter product of PCE [a/]	○	◉	0
DCE*		Daughter product of TCE. If cis is greater than 80% of total DCE it is likely a daughter product of TCE[a/]; 1,1-DCE can be a chem. reaction product of TCA	○	◉	0
VC*		Daughter product of DCE[a/]	○	◉	0
1,1,1-Trichloroethane*		Material released	○	◉	0
DCA		Daughter product of TCA under reducing conditions	○	◉	0
Carbon Tetrachloride		Material released	○	◉	0
Chloroethane*		Daughter product of DCA or VC under reducing conditions	○	◉	0
Ethene/Ethane	>0.01 mg/L	Daughter product of VC/ethene	○	◉	0
	>0.1 mg/L	Daughter product of VC/ethene	○	◉	0
Chloroform		Daughter product of Carbon Tetrachloride	○	◉	0
Dichloromethane		Daughter product of Chloroform	○	◉	0

* required analysis.

a/ Points awarded only if it can be shown that the compound is a daughter product (i.e., not a constituent of the source NAPL).

SCORE

Reset

End of Form