PREPARED FOR:

TOWN OF KERNERSVILLE
PUBLIC WORKS DEPARTMENT
P.O. BOX 728
KERNERSVILLE, NORTH CAROLINA 27285-0728

TOWN OF KERNERSVILLE LANDFILL
PERMIT NO. 34-04

CORRECTIVE ACTION PLAN

OCTOBER 2014

PREPARED BY:

2211 WEST MEADOWVIEW ROAD, SUITE 101
GREENSBORO, NORTH CAROLINA 27407
NC LICENSE NUMBER: C-0782
PHONE: (336) 323-0092
FAX: (336) 323-0093

JOYCE PROJECT NO. 00838.1501.12, TASK 04

CORRECTIVE ACTION PLAN

TOWN OF KERNERSVILLE LANDFILL
KERNERSVILLE, NC
PERMIT NUMBER 34-04

OCTOBER 2014

Prepared by:

JOYCE ENGINEERING

2211 West Meadowview Road, Suite 101
Greensboro NC, 27404

This Corrective Action Plan (CAP) was prepared in accordance with the requirements of 15A NCAC 13B and generally accepted standards of environmental practice for the exclusive use of and reliance upon by the referenced client for specific application to the referenced site. No other warranty is either expressed or implied.

Reuse and reliance of this document by other parties, or for purposes other than those specified, without written authorization, will be at the sole risk of the party or parties utilizing this document. Joyce Engineering, Inc. shall incur no liability resulting from claims, damages, losses, and expenses that might arise from unauthorized use and reliance of this document.

Conclusions presented in this report are based upon a review of available information, results of our field studies, results of chemical analyses, and professional judgment. Our conclusions do not reflect variations in subsurface groundwater quality that might exist between or beyond sampling points or between specific sampling events.

To the best of our knowledge, information provided by others is true and accurate, unless otherwise noted.

NORTH CAROLINA LICENSED SEAL 1349 GEOLOGIST G. VAN NESS BURBACH

G. Van Ness Burbach, Ph.D., P.G.
NC License # 1349

CORRECTIVE ACTION PLAN
Town of Kernersville Landfill, Permit No. 34-04

Executive Summary

On behalf of the Town of Kernersville, Joyce Engineering (JOYCE) has prepared this Corrective Action Plan (CAP) for the Town of Kernersville Landfill (facility). This CAP has been prepared in accordance with 15A NCAC 13B § .0500 and .0600 of the North Carolina Solid Waste Management Regulations (NCSWMR) and in response to the Groundwater Protection Standard (GPS) exceedances for several volatile organic compounds (VOCs) in groundwater monitoring wells at the facility.

On November 1, 2012, the Town of Kernersville (the Town) received notification from the North Carolina Department of Natural Resources (DENR) that because of the detection of groundwater impacts at the site that could potentially be crossing the property boundary, the Town needed to submit a Phased Groundwater Assessment Plan and complete the described groundwater assessment. In January 2013, JOYCE, on behalf of the Town, submitted a Groundwater Assessment Plan, which was approved by the DENR on February 14, 2013. In May 2013, JOYCE submitted a Groundwater Assessment Report for the facility. In a letter dated July 16, 2013, the DENR approved the Groundwater Assessment Report and called for the Town to select a remedy and submit Corrective Action Application within 1 year of the date of that letter. In July 2014, on behalf of the Town, JOYCE submitted the Corrective Action Application selecting Monitored Natural Attenuation (MNA) plus phytoremediation as the remedy. The remedy was approved by DENR in a letter dated July 23, 2014.

This CAP presents MNA plus phytoremediation as the selected remedy for groundwater remediation at the Town of Kernersville Landfill, and lays out plans to implement this remedy, as well as contingency plans in case the selected remedy proves ineffectual. This CAP also includes an updated Water Quality Monitoring Plan (WQMP) for the facility incorporating monitoring for the CAP. The selected remedy is believed to be protective of human health and the environment, capable of attaining the GPS for the solid waste constituents experiencing GPS exceedances, and compliant with standards for managing wastes.

CORRECTIVE ACTION PLAN
Town of Kernersville Landfill, Permit No. 34-04

TABLE OF CONTENTS

EXECUTIVE SUMMARY i

1.0 INTRODUCTION 1
1.1 Site Background 1
1.2 Groundwater Monitoring Network 1
1.3 Surface Water Monitoring 2
1.4 Aquifer Characteristics and Groundwater Flow 2
1.4.1 Groundwater Flow 3
1.4.2 Vertical Gradients 3
1.5 Contaminant Distribution 3
1.6 Site Conceptual Model 4
1.6.1 Site Geology 4
1.6.2 Site Hydrogeology 5
1.7 Regulatory Status 5

2.0 CONTAMINANT CHARACTERIZATION 6
2.1 Constituents of Concern 6
2.2 Characteristics of COCs 6
2.2.1 Benzene 7
2.2.2 1,1-Dichloroethane 7
2.2.3 1,2-Dichloroethane 7
2.2.4 cis-1,2-Dichloroethylene 8
2.2.5 1,2-Dichloropropane 8
2.2.6 Tetrachloroethylene 9
2.2.7 Trichloroethylene 9
2.2.8 Vinyl Chloride 10
2.3 Contaminant Source Confirmation 10
2.4 Source Control Measures 11
2.5 Groundwater End Use 11
2.6 Sensitive Receptor Pathways 11
2.7 Background Concentrations 12
2.8 Groundwater Protection Standards (GPS) 12
2.9 Surface Water Quality Standards (SWQS) 13
2.10 Media of Concern 13

3.0 SELECTED AND APPROVED REMEDY / TECHNICAL APPROACH 14
3.1 Selection of Remedy 14
3.2 MNA Evaluation 14
3.2.1 Evaluation of Anaerobic Degradation of Contaminants 16
3.2.2 Evaluation of Aerobic Degradation of Contaminants 17

CORRECTIVE ACTION PLAN
Town of Kernersville Landfill, Permit No. 34-04

TABLE OF CONTENTS

3.2.3 Summary of MNA Evaluation 17
3.2.4 MNA Monitoring and Modeling 18
3.3 Phytoremediation Evaluation 19
3.4 Remedy Evaluation Factors 21
3.4.1 Long-Term and Short-Term Effectiveness 21
3.4.2 Controlling the Source 23
3.4.3 Remedy Implementation 23
3.4.4 Owner/Operator Capability 24
3.4.5 Community Concerns 24

4.0 WATER QUALITY MONITORING PLAN 25
4.1 Introduction 25
4.1.1 Site Description 25
4.1.2 Site Geology and Hydrogeology 25
4.2 Groundwater Monitoring 26
4.2.1 Installation and Maintenance of the Groundwater Monitoring Network 26
4.2.2 Well Abandonment 27
4.2.3 Groundwater Sampling Methodology 27
4.2.4 Static Water Levels 27
4.2.5 Purging and Sampling Methodology 27
4.2.6 Sample Collection, Bottling, and Transportation 28
4.2.7 Field/Equipment and Trip Blanks 30
4.3 Sample Analytical Requirements 31
4.3.1 Semiannual Compliance Monitoring 31
4.3.2 Corrective Action Monitoring 31
4.4 Reporting and Record Keeping 32
4.5 Comparisons to Standards 33
4.6 Surface Water Monitoring 33
4.7 Ability to Effectively Monitor Releases 34

5.0 EVALUATION OF EFFECTIVENESS AND REPORT SUBMITTALS 34
5.1 Physical and Chemical Changes in Aquifer Conditions 34
5.2 Physical and Chemical Changes in Plume Characteristics 34
5.3 Refining the Site Conceptual Model 35
5.4 Evaluation of Remedy Effectiveness 35

6.0 CORRECTIVE ACTION PROGRAM REPORTING 36

7.0 CONTINGENCY PLAN 36
7.1 Contingency Remedies 36
7.2 Triggering Events 37

TABLE OF CONTENTS

7.3 Performance Criteria for Contingency Plan 38

8.0 SCHEDULE AND MAINTENANCE 38

8.1 Schedule Considerations 38
8.2 Timeline 39
8.3 Operations and Maintenance (O&M) 39
8.4 Safeguards and Safety 39
8.5 Modification of Corrective Action or Schedule 40

9.0 COMPLETION OF CORRECTIVE ACTION 40

10.0 REFERENCES 40

11.0 ACRONYMS 43

CORRECTIVE ACTION PLAN
Town of Kernersville Landfill, Permit No. 34-04

TABLE OF CONTENTS

TABLES

Table 1 Historical Groundwater Elevations
Table 2 Estimated Hydraulic Gradient and Linear Flow Velocity
Table 3 GPS Exceedances since November 2011
Table 4 Historical Groundwater Constituents
Table 5 Historical Surface Water Constituents
Table 6 Monitored Natural Attenuation Parameters
Table 7 EPA Biodegradation Screening Matrix
Table 8 Corrective Action Implementation Schedule

CHART

Chart 1 VOC Concentrations vs. Time

FIGURES

Figure 1 Site Location Map
Figure 2 Geologic Map

DRAWINGS

Drawing 1 Groundwater Surface Map (June 5, 2014)
Drawing 2 Total VOCs Isoconcentration Map (June 5, 2014)
Drawing 3 Tree Survey (August 21, 2014)

APPENDICES

Appendix A NC Appendix I and II Constituents with Groundwater Standards
Appendix B NC-2B Surface Water Standards
Appendix C Laboratory Report, Chain of Custody, & Field Logs (June 2014 MNA Data)
Appendix D BIOCHLOR Modeling Input & Output
Appendix E Sample Field Log and Chain of Custody
Appendix F Tree Inspection Form

CORRECTIVE ACTION PLAN
Town of Kernersville Landfill, Permit No. 34-04

1.0 INTRODUCTION

On behalf of the Town of Kernersville, Joyce Engineering (JOYCE) has prepared this Corrective Action Plan (CAP) for the Town of Kernersville Landfill, Permit #34-04 (facility). This CAP has been prepared in accordance with 15A NCAC 13B § .0500 and .0600 of the North Carolina Solid Waste Management Rules (NCSWMR) and in response to the Groundwater Protection Standard (GPS) exceedances for several volatile organic compounds (VOCs) in groundwater monitoring wells at the facility.

1.1 Site Background

The Town of Kernersville Landfill is a closed, unlined municipal solid waste (MSW) landfill located on approximately 58.2 acres in Forsyth and Guilford Counties, NC, approximately 10 miles north of the City of Kernersville. The waste disposal area comprises approximately 13.8 acres. The property boundary is indicated on an excerpt from the 7.5 minutes USGS topographic map for Belews Creek, North Carolina (Figure 1). The facility was issued a Permit to Operate on May 15, 1985 and a letter of closure was issued on December 10, 1991.

The area surrounding the landfill is zoned residential/agricultural and contains open fields and woodlands. The landfill is separated from the Waste Management Piedmont Landfill and Recycling Center Facility to the north by Freeman Road. The landfill is bounded to the south and southwest by an unnamed tributary of Belews Creek. Groundwater at the site flows to the southwest toward the unnamed tributary. Drawing 1 presents a site map showing the layout of the facility.

1.2 Groundwater Monitoring Network

The current groundwater compliance monitoring network includes six monitoring wells, including one upgradient well (MW-6) and five downgradient wells (MW-2, MW-3S, MW-3D, MW-4 and MW-5). Monitoring well MW-6 serves as the background well for the facility. Monitoring well MW-6 replaced MW-1 as the facility's background well due to MW-1 frequently having insufficient water column to sample. Downgradient monitoring wells MW-2, MW-3S, MW-3D, MW-4, and MW-5 are monitored as part of the compliance network for the facility. MW-1 is monitored for water levels only, as conditions permit. Groundwater samples are collected semiannually during the second and fourth quarters. Samples are analyzed for all constituents listed in the NCSWMR Appendix I during both semiannual events. The locations of the monitoring wells are shown on Drawing 1. These wells are summarized below, along with their current monitoring program status.

Monitoring Well	Classification	Monitoring Program	Total Depth from TOC* (ft)
MW-1	Former Background	Water Levels Only	34.69
MW-2	Compliance	Detection (.0500)	13.18
MW-3S	Compliance	Detection (.0500)	24.00
MW-3D	Compliance	Detection (.0500)	56.96
MW-4	Compliance	Detection (.0500)	14.40
MW-5	Compliance	Detection (.0500)	11.36
MW-6	Background	Detection (.0500)	20.46

*TOC = Top of casing.

1.3 Surface Water Monitoring

Surface water at the site is monitored semiannual in conjunction with the groundwater sampling events. Samples are collected from three surface water monitoring points (SW-1, SW-2, and SW-3). The locations of the surface water monitoring points are shown on Drawing 1, and are described in the table below. Surface water samples will be collected and analyzed for the NCSWMR Appendix I list of constituents during both semiannual monitoring events. The results will be compared to the 15A NCAC 2B (NC 2B) Surface Water Standards in a value-to-value comparison.

Sampling Point	Description
SW-1	Creek on the southwest side of the Town of Kernersville Landfill. Upstream of the landfill.
SW-2	Creek on southwest side of the Town of Kernersville Landfill. Downstream of MW-4 at the property boundary.
SW-3	Creek on the southwest side of the Town of Kernersville Landfill, near MW-2. Upstream of SW-2 and downstream of SW-1.

1.4 Aquifer Characteristics and Groundwater Flow

The water table under the area of investigation was encountered in the unconfined aquifer that is mostly in saprolite, but is believed to grade into highly fractured bedrock with depth. Groundwater in the saprolite feeds the fractures in the bedrock and is discharged into creeks south and southwest of the landfill. Groundwater flow at deeper levels within the fractured bedrock is controlled by fracture orientation and connectivity. This unconfined aquifer is pervasive across the site and the water table generally mimics the surface topography.

Depth to groundwater at the site ranges from approximately 2-5 feet below ground surface (ft-bgs) on the downgradient (southwest) side of the site, to about 28-33 ft-bgs near the northeast corner of the waste unit. Groundwater elevation ranges from approximately 785 feet above mean sea level (ft-amsl) on the upgradient side of the site to approximately 755 ft-amsl on the down gradient side of the site. Groundwater flow direction at the site is from the northeast to the southwest. Historical groundwater elevation data for the facility are presented in Table 1. The

groundwater elevations and flow direction based on the June 5, 2014 water level data are shown on Drawing 1.

1.4.1 Groundwater Flow

Using the hydraulic gradients shown on Drawing 1 based on June 2014 water level data, the linear flow velocity (***V***) was estimated using the modified Darcy equation: ***V=Ki/n***. The hydraulic gradient (***i***) is 0.033 ft/ft for the flow path shown on Drawing 1. An effective porosity value (***n***) of 0.30 (30%) was estimated based on typical values of porosity for saprolite aquifers in the Piedmont, and a hydraulic conductivity (***K***) 1.73 ft/day was estimated from slug tests completed by JOYCE in April 2013 (JOYCE, 2013b). The calculated groundwater flow rate averages approximately 0.19 ft/day (68 ft/year). The hydraulic gradient and linear flow velocity calculations are shown in Table 2.

The linear velocity equation and resulting rates make the simplified assumptions of a homogeneous and isotropic aquifer. Actual velocities may vary significantly due to the heterogeneous, anisotropic conditions typical in piedmont aquifers.

1.4.2 Vertical Gradients

Monitoring wells MW-3S and MW-3D represent a nested pair of wells with different screened intervals; unfortunately detailed construction information is not available for these wells. Based on the measured total depths of the two wells, we assume that MW-3S is screened from 14-24 feet below the top of casing (ft-TOC), and MW-3D is screened from 47-57 ft-TOC, giving a vertical distance between screen midpoints of 33 feet. The groundwater elevation is typically higher in MW-3D than in MW-3S, indicating an upward vertical hydraulic gradient.

Based on the June 5, 2014 water level measurements, the groundwater elevations in MW-3S and MW-3D were 750.67 ft-amsl and 752.14 ft-amsl, respectively. This gives us a calculated upward gradient of 0.045 ft/ft between these two wells, indicating an upward component to groundwater flow. Since these wells are located near the creek southwest of the landfill, these data support the contention that the creek is a groundwater discharge feature.

1.5 Contaminant Distribution

Since 2009, a number of VOCs have been detected at concentrations that exceed their respective 15A NCAC 2L.0202 (NC 2L) groundwater standards. The constituents of concern (COCs) for the facility include the VOCs that have been detected in exceedance of NC 2L standards in one or more downgradient well at least once in the past 3 years. These COCs include benzene, 1,1-dichloroethane, 1,2-dichlorethane, cis-1,2-dichloroethylene, 1,2-dichloropropane (1,2-DCP), tetrachloroethylene, trichloroethylene, and vinyl chloride. Monitoring wells impacted by VOCs include MW-2, MW-3S, MW-3D and MW-4, which are located southwest of the waste unit approximately 130 feet to 450 feet from the western boundary of the facility. In addition to the VOCs, there have been isolated occurrences of metals detected above the NC 2L or the DENR

Solid Waste Section (SWS) groundwater protection standards (GWPS) in both upgradient and downgradient monitoring wells at the site; however, in the last three years the only metal with exceedances has been cobalt in MW-5. MW-5 is located on the east side of the landfill, in a cross-gradient location relative to waste.

Table 3 summarizes the GPS exceedances at the facility in the last three years, and Table 4 presents all historical constituent detections for the facility since December 2009. The table below summarizes total VOC concentrations (the sum of all detected VOCs) for the facility monitoring wells. Chart 1 shows total VOCs concentrations vs. time for MW-2, MW-3S, MW-3D, and MW-4. Drawing 2 shows the total VOC isoconcentration contours for the June 2014 sampling event.

Total VOC Concentrations (µg/L)

Date	MW-6	MW-2	MW-3S	MW-3D	MW-4	MW-5
30-Dec-09	0.0	125.6	20.6	68.7	54.9	0.0
01-Jun-10	0.0	50.6	13.0	, J.39.3	39.3	0.0
29-Dec-10	0.0	130.9	23.5	68.9	54.2	0.0
29-Jun-11	0.0	122.9	30.9	82.1	61.3	4.6
01-Nov-11	0.0	126.1	26.9	77.3	53.0	0.0
01-May-12	0.0	107.9	23.7	75.5	50.1	0.0
07-Nov-12	0.0	129.0	23.1	89.1	60.4	0.0
09-May-13	0.0	86.3	18.6	62.4	40.7	0.0
07-Nov-13	0.0	116.3	19.6	84.9	50.1	0.0
05-Jun-14	0.0	109.4	21.9	76.6	47.3	0.0

Table 5 presents historical surface water data. Surface water samples SW-1, SW-2, and SW-3 have shown no detections of VOCs except for some blank-qualified detections of acetone in June 2011 and sporadic detections of cis-1,2-dichloroethylene (c-1,2-DCE) in both upstream and downstream samples. The c-1,2-DCE detections have all be estimated concentrations below the Solid Waste Section Limits (SWSL). There have been no exceedances of NC 2B surface water standards. These data add control for the downgradient extent of the plume since the creek is considered a groundwater discharge feature. The creek is expected to act as a natural barrier to southward migration of the plume.

1.6 Site Conceptual Model

1.6.1 Site Geology

The Town of Kernersville Landfill is located in the Piedmont physiographic providence of North Carolina and is underlain by intrusive granitic rocks of Pennsylvanian to Permian age which are part of the Charlotte Belt Geologic Unit. A geologic map of the area has been included as Figure 2 (Espenshade, et al, 1975). The geologic map shows that rock underlying the site is primarily quartz monzonite and granodiorite, typically containing large microcline phenocrysts as well as biotite, muscovite, epidote, and hornblende. It is generally nonfoliated, and may contain thin

layers of mafic rock. Just south of the site is an area mapped as a mafic intrusive body, mainly composed of gneissic metagabbro and metadiorite. The geologic map does not show any diabase dikes mapped near the site location.

There is relatively limited geological data available for the Kernersville landfill. JOYCE could not locate drilling records or boring logs for wells on the property through a review of both the Town of Kernersville records and DENR records. In 2012, JOYCE installed a number of gas probes at the site and boring records were prepared for those probe installations. In most cases, the borings for the gas probes encountered uniform red clayey sands that appeared saprolitic. Depths of borings for the probes ranged from 8 feet to 34 ft-bgs. Bedrock was not encountered in any of those borings.

1.6.2 Site Hydrogeology

The uppermost aquifer is unconfined and includes both saprolite and the uppermost fractured bedrock, which are well connected and act as a single aquifer. Typically in the Piedmont, the saprolite grades into weathered bedrock which grades into fractured competent bedrock, resulting in an aquifer in which porosity and permeability decrease significantly with depth. Groundwater can occur in substantial volumes where soils and saprolite are very thick; but typically, groundwater is found in minimal volumes in bedrock, primarily restricted to fractures. Groundwater in the saprolite feeds the fractures in the bedrock and is discharged into creeks south and southwest of the landfill. Although the regolith and bedrock are hydraulically connected, the effective porosity generally decreases with depth into the underlying fractured bedrock. Groundwater flow at deeper levels within the fractured bedrock is controlled by fracture orientation and connectivity. This unconfined aquifer is pervasive across the site.

The water table beneath the facility generally mimics the surface topography, ranging in depth from 3 to 30 ft-bgs. Groundwater flow is to the southwest, and discharges to the creeks south and southwest of the landfill. The creeks form a hydrologic divide, so that groundwater from the site is not expected to migrate beyond them.

1.7 Regulatory Status

The Kernersville Landfill is regulated under §.0500 of the NCSWMR, and is monitored in accordance with the requirements of §.0600 of the NCSWMR. On November 1, 2012, the Town of Kernersville received notification from DENR that because of the detection of groundwater impacts at the site that could potentially be crossing the property boundary, the Town needed to submit a Phased Groundwater Assessment Plan and complete the described groundwater assessment. In January 2013, JOYCE, on behalf of the Town, submitted a Groundwater Assessment Plan, which was approved by DENR on February 14, 2013. In May 2013, JOYCE submitted a Groundwater Assessment Report for the facility. In a letter dated July 16, 2013, DENR approved the Groundwater Assessment Report and called for the Town to select a remedy and submit a Corrective Action Application within 1 year of the date of that letter. In July 2014, on behalf of the Town, JOYCE submitted the Corrective Action Application selecting Monitored Natural Attenuation (MNA) plus

phytoremediation as the remedy. The remedy was approved by DENR in a letter dated July 23, 2014.

2.0 CONTAMINANT CHARACTERIZATION

2.1 Constituents of Concern

The VOCs that have been detected in exceedance of NC 2L standards in one or more downgradient well at least once in the past 3 years (six sampling events) constitute the COCs for this facility. The current COCs include the following:

- Benzene;
- 1,1-Dichloroethane (1,1-DCA,);
- 1,2-Dichlorethane (1,2-DCA);
- cis-1,2-Dichloroethylene (c-1,2-DCE);
- 1,2-Dichloropropane (1,2-DCP);
- Tetrachloroethylene (PCE);
- Trichloroethylene (TCE); and
- Vinyl chloride (VC)

Monitoring wells impacted by VOCs include MW-2, MW-3S, MW-3D and MW-4, which are located southwest of the waste unit, between the waste unit and the creek. MW-4, which is the well closest to the property boundary, is approximately 135 feet east of the western boundary of the facility. Table 3 summarizes the GPS exceedances at the facility in the last three years.

In addition to the VOCs, cobalt in MW-5 has been detected in exceedance of its GWPS. Cobalt is a naturally-occurring metal in rock and soil of the North Carolina piedmont. *A Geochemical Atlas of North Carolina* (Reid, 1993), reports several soil samples from within 5-15 miles of the Kernersville Landfill with cobalt concentrations between 6 mg/kg and 10 mg/kg, which are above the 75th percentile of cobalt concentrations in the state. High levels of cobalt have primarily been detected in MW-5 at this site; however, natural concentrations of metals can vary significantly within a small area, so this is not unusual. Also, groundwater from MW-5 is generally more turbid than most wells and the pH is relatively low, conditions which typically result in higher total metal concentrations. The fact that MW-5 does not have any exceedances for VOCs also supports the contention that the cobalt in MW-5 is not a result of impact from the waste. For these reasons, we believe the cobalt in MW-5 is natural and cobalt will not be considered a COC for this facility.

2.2 Characteristics of COCs

The following information is from one or more of the following sources:

- The United Stated Environmental Protection Agency (EPA): http://www2.epa.gov/;

- Agency for Toxic Substances and Disease Registry (ATSDR): http://www.atsdr.cdc.gov/;
- The United Kingdom Health Protection Agency (HPA): http://www.hpa.org.uk/; or
- Wikipedia: http://en.wikipedia.org/.

2.2.1 Benzene

Benzene (molecular formula C_6H_6) is a colorless liquid or gas with a sweet-smelling odor. The vapor pressure of benzene is characteristic of the rapid evaporation of aromatic hydrocarbons into air. Benzene is highly flammable. The origin of benzene can be from both natural and human processes and activities. Benzene naturally occurs in crude oil and is found in refined petroleum products such as gasoline. Benzene can be released in volcanic activity, forest fires, or even cigarette smoke. Benzene is used to make other chemicals, which are in turn used in the production of some plastics, resins, nylon and other synthetic fibers, some types of rubber, lubricants, dyes, detergent, solvents, drugs, and pesticides. Benzene is slightly soluble in water.

The primary human exposure pathway for benzene is via inhalation. Dermal absorption is poor. Reactive metabolites such as benzene oxide have been implicated in the mechanisms of benzene toxicity. Health effects and symptoms of acute exposure to benzene include drowsiness, dizziness, delirium, loss of consciousness, respiratory arrest, and/or death. Health effects of chronic exposure include anemia and leukemia. Benzene is a known human carcinogen and clastogen, but is not considered to be a reproductive toxicant.

2.2.2 1,1-Dichloroethane

1,1-Dichloroethane (a.k.a - ethylidene dichloride, ethylidene chloride, CFC-150a, or 1,1-DCA) is a chlorinated hydrocarbon with the molecular formula $C_2H_4Cl_2$. It is mainly used as a feedstock in chemical synthesis, chiefly of 1,1,1-trichloroethane. It is also used as a solvent for plastics, oils and fats, as a degreaser, as a fumigant in insecticide sprays, in halon fire extinguishers, and in cementing of rubber. It is used in manufacturing of high-vacuum resistant rubber and for extraction of temperature-sensitive substances. Thermal cracking at 400–500 °C and 10 MPa yields vinyl chloride. In groundwater, 1,1-DCA commonly degrades to chloroethane.

Acute inhalation exposure to high levels (105,000 milligrams per cubic meter [mg/m3]) of 1,1-DCA in humans results in CNS depression and a cardiostimulatory effect, resulting in cardiac arrhythmias. Acute dermal exposure to 1,1-DCA in humans can cause skin burns or rashes. Tests involving acute exposure of rats and mice have shown 1,1-DCA to have low acute toxicity from inhalation exposure and moderate acute toxicity from oral exposure. No information is available on the chronic effects or carcinogenic effects of 1,1-DCA in humans

2.2.3 1,2-Dichloroethane

1,2-Dichloroethane (a.k.a. - ethylene dichloride, EDC, or 1,2-DCA) is a chlorinated hydrocarbon with the molecular formula $C_2H_4Cl_2$. It is mainly used to produce vinyl chloride monomer

(VCM), the major precursor for polyvinyl chloride (PVC) production. It is a colorless liquid with a chloroform-like odor. 1,2-DCA is also used generally as an intermediate for other organic chemical compounds and as a solvent. It forms azeotropes with many other solvents, including water (b.p. 70.5 °C) and other chlorocarbons. In groundwater, 1,2-DCA commonly degrades to chloroethane.

1,2-DCA is toxic (especially by inhalation due to its high vapor pressure), highly flammable, and carcinogenic. Its high solubility and 50-year half-life in anoxic aquifers make it a perennial pollutant and health risk. The available information suggests that massive, acute inhalation exposure to 1,2-DCA can induce neurotoxic, nephrotoxic, and hepatotoxic effects in humans, as well as respiratory distress, cardiac arrhythmia, nausea, and vomiting.

2.2.4 cis-1,2-Dichloroethylene

cis-1,2-Dichloroethylene (a.k.a. – cis-1,2-dichloroethene or c-1,2-DCE) is an organochloride with the molecular formula $C_2H_2Cl_2$. 1,2-Dichloroethylene can exist as either of two geometric isomers, cis-1,2-dichloroethylene or trans-1,2-dichloroethylene, but is often used as a mixture of the two. These compounds have few industrial applications. c-1,2-DCE is a highly flammable, colorless liquid with a sharp, harsh odor. It has modest solubility in water. It often forms as a degradation product by the reductive dehalogenation of trichloroethylene and tetrachloroethylene, and it similarly degrades to vinyl chloride. The *cis* isomer is more readily metabolized than the *trans* isomer in in vitro systems. There is some evidence of toxicological and transient immunological effects and limited evidence of some genotoxicity in rats from both isomers. There is no information about carcinogenicity.

2.2.5 1,2-Dichloropropane

1,2-Dichloropropane (a.k.a. - propylene dichloride, 1,2-DCP) is an organic compound classified as a chlorocarbon, with the chemical formula $C_3H_6Cl_2$. It is a colorless, flammable liquid with a sweet odor. It is obtained as a byproduct of the production of epichlorohydrin, which is produced on a large scale. 1,2-DCP is an intermediate in the production of tetrachloroethylene and other chlorinated hydrocarbons. It was once used as a soil fumigant, chemical intermediate, as well as an industrial solvent and was found in paint strippers, varnishes, and furniture finish removers, but some of these uses have been discontinued.

EPA has found short-term exposures to 1,2-DCP at levels above the EPA's maximum contaminant limit (MCL) to potentially impair the functions of the liver, kidneys, adrenal glands, bladder, and the gastrointestinal and respiratory tracts. Long-term exposures to 1,2-DCP at levels above the MCL have been found to potentially affect the liver, kidneys, bladder, gastrointestinal tract and the respiratory tract. There is some evidence that 1,2-DCP may have the potential to cause cancer from a lifetime exposure at levels above the MCL. The National Institute for Occupational Safety and Health (NIOSH) has classified 1,2-dichloropropane as a carcinogen and "immediately dangerous to life and health" (IDLH).

2.2.6 Tetrachloroethylene

Tetrachloroethylene (a.k.a. - tetrachloroethene, perchloroethylene, perc, or PCE) is a chlorocarbon with the formula C_2Cl_4 ($Cl_2C{=}CCl_2$). It is a colorless liquid widely used for dry cleaning of fabrics, hence it is sometimes called "dry-cleaning fluid." It has a sweet odor detectable by most people at a concentration of 1 part per million (1 ppm). Most PCE is produced by high temperature chlorinolysis of light hydrocarbons. Side products include carbon tetrachloride, hydrogen chloride, and hexachlorobutadiene. In groundwater, PCE degrades via reductive dehalogenation to trichloroethylene.

PCE is an excellent solvent for organic materials. It is volatile, highly stable, and nonflammable. For these reasons, it is widely used in dry cleaning, usually as a mixture with other chlorocarbons. It is also used to degrease metal parts in the automotive and other metalworking industries. It appears in a few consumer products including paint strippers and spot removers. PCE was once extensively used as an intermediate in the manufacture of HFC-134a and related refrigerants.

Like many chlorinated hydrocarbons, PCE is a central nervous system depressant and can enter the body through respiratory or dermal exposure. PCE dissolves fats from the skin, potentially resulting in skin irritation. Effects resulting from acute (short term) high-level inhalation exposure of humans to PCE include irritation of the upper respiratory tract and eyes, kidney dysfunction, and neurological effects such as reversible mood and behavioral changes, impairment of coordination, dizziness, headache, sleepiness, and unconsciousness. The primary effects from chronic (long term) inhalation exposure are neurological, including impaired cognitive and motor neurobehavioral performance. PCE exposure may also cause adverse effects in the kidney, liver, immune system and hematologic system, and on development and reproduction. Studies of people exposed in the workplace have found associations with several types of cancer including bladder cancer, non-Hodgkin lymphoma, and multiple myeloma. EPA has classified PCE as likely to be carcinogenic to humans.

2.2.7 Trichloroethylene

Trichloroethylene (a.k.a. - trichloroethene, TCE, trichlor, Trike, Trilene) is a chlorocarbon with the formula C_2HCl_3. It is a clear non-flammable liquid with a sweet smell. It is a halocarbon commonly used as an industrial solvent. TCE is also used in the manufacture of a range of fluorocarbon refrigerants such as 1,1,1,2-tetrafluoroethane, more commonly known as HFC 134a. In groundwater, TCE degrades via reductive dehalogenation to dichloroethylenes (including c-1,2-DCE). TCE was used as a volatile anesthetic and as an inhaled obstetrical analgesic in millions of patients; however, fetal toxicity and concerns for carcinogenic potential of TCE led to its abandonment in developed countries by the 1980s.

Acute inhalation or ingestion of TCE can cause systemic effects such as headache, dizziness, nausea and vomiting followed by loss of coordination and drowsiness. Coma, cardiac arrhythmias and death may occur following substantial exposures. Local effects following ingestion of trichloroethylene include dyspepsia, gastritis and diarrhea. Dermal exposure to TCE

will cause irritation with erythema. Prolonged contact may cause severe irritation with blisters and burns. Chronic inhalation of TCE can cause neurological, liver and kidney damage. Chronic dermal exposure may cause dermatitis. In 2005, the United States EPA formally characterized the chemical as a human carcinogen as well as a non-carcinogenic health hazard.

2.2.8 Vinyl Chloride

Vinyl chloride (a.k.a. - VC, vinyl chloride monomer, VCM, or chloroethene) is an organochloride with the formula $H_2C{=}CHCl$. VC is a gas with a sweet odor. It is highly toxic, flammable, and carcinogenic. This colorless compound is an important industrial chemical chiefly used to produce the polymer polyvinyl chloride (PVC). VC is among the top twenty largest petrochemicals (petroleum-derived chemicals) in world production. VC is a chemical intermediate, not a final product. Due to the hazardous nature of VC to human health, there are currently no end products that use VC in its monomer form (VCM). In the past, VCM has been used as a refrigerant. VC can be formed in the environment when soil organisms break down chlorinated solvents (PCE, TCE, &1,2-DCE).

The hepatotoxicity of VC has long been established since the 1930s. According to the EPA, VC emissions from polyvinyl chloride (PVC), ethylene dichloride, and VC monomer plants may reasonably be anticipated to result in an increase in mortality or an increase in serious irreversible or incapacitating reversible illness. Acute exposure of humans to high levels of VC via inhalation in humans has resulted in dizziness, drowsiness, headaches, and giddiness. Acute exposure to extremely high levels of VC has caused loss of consciousness, lung and kidney irritation, and inhibition of blood clotting in humans and cardiac arrhythmias in animals. Liver damage may result in humans from chronic exposure to vinyl chloride, through both inhalation and oral exposure. A small percentage of individuals occupationally exposed to high levels of VC in air have developed a set of symptoms termed "vinyl chloride disease." Animal studies have reported effects on the liver, kidney, and the central nervous system from chronic exposure to VC. Several epidemiological studies have reported an association between VC exposure in pregnant women or their husbands and an increased incidence of birth defects, while other studies have not reported similar findings. Inhaled VC has been shown to increase the risk of a rare form of liver cancer (angiosarcoma of the liver) in humans. The EPA has classified VC as a Group A, human carcinogen.

2.3 Contaminant Source Confirmation

There are two possible sources of the above-listed COCs. The first source is leaching of constituents from waste in the closed, unlined MSW landfill into the groundwater as a result of percolation of rainwater through the waste. The second is partitioning of VOC's in landfill gas into the groundwater, either within a well, or in the capillary fringe where vapors in the vadose zone come into contact with groundwater near a well. Leachate is expected to only impact groundwater down-gradient of the landfill. Impacts detected upgradient or side-gradient from the landfill are most-likely indicative of gas impacts; however, gas can also affect down-gradient

wells. Since all of the GPS exceedances for the COCs are in downgradient wells, they are believed to be primarily due to the leaching of constituents from waste.

Waste Management's closed Piedmont Landfill is located adjacent to and north of the Town of Kernersville Landfill, and could be a potential source of the COCs; however, the Piedmont Landfill is a lined landfill with no evidence of a release. Also, the impacted wells at the Kernersville landfill are not directly downgradient of the Piedmont landfill; therefore we consider it unlikely that the Piedmont landfill is contributing the observed COC exceedances. There are no other known on-site or off-site sources.

2.4 Source Control Measures

The facility stopped receiving waste in 1991, and was closed with a 2-foot cap of compacted soil. A letter of closure was issued by the DENR on December 10, 1991. The Town has maintained the cap and it is in good condition with no observed areas of standing water, erosion, or failures of the cap. Passive landfill gas vents have been installed in the landfill to help prevent gas buildup and migration. No additional source control measures are planned at this time.

2.5 Groundwater End Use

There is no municipal or public water supply available to the facility or surrounding properties. There is an active water supply well located at the Town of Kernersville Police shooting range located on the northeastern portion of the facility property approximately 800 feet from the waste unit. The Waste Management Piedmont Landfill also has an active supply well on the adjoining property located approximately 870 feet north of the Town of Kernersville landfill. These two supply wells are located upgradient of the Kernersville Landfill waste unit, and so they are highly unlikely to be impacted by the facility.

The nearest residential structures are over 1200 feet southwest of the waste unit. While the groundwater flow from the site is toward the southwest, the creek that runs southwest of the landfill is expected to act as a groundwater divide, so groundwater from the landfill area will not flow toward the residences. There are no known potable surface water intakes within at least one mile of the Kernersville Landfill.

2.6 Sensitive Receptor Pathways

The only surface water feature on or near the facility is the small unnamed tributary of East Belews Creek which runs southwest of the waste unit. The unnamed tributary flows northwest from the site approximately ½ mile to East Belews Creek, which then flows north approximately 1 mile to Belews Lake. This is the only potential receptor for impacted groundwater from the facility. East Belews Creek is classified as "Class C" waters, which are protected for uses such as secondary recreation, fishing, wildlife, fish consumption, aquatic life including propagation, survival and maintenance of biological integrity, and agriculture. It is not designated as a water supply.

Three surface water points (SW-1, upstream; SW-2, downstream; and SW-3, in between) on the unnamed tributary are sampled semiannually in conjunction with groundwater sampling at the Kernersville Landfill. Historical surface water sampling data (Table 5) indicate that there have been no exceedances of NC 2B surface water standards, indicating that discharge into the creek has not significantly impacted the surface water; therefore, the surface water does not constitute a sensitive receptor pathway risk.

As a part of every semiannual monitoring event, JOYCE has instituted a visual inspection program in order to detect potential releases. This inspection program involves field personnel making the following observations:

- Observation of stressed biological community (e.g., dead or dying vegetation);
- Indications of leachate impact (e.g., seeps, impacted surface water);
- Observations of erosion; and
- Negative changes around the waste facility.

None of the above conditions has been observed, and there is no evidence of distressed vegetation or obvious impacts to wildlife as a result of exposure to the contaminant plume associated with this facility. Flora and fauna on or above the ground surface or in the surface water are at minimal risk because the soil is not a significantly impacted medium and there have been no NC 2B exceedances in the surface water samples. Soil microorganisms are known to use the organic acids and by-products of the degradation process of the groundwater plumes as a food source. For these reasons, the potential risk to the environment from the impacted groundwater is considered to be low.

The only on-site receptor pathways will be through direct contact with contaminated groundwater by personnel involved in sampling monitoring wells on the site. Personnel engaged in these activities are well-trained in sampling techniques, personal protective equipment, and incident response so as to minimize the potential for unsafe exposure.

2.7 Background Concentrations

Monitoring well MW-6 is designated as the background well for the facility. It is located approximately 350 feet northeast (upgradient) of the limits of waste. Facility background data used to evaluate the groundwater monitoring data include all data collected for MW-6 from December 2009 to present. Results from historical sampling events indicate only the presence of naturally occurring metals in MW-6; no VOCs have been detected in MW-6. The historical concentrations of constituents in the background well are included in Table 4.

2.8 Groundwater Protection Standards (GPS)

The regulatory GPS for constituents detected in the groundwater for this site are equal to the 15A NCAC 2L.0202 (NC 2L) Groundwater Standards for each constituent, with the following three

exceptions: 1) for constituents which have no official NC 2L standard, the DENR-SWS has established GWPS values; 2) for constituents with NC 2L standards or GWPS below the Solid Waste Section Limits (SWSL), the GPS is the SWSL; and 3) if the statistical background value for a constituent is greater that the NC 2L, GWPS, or SWSL, the background value can be considered the GPS, with DENR approval. A list of all NC Appendix I and II constituents and their respective NC 2L Standards and/or GWPS values is included in Appendix A of this report. Constituents with GPS exceedances in compliance wells during the last three years are summarized in Table 3.

2.9 Surface Water Quality Standards (SWQS)

The surface water quality standards (SWQS) for constituents detected in the groundwater for this site are equal to the 15-NCAC-2B (NC-2B) Surface Water Standards for Water Supply-classified surface waters. For any detected constituent without a listed NC-2B standard, the SWQS will be considered equal to the SWSL. If a background value higher than the NC-2B standard or the SWSL can be established for a constituent, the background can be considered the SWQS. A list of all NC-2B Surface Water Standards is included in Appendix B of this report. The landfill is bordered to the southwest by an unnamed tributary to the East Belews Creek, which is classified "C", for waters protected for secondary recreation, aquatic life, and wildlife. There have been no SWQS exceedances for this site.

2.10 Media of Concern

The facility's COCs have been detected in exceedance of applicable standards in one exposure medium at the landfill: groundwater. Groundwater beneath the landfill property appears to have been impacted by leachate that originates from the unlined landfill. Groundwater is the primary media of concern.

Surface water is a potential exposure medium. Surface water samples are collected semiannually upgradient and downgradient from the waste cell from an unnamed tributary of the East Belews Creek to the southwest of the waste area. The surface water samples have not contained concentrations of COCs above NC 2B surface water standards; however, there have been some estimated detections of c-1,2-DCE below the SWSL in both upstream and downstream surface water samples. No other VOCs have confirmed detections in surface water samples from the facility.

Soil is not considered to be an exposure medium, since the COC concentrations in the soil are expected to be very low outside of the landfill waste footprint, where impacts from leachate may be occurring. Outside of the waste footprint, impacts to soil are expected only from landfill gas and volatile emissions from groundwater. Since the potential risk associated with dermal contact or ingestion of impacted soils is considered very low, soil is not considered as an exposure medium.

Landfill gas is a potential exposure medium, since quarterly compliance monitoring results indicate methane concentrations in soil are above the regulatory limit of 5% methane by volume in some of the facility's gas probes. Mitigation and control of landfill gas migration at the facility are currently being addressed separately from groundwater corrective action. A Landfill Gas Corrective Action Plan was submitted in September 2013 and was approved by DENR on October 24, 2013.

3.0 SELECTED AND APPROVED REMEDY / TECHNICAL APPROACH

3.1 Selection of Remedy

In January 2013, JOYCE, on behalf of the Town, submitted a Groundwater Assessment Plan, which was approved by the DENR on February 14, 2013. In May 2013, JOYCE submitted a Groundwater Assessment Report for the facility. In a letter dated July 16, 2013, the DENR approved the Groundwater Assessment Report and called for the Town to select a remedy and submit a Corrective Action Application within 1 year of the date of that letter.

There are numerous technologies available that can remediate groundwater contaminated with dissolved-phase VOCs; however, the selection of a successful remedy is based on the geologic and hydrogeologic conditions underlying the facility, and the potential risks associated with the release. Additionally, the type and size of the source (one that can be removed versus one that cannot be removed) and the urgency of the remedial effort, or aggressiveness, are considered when selecting a remedy. The need for an aggressive or non-aggressive remedy is usually controlled by the risk(s) associated with the release (i.e., a high risk may dictate an aggressive remedy while a low risk may dictate a less aggressive, more cost effective remedy). Additionally, the use of more than one remedy may be required to meet regulatory standards.

Based on the results of the Groundwater Assessment Report and the above considerations, JOYCE recommended a combination of Monitored Natural Attenuation (MNA) and phytoremediation as the most appropriate remedy for the facility. In their regular meeting on April 1, 2013, the Kernersville Board of Alderman approved MNA plus phytoremediation as the selected remedy for the facility. In July 2014, on behalf of the Town, JOYCE submitted the Corrective Action Application selecting MNA plus phytoremediation as the selected remedy. The remedy was approved by DENR in a letter dated July 23, 2014.

3.2 MNA Evaluation

MNA consists of monitoring natural attenuation processes (both biological and physical), and is a proven remedial alternative for sites where biological processes are documented and a more aggressive remedy is not required (i.e., the plume does not pose an immediate or substantial risk and it has not migrated off-site). The physical attenuation processes (dispersion, dilution, adsorption, vaporization, abiotic degradation, precipitation, etc.) are important parts of MNA; however, with long-term sources, it is primarily the biological processes (biodegradation by naturally occurring bacteria) that result in the transformation and/or destruction of organic contaminants in the soil, surface water, and groundwater.

Natural attenuation processes occur nearly everywhere, but to varying degrees of effectiveness depending on the types and concentrations of contaminants present and the physical, chemical, and biological characteristics of the soil and groundwater. According the US-EPA OSWER Directive 9200.4-17P (EPA, 1999), natural attenuation processes may reduce the potential risk posed by site contaminants in three ways:

1. Transformation of contaminant(s) to a less toxic form through destructive processes such as biodegradation or abiotic transformations;
2. Reduction of contaminant concentrations whereby potential exposure levels may be reduced; and
3. Reduction of contaminant mobility and bioavailability through sorption onto the soil or rock matrix.

Under MNA, a site is monitored at regular intervals to demonstrate that biodegradation and demobilization processes (or indicators thereof) are occurring at a rate sufficient to prevent potential exposures, and that the dissolved-phase contaminants are not migrating to a receptor. It may also include measurements of contaminant concentrations in soil, groundwater, or soil gas; measurements of bioactivity indicators such as carbon dioxide production or oxygen consumption; and measurements of inorganic MNA indicators such as pH, redox potential, sulfide, and organic carbon content.

MNA is most widely used for sites with aromatic and chlorinated organic compounds. For aromatic hydrocarbons like benzene, the primary and most efficient mode of biodegradation is aerobic; although aromatic hydrocarbons can also degrade anaerobically (Aburto, 2009; Musat, 2008; Jindrová, et al, 2002). Many microorganisms, including bacteria and fungi, are capable of degrading organic pollutants. Aerobic biodegradation is based on two processes: growth and cometabolism. In a growth process, organic pollutants are used as the sole source of carbon and energy by the microorganisms, and the process results in complete degradation of organic pollutants. Cometabolism refers to processes whereby an organic compound is metabolized in the presence of a growth substrate which is the primary carbon and an energy source (Fritsche and Hofrichter, 2008).

Chlorinated hydrocarbons, including chlorinated ethylenes like PCE, TCE, c-1,2-DCE, and vinyl chloride, as well as chlorinated ethanes like 1,1-DCA and 1,2-DCA, can be degraded either aerobically or anaerobically; however, anaerobic process are generally more efficient. The anaerobic and aerobic degradation processes are very different. In aerobic conditions, aerobic bacteria ingest the hydrocarbons, which are metabolized with oxygen to produce carbon dioxide and water. The primary environmental requirements for aerobic degradation are the presence of sufficient concentrations of dissolved oxygen and nutrients for the bacteria.

In anaerobic conditions, chlorinated hydrocarbons are degraded by a process called reductive dehalogenation. Anaerobic microorganisms use chlorinated hydrocarbons as electron acceptors just as aerobic organisms use oxygen. This requires a suitable electron donor such as hydrogen

or other organic compounds. The degradation sequence in reductive dehalogenation for chlorinated ethylenes is generally:

Tetrachloroethylene ⇨ Trichloroethylene ⇨ Dichloroethylenes ⇨ Vinyl Chloride ⇨ Ethylene.

Similarly, the degradation sequence in reductive dehalogenation for chlorinated ethanes is generally:

Trichloroethane ⇨ Dichloroethanes ⇨ Chloroethane ⇨ Ethane.

The primary environmental requirements for anaerobic degradation are the presence of sufficient concentrations of other organic molecules that can serve as electron donors for energy metabolism, and a reducing (anaerobic) environment. As chlorinated hydrocarbons travel in groundwater further from decomposing waste, groundwater conditions become increasingly aerobic and less reductive. Upon encountering aerobic groundwater conditions, vinyl chloride degrades to ethane, carbon dioxide, and water.

3.2.1 Evaluation of Anaerobic Degradation of Contaminants

During the June 5, 2014 sampling event, MNA indicator parameters were measured for site monitoring wells MW-2, MW-3S, MW-3D, MW-4, and MW-6. *Table 6* summarizes the MNA parameter data. The laboratory report, chain-of-custody, and field data logs for the MNA parameter data from the June 2014 event are included in *Appendix C* of this report.

The MNA parameter data were evaluated in general accordance with the United States Environmental Protection Agency's (EPA's) *Technical Protocol Manual* (EPA, 1998) to determine whether the conditions are conducive to, or whether there is evidence for anaerobic degradation of the chlorinated hydrocarbons. Specifically, the results were evaluated according to the weighted system presented in Table 2.3 of the *Technical Protocol Manual*, referred to hereafter as the EPA Biodegradation Screening Matrix. According to this manual, a score less than 5 indicates that there is inadequate evidence for anaerobic natural attenuation, a score of 6 to 14 indicates that there is limited evidence for anaerobic natural attenuation, a score of 15 to 20 indicates that there is adequate evidence for anaerobic natural attenuation, and a score greater than 20 indicates that there is strong evidence that anaerobic natural attenuation is occurring.

The EPA Biodegradation Screening Matrix for this facility is presented in *Table 7*. The Screening Matrix evaluation was performed primarily based on the June 2014 results for MW-2 (the most highly impacted well), compared where appropriate to the results for the background well, MW-6. One difficulty in evaluation of the Screening Matrix is that the matrix assumes some compounds (such as, but not limited to methane, TCE, c-1,2-DCE, and vinyl chloride) are daughter products of biodegradation within the plume; however, at a landfill we cannot eliminate the possibility that they may be contaminants released directly from the landfill. If we include the scores for these potential daughter products, our total score could be artificially high; on the other hand, if we exclude them, the score might be artificially low. *Table 7* presents scoring results both with and without the questionable daughter product scores.

Without any daughter product scores, the site obtained a score of 10 (limited evidence of biodegradation); however, with all daughter product scores, the score was 23 (strong evidence of biodegradation). The most appropriate score is probably between these two extremes indicating adequate evidence that anaerobic natural attenuation is taking place at this site.

3.2.2 Evaluation of Aerobic Degradation of Contaminants

Dissolved oxygen (DO) is the most thermodynamically favored electron acceptor used by microbes for the biodegradation of organic carbon. DO concentrations of 0.5 mg/L or less in groundwater are most conducive to anaerobic biodegradation of chlorinated VOC's, and DO concentrations of 5.0 mg/L or greater in groundwater are most conducive to aerobic biodegradation of VOC's. In between these values, both can occur to some degree.

DO measurements recorded at the site during the June 2014 sampling event ranged from 1.0 mg/L in MW-3D to 17.0 mg/L in MW-4. The low DO in MW-3D is likely due to it being a deep-screened well, sampling the deeper part of the aquifer. The results for the wells located nearest the center of the plume (MW-2 and MW-3S, both had DO of 2.0 mg/L, and the site background well (MW-6) had DO equal to 3 mg/L. These data indicate that the conditions in the aquifer beneath the site are generally amenable to both aerobic and anaerobic degradation taking place simultaneously, with the possible exception of the area around MW-4. The high DO value recorded for MW-4 is unusual, and given the consistent readings at other wells at the site, may be anomalous. Future DO readings may refute the MW-4 result; however, it may be that aerobic conditions prevail at the edge of the plume while more anaerobic conditions prevail elsewhere.

Another indicator parameter for aerobic/anaerobic conditions is the oxidation-reduction potential (ORP). The ORP measured in June 2014 in wells MW-2, MW-3S, and MW-6 was 93 mV, 66 mV, and 99 mV, respectively. These values are fairly high, indicating mostly aerobic conditions; however, they are not high enough to exclude some anaerobic activity. The lowest ORP (15 mV) was in MW-3D, indicating that less aerobic conditions exist in the deeper part of the aquifer, which is consistent with the low DO measured in that well. The ORP in MW-4 was 38 mV, which is inconsistent with the high DO recorded in that well.

3.2.3 Summary of MNA Evaluation

The evaluation of indicator parameter data and historical observations of the plume indicate that biodegradation is occurring beneath the facility at a rate that will prevent additional migration of contaminants beyond the property line and will likely reduce concentrations of COCs to concentrations below GPS within the delineated plume with time. Conditions are generally favorable for both aerobic and anaerobic biodegradation to take place.

An evaluation of the risks posed to human health and the environment suggests that there is low risk due to the fact that groundwater contamination is contained within the facility property

boundary, and there is a creek that is expected to act as a hydrologic divide, preventing migration beyond it. Also, the adjoining property is undeveloped and heavily wooded, and there are no known human receptors at risk.

We conclude that MNA is an appropriate remedial measure for the Town of Kernersville Landfill.

3.2.4 MNA Monitoring and Modeling

A *Water Quality Monitoring Plan* (WQMP) incorporating MNA monitoring is presented in Section 4.0 of this report. Under this WQMP, selected monitoring wells will be sampled semiannually for the complete list of MNA parameters for a baseline period extending through four sampling events. After the baseline period, the MNA data will be evaluated and recommendations will be made regarding possible changes to the list of parameters and/or the frequency of the analyses.

The EPA's BIOCHLOR Natural Attenuation Decision Support System (Version 2.2) will be used as a screening model to evaluate MNA at the Town of Kernersville Landfill facility. BIOCHLOR is an easy-to-use screening model which simulates remediation by natural attenuation of dissolved solvents at chlorinated solvent release sites (Aziz, et al, 2000). BIOCHLOR includes three different model types:

- Solute transport without decay;
- Solute transport with biotransformation modeled as a sequential first-order decay process; and
- Solute transport with biotransformation modeled as a sequential first-order decay process with two different reaction zones (i.e., each zone has a different set of rate coefficient values).

The software, programmed in the Microsoft Excel spreadsheet environment and based on the Domenico analytical solute transport model, has the ability to simulate one-dimensional advection, three-dimensional dispersion, linear adsorption, and biotransformation via reductive dechlorination (the dominant biotransformation process at most chlorinated solvent sites). Reductive dechlorination is assumed to occur under anaerobic conditions and dissolved solvent degradation is assumed to follow a sequential first-order decay process.

BIOCHLOR modeling was run for the Town of Kernersville Landfill for the chlorinated ethylenes (PCE, TCE, DCE, & VC) based on the June 2014 concentrations for a simulated 10 years of biodegradation. The input and output of the BIOCHLOR modeling are presented in Appendix D and the results of the modeling are summarized below.

Constituent	Mass Removed	% Biotransformed	% Change in Mass Rate
Tetrachloroethylene (PCE)	0.1 Kg	70.9%	98.0%
Trichlorethylene (TCE)	0.4 Kg	65.5%	96.3%
Dichloroethylenes (DCE)	1.5 Kg	53.3%	89.8%
Vinyl Chloride (VC)	-1.2 Kg	-285.7%	-277.6%

3.3 Phytoremediation Evaluation

Phytoremediation is the use of plants, especially trees, to remove, transfer, or stabilize contaminants in soil and/or groundwater. Plants may remove contaminants from groundwater from either direct plant uptake and metabolization or by microbial degradation in the root zone. Contaminants in groundwater can be removed when plant-produced enzymes break down contaminants that enter the plant during transpiration (phytodegredation). Another method by which plants can enhance groundwater quality is by phytoaccumulation, which is the process of uptake and storage of contaminants in the root systems or other parts of the plants. Plants may also uptake contaminants and transpire them through the leaves (phytovolatization). Finally, plants can provide secretions that enhance microbial activity in the root zone that aid in the breakdown of contaminants (ITRC, 1999). Phytoremediation via direct uptake of groundwater contaminants has been demonstrated to be a very efficient removal mechanism for aromatic hydrocarbons, such as those observed at the site.

Generally the octanol-water partition coefficient (log K_{ow}) of organic contaminants must be between 1.0 and 3.5 (moderately hydrophobic organic chemicals) to be susceptible to uptake by plants. Hydrophobic chemicals (log K_{ow}>3.5) are bound too strongly to roots and soil to be translocated within the plants. Water-soluble chemicals (log K_{ow}<1.0) are neither sufficiently sorbed to roots nor actively transported through plant membranes (Briggs, et. al., 1982). The log K_{ow} of the COCs for this facility are given below, and all are within the range to be susceptible to phytoremediation.

Constituent of Concern	Log K_{ow}
Benzene	2.13
Chloroethane	1.43
1,1-Dichloroethane (1,1-DCA)	1.79
1,2-Dichloroethane (1,2-DCA)	1.47
cis-1,2-Dichloroethylene (cis-1,2-dichloroethene, c-1,2-DCE)	1.86
1,2-Dichloropropane (propylene dichloride, 1,2-DCP)	1.97
Tetrachloroethylene (tetrachloroethene, PCE)	2.67
Trichloroethylene (trichloroethene, TCE)	2.17
Vinyl chloride (VC)	1.50

Root contact is a primary limitation on phytoremediation applicability. Remediation via plants requires that the contaminants be in contact with the root zone of the plants. Either the plants

must be able to extend roots to the contaminants, or the contaminated media must be moved to within range of the plants. Rhizodegradation, which is the breakdown of an organic contaminant in soil through microbial activity that is enhanced by the presence of the root zone, is the most effective mode of phytoremediation for petroleum hydrocarbons (US-EPA, 2000).

The groundwater is very shallow in the area of the plume (1-2 ft-bgs in the vicinity of MW-2, 2-5 ft-bgs in the vicinity of MW-4, and 7-11 ft-bgs in the vicinity of MW-3S&D). This puts most if not all of the plume within reach of the root systems of large trees, like poplars and sweet gums, and the shallower parts of the plume will be within reach of even the shallower root systems of grasses and shrubs. Typically, phytoremediation as a remedial technology includes selection of a plant species, planting the selected species, and possibly harvesting the plants at some time in the future; however, at this site, we believe that phytoremediation is already taking place with existing flora and site conditions.

A survey of tree species, health, and maturity already present within the plume area was conducted on August 21, 2014. The tree survey covered the western, southern, and eastern sides of the landfill from the edge of waste to about 20-50 feet beyond the creek. Drawing 3 shows the results of the tree survey. The tree survey was divided into three areas based on similar flora assemblages. Area 1 was the east side of the landfill, Area 2 was the south side from the eastern corner to a point between MW-2 and MW-3S&D, and Area 3 was from that point westward, and partly up the west side of the landfill. All three areas are heavily wooded with abundant mature trees, young trees, and undergrowth. Area 1 is predominantly sweetgum (Liquidambar styraciflua), yellowwood (Cladrastis kentukea), and tulip poplar (Liriodendron tulipifera). There also were several areas of apparent wetlands observed in Area 1. Area 2 is predominantly American sycamore (Platanus occidentalis), with lesser amounts of tulip poplar, black willow, and sweetgum. Area 3 is predominantly tulip poplar with smaller amounts of sweetgum and black maple.

The trees and other plants present on site are expected to effectively metabolize and/or transpire observed groundwater contamination, and rhizodegradation in the root zone is expected to further remediate the groundwater. Poplars have been well-studied in phytoremediation applications (Landmeyer, 2001; Gordon, et al, 1997; Ferro, et al, 1999), and are one of the most commonly recommended trees for phytoremediation of VOCs, metals, and radionuclides. American sycamore, sweetgum, and willows have less documentation; however, they have also been used successfully in similar phytoremediation applications (McCutcheon and Schnoor, 2004; Negri and Hinchman, 2000). Other trees and herbaceous plants in and downgradient of the plume are also likely to contribute to phytoremediation. Furthermore, wetlands are among the most biologically active ecosystems, and are considered to have high potential for phytoremediation of VOCs and other contaminants (Williams, 2002). The presence of wetlands downgradient of the plume is expected to enhance phytoremediation at this site.

The fact that the COCs for this site are all highly susceptible to phytoremediation, coupled with the fact that there are adequate trees and other plants as well as wetlands in the vicinity of and downgradient of the plume, make phytoremediation a viable remedial technology for this

facility. Since adequate florae are already present, phytoremediation will require little or no capital expenditure or significant ongoing maintenance.

3.4 Remedy Evaluation Factors

3.4.1 Long-Term and Short-Term Effectiveness

1. *Magnitude of reduction of existing risks.*

   Existing risk at the facility is limited to environmental professionals and/or Town employees participating in compliance groundwater monitoring activities. Specifically, the sampling and handling of contaminated groundwater from within groundwater contamination plumes beneath the facility create risk. Natural attenuation lowers this risk by reducing concentrations of COCs within the contaminant plume over time.

2. *Magnitude of residual risks in terms of likelihood of further releases due to wastes remaining following implementation of a remedy;*

   Natural attenuation and phytoremediation will not prevent further releases of COCs from the waste unit; however, natural attenuation appears to be occurring beneath the facility at a rate that will prevent migration of the COCs beyond the property boundary at concentrations exceeding their respective GPS. Wastes anticipated to be produced by this remedy will be limited to purge water associated with performing groundwater monitoring events at the facility. The purge water will be discharged to the ground surface and allowed to naturally infiltrate to the water table. It is anticipated that the process of purging and temporarily containerizing the purge water will cause the COCs to volatilize; therefore, the infiltrating purge water is expected to contain lower concentrations of VOCs than currently in the groundwater.

3. *The type and degree of long-term management required, including monitoring, operation, and maintenance;*

   MNA and phytoremediation will not require long-term operation and maintenance activities, except for increased groundwater monitoring for MNA and periodic evaluations of the trees in the area of concern for phytoremediation. Long-term monitoring of facility compliance wells, performance wells, and sentinel points will be required. The monitoring plan for the facility is provided in Section 4.0. The monitoring plan will be implemented upon approval of this CAP, and will be completed when no NCSWMR Appendix I or II constituents have been detected in groundwater above GPS for three consecutive years, or upon determining that natural attenuation is not providing appropriate remediation for the facility. If the latter is determined, the contingency measures discussed in Section 6.0 may be implemented.

4. *Short-term risks that might be posed to the community, workers, or the environment during implementation of such a remedy, including potential threats to human health and the environment associated with excavation, transportation, and redisposal or containment;*

   Short-term risk associated with MNA is limited to environmental professionals and/or Town employees participating in MNA groundwater monitoring activities. Specifically, the sampling and handling of contaminated groundwater from monitoring wells constructed within groundwater contamination plumes create risk; however, the potential for human exposure to landfill contaminants by environmental personnel and/or Town employees will be low as long as standard health and safety procedures are followed during sampling activities.

5. *Time until full protection is achieved;*

   A schedule for achievement of the final remedial objective (COC levels below the GPS at all points within the plume beyond the point of compliance) is dependent upon the rate and duration of continued leaching of contaminants from the landfill. Any prediction of a timeframe for achievement of concentration levels below the GPS at this time would be an estimate based on available data and professional judgment. Natural attenuation and phytoremediation will be monitored in accordance with the monitoring plan (Section 4.0), will be implemented upon approval of this CAP, and will be completed when no NCSWMR Appendix I or II constituents have been detected in groundwater above GPS for three consecutive years, or upon determining that natural attenuation is not providing appropriate remediation for the facility.

6. *Potential for exposure of humans and environmental receptors to remaining wastes, considering the potential threat to human health and the environment associated with excavation, transportation, redisposal, or containment;*

   MNA activities will be performed by environmental personnel trained to minimize their exposure to COCs by using appropriate personal protective equipment and by avoiding contact with contaminated groundwater and vapors.

   The facility is closed, so there will no opportunity for facility workers to come in contact with groundwater from the plumes of contamination. The general public is not expected to come in contact with contaminated media since access to the contaminated media is restricted.

7. *Long-term reliability of the engineering and institutional controls; and*

   Natural attenuation and phytoremediation are proven remedies for facilities similar to the Kernersville Landfill (i.e., a facility with low contaminant concentrations and low risk associated with the delineated contamination). In addition, historical data suggest that natural attenuation is occurring at a rate that

will prevent off site migration of the delineated contaminant plume. As leaching of VOCs from the landfill decreases over time, natural attenuation plus phytoremediation is expected to reduce concentrations of COCs, eventually to below their respective GPS. MNA plus phytoremediation is considered a reliable remedy to meet clean-up goals at the facility.

8. *Potential need for replacement of the remedy.*

   Replacement of MNA plus phytoremediation as the facility remedy may be performed upon determining that the remedy is not preventing migration of COCs beyond the property boundaries into the adjacent property. This will be determined by monitoring surface water sampling locations (SW-2 and SW-3) downgradient of the impacted monitoring wells in accordance with the methods described in Section 4.0. In the event that future monitoring indicates that natural attenuation plus phytoremediation is inadequate for controlling the plume, the contingency remedies discussed in Section 6.0 may be implemented.

3.4.2 Controlling the Source

1. *The extent to which containment practices will reduce further releases; and*

   MNA plus phytoremediation will not reduce further releases; however, natural attenuation plus phytoremediation is expected to prevent releases from migrating beyond the facility property boundary into the adjacent property.

2. *The extent to which treatment technologies may be used.*

   MNA plus phytoremediation use natural processes to treat releases of solid waste constituents. The historical data indicate that natural attenuation is occurring beneath the facility at a rate that will likely prevent migration of solid waste constituents beyond the facility property boundary at concentrations exceeding GPS and will eventually reduce concentrations of COCs to levels below their respective GPS.

3.4.3 Remedy Implementation

1. *Degree of difficulty associated with constructing the technology;*

   Natural attenuation and phytoremediation are already occurring at the facility; therefore, MNA and phytoremediation will be easily implemented upon amending the facility permit to include this CAP.

2. *Expected operational reliability of the technologies;*

   Natural attenuation is considered a reliable remedy for facilities that are experiencing contaminant plumes with low level concentrations of solid waste constituents, contaminant plumes contained within the facility boundary and/or

demonstrated to be stable or shrinking in size), and/or low levels of risk associated with the delineated groundwater contaminant plumes. Phytoremediation adds additional operational reliability and requires little additional operational expense. MNA and phytoremediation are reliable remedies for reported contamination at the landfill. A monitoring plan is included in Section 4.0 of this report as part of this remedy. The monitoring plan provides factors to determine whether natural attenuation and phytoremediation continue to be successful remedies.

3. *Need to coordinate with and obtain necessary approvals and permits from other agencies;*

   None of the proposed remediation activities will require approvals or permits from other agencies.

4. *Availability of necessary equipment and specialists; and*

   Natural attenuation and phytoremediation processes are monitored by readily available laboratory and field procedures.

5. *Available capacity and location of needed treatment, storage, and disposal services.*

   No treatment, storage, or disposal services are required to implement MNA and phytoremediation at the Kernersville Landfill.

3.4.4 Owner/Operator Capability

MNA is the monitoring of the natural processes already occurring beneath the facility and requires only ongoing groundwater monitoring. Similarly, phytoremediation is a naturally occurring process and requires only periodic monitoring of the health of the flora in the area of concern. The Town will likely retain a qualified environmental consulting firm to perform all groundwater monitoring and reporting activities associated with the landfill. The Town anticipates continuing its use of environmental consulting firms to perform activities associated with this remedy. In addition, the Town has budgeted for additional monitoring requirements associated with this remedy. Therefore, the Town is capable of performing MNA and phytoremediation.

3.4.5 Community Concerns

Because the Kernersville facility is regulated under the .0500 rules of the NCSWMR, no ACM or associated public meeting was required. Since the landfill is closed, public access is restricted, and there is no evidence of contamination plumes extending beyond the property boundary, there is no reason to suspect and significant community concern.

4.0 WATER QUALITY MONITORING PLAN

4.1 Introduction

This *Water Quality Monitoring Plan* (WQMP) will serve as a guidance document for collecting and analyzing groundwater and surface water samples, managing the associated analytical results, and monitoring for any potential releases to the uppermost aquifer from the Town of Kernersville Landfill, Permit No. 34-04. This WQMP will replace the previous WQMP dated December 2010. The WQMP complies with 15A NCAC 13B .0500 & .0601 of the North Carolina Solid Waste Management Rules, (NCSWMR). The Plan also addresses the requirements for surface water monitoring specified in Rule .0602.

4.1.1 Site Description

The Town of Kernersville Landfill is a closed, unlined municipal solid waste (MSW) landfill located on approximately 58.2 acres in Forsyth and Guilford Counties, NC, approximately 10 miles north of the City of Kernersville. The waste disposal area comprises approximately 13.8 acres. The property boundary is indicated on an excerpt from the 7.5 minutes USGS topographic map for Belews Creek, North Carolina (Figure 1). The facility was issued a Permit to Operate on May 15, 1985 and a letter of closure was issued on December 10, 1991.

The area surrounding the landfill is zoned residential/agricultural and contains open fields and woodlands. The landfill is separated to the North from the Waste Management Piedmont Landfill and Recycling Center Facility by Freeman Road. The landfill is bounded to the south by an unnamed tributary of Belews Creek.

4.1.2 Site Geology and Hydrogeology

The Town of Kernersville Landfill is located in the Piedmont physiographic providence of North Carolina and is underlain by intrusive granitic rocks of Pennsylvanian to Permian age which are part of the Charlotte Belt Geologic Unit. The uppermost aquifer is unconfined and includes both saprolite and uppermost fractured bedrock, which are strongly connected. The groundwater level measurements taken in June 2014 were used to construct the groundwater surface contours shown in Drawing 1. Historical static water levels are provided in Table 2. Groundwater flow at the site is generally to the southwest.

Using the hydraulic gradients shown on Drawing 1 based on June 2014 water level data, the linear flow velocity (***V***) was estimated using the modified Darcy equation: ***V=Ki/n***. The hydraulic gradient (***i***) is 0.033 ft/ft for the flow path shown on Drawing 1. An effective porosity value (***n***) of 0.30 (30%) was estimated based on typical values of porosity for saprolite aquifers in the Piedmont, and a hydraulic conductivity (***K***) 1.73 ft/day was estimated from slug tests completed by JOYCE in April 2013 (JOYCE, 2013b). The calculated groundwater flow rate averages approximately 0.19 ft/day (68 ft/year). The hydraulic gradient and linear flow velocity calculations are shown in Table 2.

4.2 Groundwater Monitoring

The current groundwater compliance monitoring network includes six monitoring wells, including one upgradient well and five downgradient wells. The facility's monitoring wells are summarized below, along with their current monitoring program status.

Monitoring Well	Classification	Monitoring Program	Total Depth from TOC* (feet)
MW-1	Former Background	Water Levels Only	34.69
MW-2	Compliance/Performance	Detection (.0500) / MNA	13.18
MW-3S	Compliance/Performance	Detection (.0500) / MNA	24.00
MW-3D	Compliance/Performance	Detection (.0500) / MNA	56.96
MW-4	Compliance/Performance	Detection (.0500) / MNA	14.40
MW-5	Compliance	Detection (.0500)	11.36
MW-6	Background	Detection (.0500) / MNA	20.46

*TOC = Top of casing.

The locations of the monitoring wells are shown on Drawing 1. Monitoring well MW-6 serves as the upgradient background well for the facility. Monitoring well MW-6 replaced MW-1 as the facility's background well due to infrequent monitoring as a result of low well volumes or dryness of the well. MW-1 is now monitored for water levels only, as conditions permit. Downgradient monitoring wells MW-2, MW-3S, MW-3D, MW-4, and MW-5 are monitored as part of the compliance network for the facility.

Under the CAP for the facility, wells MW-2, MW-3S, MW-3D, and MW-4 will serve both as compliance wells and as performance wells for MNA. The performance wells will be sampled for MNA indicator parameters beginning with the first semiannual sampling event after approval of the CAP by the DENR. The background well, MW-6, will also be sampled for MNA parameters to provide MNA background data.

4.2.1 Installation and Maintenance of the Groundwater Monitoring Network

The existing monitoring wells will be used and maintained in accordance with design specifications throughout the life of the monitoring program. The specifications are outlined in 15A NCAC Subchapter 2C, Section .0100. Further guidance is provided in the *Draft North Carolina Water Quality Monitoring Guidance Document for Solid Waste Facilities; Solid Waste Section, Division of Solid Waste Management; Department of Environment, Health and Natural Resources (March 1995).* Routine well maintenance will include inspection and correction/repair of, as necessary, identification labels, concrete apron condition, locking caps and locks, and access to the wells. The Town of Kernersville will re-evaluate the monitoring network, and provide recommendations to the Division of Waste Management (DWM) for modifying, rehabilitating, abandoning, or installing replacement or additional monitoring wells, as appropriate.

4.2.2 Well Abandonment

Any monitoring wells at the site which need to be abandoned due to damage, construction activities, or approved changes in the monitoring network will be properly abandoned in accordance with the procedures for permanent abandonment, as described in 15A NCAC 2C Rule .0113(a)(2) and the *NCDENR Water Quality Monitoring Guidance Document for Solid Waste Facilities*. No wells will be abandoned without prior approval from the SWS.

4.2.3 Groundwater Sampling Methodology

Groundwater samples will be collected in accordance with Solid Waste Management Rules 15A NCAC 13B .0500 & .0601 and guidance provided in the *Draft North Carolina Water Quality Monitoring Guidance Document for Solid Waste Facilities; Solid Waste Section, Division of Solid Waste Management; Department of Environment, Health and Natural Resources* (March 1995). Details of well purging, sample withdrawal, and decontamination methods, as well as chain-of-custody procedures are outlined below.

4.2.4 Static Water Levels

Static water elevations and the total well depth will be measured to the nearest 0.01 of a foot in each well prior to the sampling of each well. An electronic water level meter will be used for the measurements. The distance from the top of the well casing to the water surface (and if not already known, the distance to the bottom of the well) will be measured using the tape attached to the probe. In between wells and following completion of the field sampling, the water level meter will be decontaminated using the following procedure.

1) Phosphate-free soap and distilled water wash;
2) Distilled water rinse;
3) Air dry.

4.2.5 Purging and Sampling Methodology

A low-yield well (one that is incapable of yielding three well volumes within a reasonable time) will be purged so that water is removed from the bottom of the screened interval. Low-yield wells will be evacuated to dryness once. Within 24 hours of purging, the first sample will be field tested for pH, temperature, and specific conductance. Samples will then be collected and containerized in the order of the parameter's volatilization sensitivity (i.e., VOCs then total metals).

A high-yield well (one that is capable of yielding more than three well volumes during purging) will be purged so that water is drawn down from the uppermost part of the water column to ensure that fresh water from the formation will move upward in the screen. At no time will a

well be evacuated to dryness if the recharge rate causes the formation water to vigorously cascade down the sides of the screen, which could cause an accelerated loss of volatiles.

A minimum of three well volumes will be evacuated from high-yield wells prior to sampling. A well volume is defined as the water contained within the well casing and pore spaces of the surrounding filter pack. The well volume will be calculated using the following formulas:

$V_c = (d_c^2/4) \times 3.14 \times h_w \times (7.48 \text{ gallons/cubic foot})$
$V_c \text{ (gallons)} = 0.163 \times h_w$ (for a 2-inch well)

where:
V_c = volume in the well casing in gallons
d_c = casing diameter in feet (d_c = 0.167 for a 2-inch well)
h_w = height of the water column in feet (i.e., well depth minus depth to water)

Each well will be evacuated (purged) and sampled with a disposable bailer or a sampling pump. The bailer or pump will be lowered gently into the well to minimize the possibility of causing degassing of the water. If sampled with a pump, flow rates will be regulated to minimize turbidity and degassing of the water.

All equipment used for sampling will be handled in such a manner to ensure that the equipment remains decontaminated prior to use. In between wells and following completion of the field sampling, water level meters, sampling pumps, or any other reusable sampling equipment will be properly decontaminated. Clean disposable gloves will be worn by sampling personnel and changed between wells.

The upgradient/background well will be sampled first, followed by the downgradient wells. The order of sampling of the downgradient wells will be evaluated each sampling event to provide a sequence going from less contaminated to more contaminated, if applicable, based on the previous sampling event.

Field measurements of temperature, pH, specific conductance, and turbidity will be made before sample collection. The direct reading equipment used at each well will be calibrated according to the manufacturer's specifications prior to each sampling event. Groundwater samples will be collected and containerized in the order of the volatilization sensitivity (i.e., VOCs first, followed by the metals).

4.2.6 Sample Collection, Bottling, and Transportation

Pre-preserved sample containers shall be properly prepared by the analytical laboratory scheduled to perform the analysis. No cleaning or preparation of sampling bottles by field personnel should be performed.

The VOC vials will be filled in such a manner that no headspace remains after filling. Immediately upon collection, all samples will be placed in coolers on ice where they will be stored prior to and during transit to the laboratory.

Samples collected will be properly containerized, packed into pre-cooled coolers, and either hand-delivered or shipped via overnight courier to the laboratory for analysis. The chain-of-custody program will allow for tracing of possession and handling of samples from the time of field collection through laboratory analysis. The chain-of-custody program will include sample labels and seals, field logs, chain-of-custody records, and laboratory logs.

Labels sufficiently durable to remain legible when wet will contain the following information:

- Job and sample identification;
- Monitoring well number or other location;
- Date and time of collection;
- Name of collector;
- Parameter or method to be analyzed; and
- Preservative, if applicable.

The shipping container will be sealed to ensure that the samples have not been disturbed during transport to the laboratory. If the sample cannot be analyzed because of damage or disturbance, whenever possible, the damaged sample will be replaced during the same compliance period.

The field log will contain sheets documenting the following information:

- Identification of the well;
- Well depth;
- Static water level depth;
- Presence of immiscible layers, odors or other indications of potential contamination;
- Purge volume (given in gallons);
- Time well was purged;
- Date and time of collection;
- Well sampling sequence;
- Field analysis data and methods;
- Field observations on sampling event;
- Name of collector(s);
- Climatic conditions (temperature, precipitation).

Sample field log sheets for groundwater and surface water are provided in Appendix E.

The chain-of-custody record is required to establish the documentation necessary to trace sample possession from time of collection to time of receipt at destination. A chain-of-custody will accompany each individual shipment and will contain the following information:

- Sample destination and transporter;
- Sample identification numbers;
- Signature of collector;
- Date and time of collection;
- Sample type;
- Identification of well;
- Number of sample containers in shipping container;
- Parameters requested for analysis;
- Signature of person(s) involved in the chain of possession;
- Inclusive dates of possession; and
- Internal temperature of shipping container upon opening (noted by the laboratory).

A copy of the completed chain-of-custody will accompany the shipment and will be returned to the shipper with the analytical results. The chain-of-custody may also be used as the analysis request sheet. A sample chain-of-custody form is included in Appendix E.

4.2.7 Field/Equipment and Trip Blanks

A field blank will be collected and analyzed during each sampling event to verify that the sample collection and handling processes have not affected the integrity of the field samples. The field blank will be prepared in the field from lab pure water (Type II reagent grade water) supplied by the laboratory. One field blank will be prepared for each sampling event. The field blank will be generated by exposing the lab pure water to the sampling environment in the same manner as actual field samples being collected. The lab will provide appropriate sample containers for generation of the field/equipment blank(s). The field blank will be subjected to the same analysis(es) as the groundwater samples. As with all other samples, the time(s) of the field blank collection will be recorded so that the sampling sequence is documented. The field blank monitors for contamination from contamination that might occur between samples and sample containers as they are opened and exposed to the sampling environment.

Whenever groundwater samples are being collected for volatiles analysis, a trip blank will be generated by the laboratory prior to shipment of sampling containers and coolers to the field, using lab pure water as described above. The trip blank shall be transported with the empty sampling containers to the field, but will not be opened at any time prior to analysis at the laboratory. The trip blank will accompany the groundwater samples in the cooler(s) back to the laboratory and will be analyzed by the same volatile methods as the associated field samples. The trip blank monitors for potential cross-contamination that might occur between samples or that may be a result of the shipping environment.

Detectable levels of contaminants found in the field blanks or trip blanks will not be used to correct the groundwater data, but will be noted accordingly. Detections of constituents in site groundwater or surface water samples may be blank-qualified if the concentration detected in the

sample is less than 5 times (or 10 times, in the case of some common laboratory contaminants such as methylene chloride and some phthalates) the concentrations of that constituent detected in the field, trip, or method blanks. Contaminants present in trip blanks or field blanks at concentrations within an order of magnitude of those observed in the corresponding groundwater samples may be cause for resampling.

4.3 Sample Analytical Requirements

4.3.1 Semiannual Compliance Monitoring

Analysis of groundwater and surface water samples from the facility will be conducted by a laboratory certified by the Department of Environment and Natural Resources (DENR). Analyses will be performed in accordance with U.S. Environmental Protection Agency (EPA) SW-846 methods. Both groundwater and surface water samples will be analyzed for the constituents listed in NCSWMR Appendix I. In addition, field analyses for temperature, pH, specific conductance, and turbidity will be performed for each sample. Appendix A includes a table of all Appendix I constituents with their respective analytical methods, CAS numbers, DENR Solid Waste Section Limits (SWSL), 15A NCAC 2L (NC 2L) groundwater standards, and solid waste section groundwater protection standards (GWPS).

4.3.2 Corrective Action Monitoring

The corrective action monitoring portion of this WQMP will be implemented during the Corrective Action Program, until constituents detected in groundwater are below the GPS within the plume for three consecutive years. If the facility's post-closure care period is still in effect at the time this WQMP is terminated, the facility will be monitored in accordance with the requirements of the NCSWMR (i.e., under the Detection Monitoring Program) until the end of the post-closure care period. Alternatively, if the post-closure care period ends before the WQMP is suspended; the post-closure care period will be extended until such time as GPS are not exceeded for three consecutive years.

Wells MW-2, MW-3S, MW-3D, and MW-4 will be considered both compliance wells and performance wells for MNA and phytoremediation. Surface water points SW-2 and SW-3 will be considered sentinel points for MNA and phytoremediation.

An initial baseline period of monitoring is needed to establish the effectiveness of MNA as a remedial option. The site background well and the performance wells shall be sampled for all MNA performance parameters on a semiannual basis for at least two calendar years (four semiannual sampling events) after approval of the CAP to establish baseline trends. MNA parameter data collected from the site prior to approval of the CAP may also be used as part of the baseline evaluation.

The MNA performance parameters provide insight into the microbial and biogeochemical reactions and processes that are occurring within the subsurface. The baseline sampling shall include the following MNA performance parameters. Some of these parameters will be analyzed

in the field at the time of sampling while others will be collected for laboratory analysis, as indicated in parentheses below.

- Nitrate (lab)
- Sulfate (lab)
- Sulfide (lab)
- Methane (lab)
- Ethene, Ethane (lab)
- TOC (lab)
- Alkalinity (lab)
- Chloride (lab)
- Dissolved Hydrogen (lab)
- Volatile Fatty Acids (lab)
- pH (field)
- Temperature (field)
- Conductivity (field)
- Turbidity (field)
- ORP (field)
- Ferrous Iron (field)
- Dissolved CO_2 (field)
- Dissolved Oxygen (field)

After the four baseline sampling events have been completed, the MNA data will be evaluated to determine the effectiveness of each of the MNA parameters in evaluating the MNA process on this site. If, after the baseline period, it is determined that some of MNA parameters are not needed to adequately characterize and evaluate the MNA process, the Town may petition the DENR to cease or reduce the frequency of analyses for those MNA parameters. At a minimum, the performance wells will continue to be sampled semiannually for temperature, pH, specific conductance, oxidation reduction potential, dissolved oxygen, nitrate, sulfate, and chloride for as long as the CAP is in effect. After the baseline period, the site background well, MW-6, may be analyzed for only those MNA parameters that require comparison to a background value for evaluation.

4.4 Reporting and Record Keeping

The laboratory analytical results will be submitted to the Solid Waste Section at least semiannually. The following measurements, analytical data, calculations, and other relevant groundwater monitoring records will be kept throughout the active life of the facility and the post-closure care period:

- Laboratory reports and chains-of-custody for all groundwater quality data, including MNA data as appropriate;
- Associated sample collection field logs and measurements, such as static water level measured in compliance wells at the time of sample collection; and
- Notices and reports of NC 2L Standard and/or GWPS exceedances, reporting or data error, missing data, etc.

In addition to the Semiannual Water Quality Monitoring Reports (WQMRs), a Corrective Action Evaluation Reports (CAER) will be required in conjunction with the first semiannual WQMR after the baseline monitoring period and every 5 years thereafter. Details of the CAER requirements are presented in Section 6.0 of this CAP.

4.5 Comparisons to Standards

Constituents detected in the groundwater samples collected from the compliance network shall be compared to the NC 2L Groundwater Standards established by 15A NCAC 2L.0202. For constituents without NC 2L Standards, the groundwater samples shall be compared to the GWPS established by the SWS. Unless otherwise established by DENR, the standards for all constituents shall be equal to their respective NC 2L Standards or GWPS (see Appendix A), unless the NC 2L Standard or GWPS is below the SWSL, in which case the standard shall be equal to the SWSL. If a statistically-determined background concentration for a constituent is greater than the applicable NC 2L or GWPS, the background may be considered the standard for comparison. The initial comparison will be performed using a value-to-value procedure. If a suspect exceedance is noted during the value-to-value comparison, a confirmation sample may be collected.

4.6 Surface Water Monitoring

In accordance with rule .0602 of the NCSWMR, surface water at the site is monitored semiannually in conjunction with the groundwater sampling events. Samples are collected from three surface water monitoring points (SW-1, SW-2, and SW-3). The locations of the surface water monitoring points are shown on Drawing 1, and are described in the table below.

Sampling Point	Description
SW-1	Creek on the south side of the Town of Kernersville Landfill. Upstream of the landfill.
SW-2	Creek on southwest side of the Town of Kernersville Landfill. Downstream of MW-4 at the property boundary.
SW-3	Creek on the south side of the Town of Kernersville Landfill. Upstream of SW-2 and downstream of SW-1. Former Piedmont Landfill & Recycling Center monitoring point SW-1.

Surface water samples will be collected from flowing water at the designated sample locations in conjunction with the semiannual groundwater sampling events. Surface water can be sampled either by: 1) collecting the sample using a properly-decontaminated graduated dipper and filling laboratory-prepared sample containers from the dipper; or 2) by dipping laboratory-prepared sample containers directly into the stream flow. If using the direct sampling method, great care should be taken to not overflow containers containing preservatives to prevent loss of preservative. Use of an unpreserved laboratory container to collect the sample and then carefully dispense it into the preserved container is acceptable. For unpreserved containers, it is preferable to completely submerge the closed container, removing the lid underwater, and then replacing the lid when the container is full before removing it from the water; however, this method is only acceptable if there is sufficient depth of flowing water. No matter what method is used to collect samples, great care should be taken to not disturb creek bed sediment during sampling, and to obtain samples from the least turbid location available. Downstream samples

should be collected first and upstream samples second. Samplers should wear clean, dedicated sampling gloves at all times while collecting or handling samples. Field parameters, including temperature, pH, and turbidity, shall be monitored at each sample location using the same sample collection technique used to collect the laboratory samples, as appropriate. Sampling techniques and protocols describe above for groundwater, including sample labeling, field log entry, and chain-of-custody procedures, shall also be followed for surface water samples.

Surface water samples will be collected and analyzed for the NCSWMR Appendix I list of constituents during both semiannual monitoring events. The results will be compared to the 15A NCAC 2B (NC 2B) Surface Water Standards in a value-to-value comparison. Appendix B includes NC 2B Surface Water Standards for NC Appendix I constituents.

4.7 Ability to Effectively Monitor Releases

Based on review of geologic and hydrogeologic data available for this facility, no geological or hydrogeological conditions have been identified which will interfere with effective monitoring of the landfill. This WQMP, when implemented, will be effective in providing early detection of any release of hazardous constituents to the uppermost aquifer beneath the landfill, so as to be protective of public health and the environment.

5.0 EVALUATION OF EFFECTIVENESS AND REPORT SUBMITTALS

5.1 Physical and Chemical Changes in Aquifer Conditions

Data obtained from the semiannual sampling events, including groundwater elevation and flow, groundwater field and indicator parameters, and constituent concentrations will be evaluated with regard to the physical and chemical conditions in the uppermost aquifer at the site. Any significant changes in the conditions in the aquifer will be reported with recommendations on corrective actions, changes in the monitoring program, or other appropriate responses.

5.2 Physical and Chemical Changes in Plume Characteristics

Data obtained from the compliance/performance wells and sentinel points will be used to annually re-evaluate the risk posed by the residual plume and to determine the need for additional wells or for implementation of an alternative remedy. The analytical results from the wells will be compared to the GPS using a value-to-value comparison method as detailed in Section 4.05. The facility may elect to conduct a confirmation sampling event if the laboratory data are suspected to be inaccurate.

If COC concentrations are observed to be less than the established GPS in the sentinel points, no action will be required and the routine compliance and corrective action monitoring will continue until the remedial objective is achieved and the Corrective Action Program is suspended. In the event that contaminant concentrations in a sentinel point are confirmed to exceed GPS, the Town may install additional monitoring wells, as needed, between the exceeding sentinel point and the

receptors of interest. Analytical data obtained from the additional well(s) will be used to re-evaluate the risk from the plume.

In the event that risk to human health or the environment is deemed unacceptable, then one or more of the contingency remedies discussed in the Section 7.0 may be implemented in the affected area. Once contaminant concentrations in the sentinel points are below established GPS, then this additional contingency portion of the remedy will be considered complete.

5.3 Refining the Site Conceptual Model

Any new information that comes to the attention of the facility, either from the data collected on site or other sources, which impacts the site conceptual model will be reported and evaluated. This includes data on site or regional geology, hydrogeology, or other aspects of the site conceptual model. The site conceptual model will be refined in response to the new information as needed and appropriate.

5.4 Evaluation of Remedy Effectiveness

The MNA plus phytoremediation remedy will be evaluated based on analytical results obtained from the performance wells MW-2, MW-3S, MW-3D, and MW-4, and the sentinel points SW-2 and SW-3. Data obtained from these wells will be plotted on site maps and trend graphs to evaluate the effectiveness of the remedy. An EPA-approved MNA screening model, such as BIOCHLOR (or similar software), which includes mass flux measurements, will be used to evaluate MNA effectiveness annually. A mass-balance assessment will also be completed annually to demonstrate an appropriate balance between source loading and plume attenuation capacity. Plume stability (chemical, biological, and physical) will be evaluated along specific flow lines within the plume and along the plume boundary. The screening model and mass-balance results will be included in the corresponding semiannual reports.

After the baseline sampling data have been collected, the data will be evaluated to determine which of the MNA parameters are needed to track the progress of MNA within the plume. Recommendations for a long-term MNA parameter list for the facility and corresponding sampling frequencies will be submitted to DENR for approval. After the long term list is approved, the MNA data will be evaluated at the approved frequencies to determine the continuing effectiveness of MNA at this facility. If it is determined that MNA plus phytoremediation is no longer effectively controlling the plume and that this presents an unacceptable risk to human health or the environment, contingency remedies may be implemented as described Section 7.0.

At least annually, a survey will be conducted of the trees in the vicinity of and immediately downgradient of the contaminant plume. The tree survey will include identification of existing species, a qualitative evaluation of the health and maturity of the trees, and an assessment of any changes in the tree population since the previous survey, especially as they may impact the

effectiveness of phytoremediation as a remedy for the site. An example Tree Inspection Form is included in Appendix F.

6.0 CORRECTIVE ACTION PROGRAM REPORTING

The routine compliance monitoring for this site shall continue to be reported semiannually in accordance with the NCSWMR and the WQMP for the facility (Section 4.0). The additional MNA data gathered for the performance wells and an evaluation of plume stability will be included in the semiannual reports. Results of BIOCHLOR modeling and mass-balance assessments will be included annually in the appropriate semiannual report. Annual phytoremediation tree survey results will be reported in the next semiannual report due after the survey is performed.

In addition to the semiannual groundwater reports, the performance criteria for the MNA plus phytoremediation remedy will be evaluated and the results will be presented to the DENR every five years in a Corrective Action Evaluation Report (CAER). The first CAER will be due within 90 days of receipt of final analytical results for the baseline sampling period, with subsequent CAER's due every five years thereafter. The CAER may provide recommended modifications to the CAP, recommendations to initiate alternative remedies, recommendations to suspend CAP monitoring, or other actions, as appropriate. The CAER shall include, at a minimum, a summary report, data tables, laboratory reports (if not previously submitted), a groundwater elevation contour map, one or more isoconcentration maps for total VOCs and/or individual COCs, and if needed, cross sections showing groundwater elevations and isoconcentration contours. The CAER will also include an evaluation of the effectiveness of the corrective action and graphs illustrating trends of key indicator parameters and/or constituents from key/representative monitoring locations.

In the event that a GPS exceedance is confirmed in one or more sentinel point samples based on routine monitoring results, the Town will notify DENR in writing of: (1) the confirmed exceedance; and (2) the Town's intended course of action to address the GPS exceedance.

After the remedial objectives of the CAP have been obtained for the required time period, The Town will notify the DENR of its intent to suspend the monitoring requirements of the CAP and of its intent to revert to Detection Monitoring.

7.0 CONTINGENCY PLAN

7.1 Contingency Remedies

This CAP includes a contingency plan to be implemented in the unlikely event that MNA plus phytoremediation are shown to be ineffective at adequately controlling and/or remediating the groundwater contaminant plume. The contingency plan includes implementation of one of two contingency remedies:

1. Control of landfill gas through installation of passive or active gas vents or an intercept trench; or
2. Installation of a reactive barrier trench to intercept and filter the shallow groundwater plume.

Additional active remedies may also be used to fulfill the remedial objectives, with approval of DENR. Prior to implementing one or more of these additional remedies, a pilot study may be performed, if appropriate, to aid in design of the remedy and/or to evaluate whether it will be effective. If evaluation of the data indicates that the chosen additional remedy may not be effective, a different remedy will be proposed, or the proposed design of the remedy may be revised as appropriate. If one or more alternate remedial measures are required, a report justifying the alternate measure(s) and outlining an implementation plan and schedule for the remedial measures will be submitted to the DENR at least 30 days prior to implementation.

If necessary, the contingency plan may include installation of additional wells to better define the extent of plume migration and/or to provide data needed to properly design the proposed remedy. In the case that there is evidence that the plume has migrated off-site, affected adjoining property owners will be notified.

7.2 Triggering Events

The following events will trigger implementation of the Contingency Plan:

- COCs are detected above their respective GPS in sentinel points SW-2 or SW-3 and it is determined that such exceedances represent an unacceptable risk to human health or the environment. In the event of a GPS exceedance in a sentinel point, the facility may conduct an additional sampling event to confirm the exceedance. If the exceedance is confirmed, the facility will submit a plan and schedule for implementation of a contingency remedy or alternative remedy to the DENR.

- A CAER determines that MNA and phytoremediation are not adequately controlling or remediating the contaminant plume and that this results in an unacceptable risk to human health or the environment. The CAER will include a plan and schedule for implementation of a contingency remedy or alternative remedy.

The Contingency Plan will be implemented upon approval by DENR of the proposed contingency remedy and implementation schedule. After an alternative remedy is implemented, samples will be obtained from the affected sample location(s) within an appropriate timeframe to confirm that the remedy is working as designed in accordance with the approved plan and schedule.

7.3 Performance Criteria for Contingency Plan

The performance criteria will consist of a value-to-value comparison of the analytical data from the affected performance well(s) or sentinel point(s) to the GPS for detected constituents. If the comparison indicates that the concentrations of the COCs have been reduced to less than the GPS, the alternative remedy will be considered complete, and the routine MNA monitoring will resume until the Corrective Action Program is suspended. If the comparison indicates that the COCs are still present at concentrations that exceed the GPS beyond the facility boundary and that such exceedances represent an unacceptable risk to human health or the environment, sampling of the affected performance well(s) or sentinel point(s) will continue to be conducted on a semiannual basis until the COC concentrations are below the GPS.

If, after six semiannual alternative remedy monitoring events, the COCs are still present at concentrations that exceed the GPS, a re-evaluation of the alternative remedy and an appropriate adjustment or alteration of the remedy will be implemented upon DENR's approval. The alternative remedy implementation and confirmation sampling will continue as specified above until the COC concentrations decrease to less than the GPS in the affected performance well(s) or sentinel point(s), unless the Town is otherwise directed by DENR.

8.0 SCHEDULE AND MAINTENANCE

8.1 Schedule Considerations

According to the NCSWMR, the owner/operator is required to specify a schedule for initiating and completing remedial activities. Such a schedule shall require the initiation of remedial activities within a reasonable period of time, taking into consideration the factors set forth in this section. The owner/operator shall consider the following factors in determining the schedule of remedial activities.

- Extent and nature of contamination
- Remedial technology capabilities
- Availability of treatment or disposal capacity for wastes during implementation of the remedy
- Desirability of utilizing technologies that are not currently available, but which may offer significant advantages over already available technologies in terms of effectiveness, reliability, safety, or ability to achieve remedial objectives;
- Potential risks to human health and the environment from exposure to contamination prior to completion of the remedy;
- Resource value of the aquifer including:
    - Current and future uses;
    - Proximity and withdrawal rates of users;
    - Groundwater quantity and quality;
    - The potential damage to wildlife, crops, vegetation, and physical structures caused by exposure to the waste constituents;

    - The hydrological characteristics of the facility and surrounding land;
    - Groundwater removal and treatment costs; and
    - The cost and availability of alternate water supplies.
- Practical capability of owner/operator; and
- Other relevant factors.

8.2 Timeline

Upon considering the above-mentioned factors and based on evaluation of data from the site, natural attenuation and phytoremediation are already occurring at this facility at a rate that is expected to prevent the migration of solid waste constituents beyond the landfill property boundary at concentrations exceeding the GPS. Therefore, this portion of the proposed remedy is already in place at the landfill. A schedule for implementing this CAP is presented in Table 8, and discussed below.

The monitoring of this remedy will begin with the first regular semiannual sampling event scheduled for more than 30 days following approval of this CAP by DENR. The monitoring of natural attenuation processes will be performed in accordance with the WQMP presented in Section 4.0. The first CAER will be due 120 days after completion of the last (4th) sampling event for the MNA baseline sampling period, with subsequent CAER's due every five years thereafter.

Once contaminant concentrations at or beyond the relevant point of compliance are below established GPS for three consecutive years, the corrective action will be considered complete. A certification that corrective action has been completed in compliance with the requirements of the NCSWMR will be submitted to DENR. If the facility is in the post-closure care period at the end of the Corrective Action Program, Detection Monitoring will be continued.

8.3 Operations and Maintenance (O&M)

The facility shall establish a site-specific, routine monitoring system inspection schedule, the frequency of which shall be appropriate for the maintenance requirements of the MNA monitoring network. Inspection results shall be recorded and placed in the facility's Operating Record.

If results of annual tree surveys indicate additional plantings, fertilization, pest control, or similar maintenance of the trees needed for phytoremediation is required, such work will be scheduled and records of the work will be placed in the facility's Operating Record.

8.4 Safeguards and Safety

The facility shall establish site-specific health and safety guidelines for the monitoring system and monitoring activities, including installation and sampling of monitoring wells. The guidelines shall include security for the monitoring wells, such as locked protective casings

and/or access restrictions, as well as descriptions of appropriate personal protective equipment for routine and anticipated activities.

8.5 Modification of Corrective Action or Schedule

Any requests for modifications of the approved corrective action and/or the implementation schedule must be submitted in writing to the Solid Waste Section, and the requested modifications may not be implemented until approved in writing by the Division of Waste Management.

9.0 COMPLETION OF CORRECTIVE ACTION

Once concentrations of the COCs are below established GPS at and beyond the relevant point of compliance for three consecutive years, the corrective action will be considered complete. If the facility is in the post-closure care period at the end of the Corrective Action Program, Detection Monitoring will be continued. After the remedial objectives of the CAP have been obtained for the required time period, the Town of Kernersville will notify the DENR of its intent to suspend the monitoring requirements of the CAP and of its intent to revert to Detection Monitoring, as appropriate. A certification that corrective action has been completed in compliance with the requirements of the NCSWMR will be submitted to DENR.

10.0 REFERENCES

The references cited herein were used to prepare this document and may or may not be cited in the text of this report.

Aburto, A., 2009. *Mixed Aerobic and Anaerobic Microbial Communities in Benzene-Contaminated Groundwater*. Journal of Applied Microbiology, Issue 1, 2009.

Aziz, Carol E., Charles J. Newell, James R. Gonzales, Patrick Hass, T. Prabhakar, and Yunwei Sun. 2000. *BIOCHLOR Natural Attenuation Decision Support System User's Manual, Version 1.0*. United States Environmental Protection Agency, Office of Research and Development, Washington DC. EPA/600/R-00/008. January 2000.

Briggs, G.C., Browmilow, R.H., and Evans, A.A., "*Relationship between Lipophicity and Root Uptake and Translocation of Non-ionized Chemicals by Barley*", Pesticide Science, Volume 13, 1982.

Brown, Philip M., Chief Geologist, 1985, *Geologic Map of North Carolina*, The North Carolina Geologic Survey, scale 1:500,000.

Espenshade, G.H., D.W. Rankin, K.Weir Shaw, and R.B. Newman, 1975. *Geologic Map of the East Half of the Winston-Salem Quadrangle, North Carolina-Virginia*. Dept. of the

Interior, United States Geological Survey, Miscellaneous Investigations Series, Map I-7090B. 1975.

Fetter, C.W., 2001, *Applied Hydrogeology*, Fourth Edition: Prentice-Hall, Inc..

Ferro, A., Kennedy, J., Kjelgren, R., Rieder, J., and S. Perrin. 1999. "*Toxicity Assessment of Volatile Organic Compounds in Poplar Trees*". International Journal of Phytoremediation. 1(1): 9-17.

Fritsche, Wolfgang, and Hofrichter, Martin, 2008. *Aerobic Degradation by Microorganisms*, in Biotechnology: Environmental Processes II, Volume 11b, Second Edition, H. J. Rehm & G. Reed, eds. WILEY-VCH Verlag GmbH. Published Online: 20 MAR 2008.

Gordon, M., N. Choe, J. Duffy, G. Ekuan, P. Heilman, I. Muiznieks, L. Newman, M. Ruszaj, B.B. Shurtleff, S. Strand, and J. Wilmoth. 1997. *Phytoremediation of Trichloroethylene with Hybrid Poplars*. p. 177-185. In E.L. Kruger etg al. (ed.) Phytoremediation of Soil and Water Contaminants. ACS symposium series 664. American Chemical Society, Washington, DC.

Interstate Technology and Regulatory Cooperation Work Group (ITRC). *Phytoremediation Decision Tree.* Prepared by: ITRC Phytoremediation Work Team. November 1999. Available at http://www.itrcweb.org.

Jindrová, E., M. Chocová, K. Demnerová, and V. Brenner, 2002. *Bacterial Aerobic Degradation of Benzene, Toluene, Ethylbenzene and Xylene.* Folia Microbiologica, Volume 47, Issue 2, pp 83-93, April 2002.

Johnson, A.I., 1967, *Specific Yield - Compilation of Specific Yields for Various Materials:* U.S. Geological Survey Water Supply Paper 1662-D.

Joyce Engineering, Inc. (JOYCE), 2010. *Water Quality Monitoring Plan, Town of Kernersville Landfill, Permit No. 34-04*. December 2010.

JOYCE, 2013a. *Groundwater Assessment Plan, Town of Kernersville Landfill, Permit #34-04*. January 2013.

JOYCE, 2013b. *Groundwater Assessment Report, Town of Kernersville Landfill, Permit #34-04*. May 2013.

JOYCE, 2013c. *Landfill Gas Corrective Action Plan, Town of Kernersville Landfill, Permit #34-04*. September 2013.

JOYCE, 2014. *First Semiannual Water Quality Monitoring Report of 2014, Town of Kernersville Landfill, Permit #34-04*. June 2014.

Landmeyer, J. 2001. *Monitoring the Effect of Hybrid Poplar Trees on Petroleum-Hydrocarbon and Chlorinated-Solvent Contaminated Ground water*. International Journal of Phytoremediation, 3:61-85.

McCutcheon, Steven C., and Jerald L. Schnoor, 2004. Phytoremediation: Transformation and Control of Contaminants. John Wiley & Sons. April 5, 2004

Miller, R. *Phytoremediation, Technology Overview Report.* Ground-Water Remediation Technologies Analysis Center (GWRTAC), available at http://ww.gwrtac.org

Musat, Florin, 2008. *Anaerobic Degradation of Benzene by a Marine Sulfate-Reducing Enrichment Culture, and Cell Hybridization of the Dominant Phylotype*. Environmental Microbiology, Issue 1, 2008.

Negri, M. C., and R. R. Hinchman. 2000. *The Use of Plants for the Treatment of Radionuclides*. in I. Raskin and B. D. Ensley, editors. Phytoremediation of Toxic Metals. John Wiley & Sons, Inc., New York.

National Research Council (NRC), 2000. *Natural Attenuation for Groundwater Remediation*. National Academy Press, Washington, D.C. pp. 108-111.

North Carolina Dept. Environment, Health, and Natural Resources, 1995, *N.C. Water Quality Monitoring Guidance Document for Solid Waste Facilities*, March 1995.

North Carolina Department of Environment and Natural Resources (NC-DENR), 2011. *North Carolina Solid Waste Management Rules*. 15 NCAC 13B. Amended April 2011.

NC-DENR, 2007. *North Carolina Solid Waste Section Guidelines for Corrective Action at Solid Waste Management Facilities*. March 2007.

Reid, Jeffery C., 1993. *A Geochemical Atlas of North Carolina*. North Carolina Geological Survey, Bulletin 93. Raleigh, NC. May 1991, revised 1993.

Schnoor, J. *Phytoremediation, Technology Evaluation Report*. GWRTAC. Available at http://ww.gwrtac.org.

United States Environmental Protection Agency (US-EPA), 1992. *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities, Addendum to Interim Final Guidance.* July 1992.

US-EPA, 1998. *Technical Protocol for Evaluating Natural Attenuation of Chlorinated Solvents in Groundwater*. ORD, EPA/600/R-98/128. September 1998.

US-EPA, 1999. *Phytoremediation Resource Guide*, EPA 542-B-99-003. June 1999. Available at http://www.epa.gov/tio.

US-EPA, 2000. *Introduction to Phytoremediation*, EPA 600-R-99-107. February 2000. Available at http://www.epa.gov/tio.

US-EPA, 2009. *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities, Unified Guidance.* March 2009.

Williams, John B., 2002. *Phytoremediation in Wetland Ecosystems: Progress, Problems, and Potential.* Critical Reviews in Plant Sciences, Volume 21, Issue 6, 2002.

11.0 ACRONYMS

ACM	Assessment of Corrective Measures (report)
AOC	Area of Concern
C&D	Construction and Demolition (Waste)
CAP	Corrective Action Plan (report)
CAER	Corrective Action Evaluation Report (report)
CPVC	Chlorinated Poly Vinyl Chloride
COC	Contaminant of Concern
DCA	Dichloroethane
DCB	Dichlorobenzene
DCE	Dichloroethylene
DCP	Dichloropropane
DENR	North Carolina Department of Environment and Natural Resources
DL	Detection Limit (for laboratory data)
DO	Dissolved Oxygen
EPA	United States Environmental Protection Agency
Ft-bgs	Feet below ground surface
Ft-amsl	Feet above mean sea level
GEU	Gas Extraction Unit
GPS	Groundwater Protection Standards [per 15A NCAC 13B.1634(g)]
GWPS	NC Solid Waste Section Groundwater Protection Standards
HASP	Site-specific Health and Safety Plan
HDPE	High-density Polyethylene
IDLH	Immediately Dangerous to Life and Health
JOYCE	Joyce Engineering, Inc.
LFG	Landfill Gas
LEL	Lower Explosive Limit
MCL	Maximum Contaminant Level (EPA)
mg/L	milligram per liter
µg/L	microgram per liter
MNA	Monitored Natural Attenuation

MSW	Municipal Solid Waste
mV	millivolt
NC 2B	North Carolina Surface Water Standards found in 15A NCAC 2B.0101
NC 2L	North Carolina Groundwater Standards found in 15A NCAC 2L.0202
NCAC	North Carolina Administrative Code
NCSWMR	North Carolina Solid Waste Management Regulations (15A NCAC 13B)
ND	Not Detected (for laboratory data)
NES	Nature and Extent Study (report)
NIOSH	National Institute for Occupational Safety and Health
O&M	Operations and Maintenance
ORP	Oxidation-Reduction Potential
OSHA	Occupational Health and Safety Association
PCE	Tetrachloroethylene
PVC	Poly Vinyl Chloride
QL	Quantitation Limit (for laboratory data)
QRA	Quantitative Risk Assessment (report)
RA	Risk Assessment (report)
RL	Reporting Limit (for laboratory data)
SWQS	Surface Water Quality Standards
SWS	DENR Division of Waste Management, Solid Waste Section
SWSL	North Carolina Solid Waste Section Reporting Limits (for laboratory data)
TCE	Trichloroethylene
TOC	Total Organic Carbon (laboratory analysis)
TOC	Top of Casing (for a well)
VC	Vinyl chloride
VOC	Volatile Organic Compound
WQMP	Water Quality Monitoring Plan (report)

TABLES

TABLE 1
HISTORICAL GROUNDWATER ELEVATIONS

	Background		Downgradient				
Well ID:	**MW-1**	**MW-6**	**MW-2**	**MW-3S**	**MW-3D**	**MW-4**	**MW-5**
TOC Elevation:	806.42	804.87	762.19	764.57	764.56	760.26	773.32
Well Depth:	34.69	20.46	13.18	24.00	56.96	14.40	11.36
30-Dec-09	772.45	786.66	759.16	751.54	752.79	754.33	769.21
01-Jun-10	773.45	788.32	758.90	750.76	752.63	753.90	769.69
16-Nov-10	773.55	787.93	759.14	750.98	752.59	753.74	769.81
29-Dec-10	773.29	787.37	758.83	749.82	752.45	753.68	769.56
29-Jun-11	773.10	786.81	758.38	750.54	752.16	753.41	769.73
01-Nov-11	771.92	785.10	758.49	754.73	751.90	753.08	769.63
01-May-12	771.88	785.32	758.54	750.86	752.34	753.55	769.55
07-Nov-12	771.65	DRY	758.20	750.30	751.61	752.87	768.57
09-May-13	769.95	787.56	759.20	752.52	753.24	754.44	-
07-Nov-13	771.46	DRY	758.09	750.12	751.50	752.79	768.13
05-Jun-14	772.22	785.84	758.45	750.67	752.14	753.36	768.57

Notes:
TOC = Top of PVC well casing.
Elevations in feet above mean sea level. Well depths in feet below TOC.

TABLE 2:
ESTIMATED HYDRAULIC GRADIENT AND LINEAR FLOW VELOCITY

			June 5, 2014				
GRADIENT CALCULATION SEGMENT	FLOW LINE LENGTH (feet)	FLOW DIRECTION	GROUND-WATER ELEV. (feet)	HORIZ. GRADIENT, *i* (ft/ft)	HYDRAULIC CONDUCTIVITY *K* (ft/day)	EFFECTIVE POROSITY *n*	LINEAR VELOCITY, *V* (ft/day)
i_1	922	SW	790	0.033	1.73	0.30	0.19
			760				

Notes:
Flow segment "i_1" shown on Drawing 1.
Hydraulic conductivity ("***K***") was estimated from slug tests completed by JOYCE in April 2013.
Effective porosity ("***n***") estimated based on typical values for NC Piedmont saprolite aqufers.
Linear Flow Velocity based on modified Darcy equation: $V = Ki/n$; which assume a homogeneous, isotropic, porous aquifer.

TABLE 3: GPS Exceedances Since November 2011

Analyte	Sample Date	Background MW-6	Downgradient MW-2	MW-3S	MW-3D	MW-4	MW-5
Cobalt	01-Nov-11	ND	ND	ND	ND	ND	5.2 J
GWPS = 70 µg/L (10/23/07)	01-May-12	ND	ND	ND	ND	ND	**13.9**
GWPS = 1 µg/L (10/1/10)	07-Nov-12	---	1.98 J	3.89 J	0.43 B	2.02 J	---
	09-May-13	ND	ND	ND	ND	ND	---
	07-Nov-13	---	ND	ND	ND	ND	---
	05-Jun-14	ND	ND	ND	ND	ND	**12.0**
Benzene	01-Nov-11	ND	**8.6**	ND	ND	ND	ND
NC 2L = 1 µg/L (10/23/07)	01-May-12	ND	**6.7**	0.36 J	0.45 J	0.42 J	ND
	07-Nov-12	---	**8.63**	0.430 J	0.504 J	0.478 J	---
	09-May-13	ND	**5.2**	0.27 J	0.32 J	0.30 J	---
	07-Nov-13	---	**6.9**	0.33 J	0.38 J	0.39 J	---
	05-Jun-14	ND	**6.0**	ND	0.42 J	0.40 J	ND
1,1-Dichloroethane	01-Nov-11	ND	**27.2**	2.3 J	4.0 J	2.3 J	ND
NC 2L =70 µg/L (10/23/07)	01-May-12	ND	**22.6**	2.0 J	3.8 J	2.0 J	ND
NC 2L = 6 µg/L (1/11/10)	07-Nov-12	---	**28.1**	2.06 J	4.08 J	ND	---
	09-May-13	ND	**18.7**	1.4 J	3.0 J	1.6 J	---
	07-Nov-13	---	**26.6**	1.7 J	4.2 J	2.2 J	---
	05-Jun-14	ND	**21.9**	1.4 J	3.9 J	1.9 J	ND
1,2-Dichloroethane	01-Nov-11	ND	0.95 J	ND	**1.3**	ND	ND
NC 2L = 0.38 µg/L (10/23/07)	01-May-12	ND	0.71 J	0.70 J	**1.1**	ND	ND
NC 2L = 0.4 µg/L (1/11/10)	07-Nov-12	---	ND	ND	ND	ND	---
	09-May-13	ND	0.50 J	0.49 J	0.81 J	ND	---
	07-Nov-13	---	0.93 J	0.66 J	**1.3**	ND	---
	05-Jun-14	ND	0.76 J	0.52 J	0.99 J	ND	ND
cis-1,2-Dichloroethylene	01-Nov-11	ND	59.4	15.2	59.3	23.2	ND
NC 2L = 70 µg/L (10/23/07)	01-May-12	ND	{48.7}	14.2	59.5	22.1	ND
	07-Nov-12	---	59.7	13.6	**71.3**	26.4	---
	09-May-13	ND	39.9	10.9	49.7	17.4	---
	07-Nov-13	---	53.9	10.7	67.1	21.8	---
	05-Jun-14	ND	47.0	11.2	58.1	20.0	ND
1,2-Dichloropropane	01-Nov-11	ND	**4.9**	0.76 J	**1.3**	ND	ND
NC 2L = 0.51 µg/L (10/23/07)	01-May-12	ND	**4.4**	0.76 J	**1.4**	0.62 J	ND
NC 2L = 0.6 µg/L (1/11/10)	07-Nov-12	---	**4.93**	ND	**1.66**	ND	---
	09-May-13	ND	**3.3**	0.51 J	0.96 J	0.45 J	---
	07-Nov-13	---	**4.4**	0.63 J	**1.3**	0.57 J	---
	05-Jun-14	ND	**4.0**	0.51 J	ND	0.41 J	ND
Tetrachloroethylene	01-Nov-11	ND	**2.9**	ND	ND	ND	ND
NC 2L = 0.7 µg/L (10/23/07)	01-May-12	ND	**3.0**	ND	ND	ND	ND
	07-Nov-12	---	**2.52**	ND	ND	ND	---
	09-May-13	ND	**1.9**	ND	ND	ND	---
	07-Nov-13	---	**1.8**	ND	ND	ND	---
	05-Jun-14	ND	**2.3**	ND	ND	ND	ND
Trichloroethylene	01-Nov-11	ND	**10.2**	ND	ND	ND	ND
NC 2L = 2.8 µg/L (10/23/07)	01-May-12	ND	**11.6**	ND	ND	ND	ND
NC 2L = 3 µg/L (1/11/10)	07-Nov-12	---	**9.97**	ND	ND	ND	---
	09-May-13	ND	**8.4**	ND	ND	ND	---
	07-Nov-13	---	**8.0**	ND	ND	ND	---
	05-Jun-14	ND	**8.9**	ND	ND	ND	ND
Vinyl chloride	01-Nov-11	ND	**5.1**	**2.6**	**6.9**	**24.0**	ND
NC 2L = 0.015µg/L (10/23/07)	01-May-12	ND	**3.5**	**2.0**	**4.8**	**21.8**	ND
NC 2L = 0.03 µg/L (1/11/10)	07-Nov-12	---	**7.94**	**2.73**	**6.99**	**29.9**	---
	09-May-13	ND	**2.8**	**1.9**	**4.2**	**18.6**	---
	07-Nov-13	---	**6.3**	**2.1**	**6.0**	**21.9**	---
	05-Jun-14	ND	**7.1**	**5.6**	**8.9**	**21.9**	ND

Notes:
All concentrations are in micrograms per liter (µg/L).
RL = Reporting limit (NC SWSL).
DL = Method Detection Limit.
NC 2L = Groundwater quality standard established in 15A NCAC 2L.0202.
GWPS = Groundwater Protection Standard establisjed by the DENR-SWS.

ND = Not detected at the laboratory's method detection limit.
J = Estimated value less than the RL but greater than the DL.
B = Blank-qualified.
--- = Monitoring well was not sampled due to damage.
Bold values are greater than the NC 2L Standard or GWPS.

TABLE 4:
HISTORICAL GROUNDWATER CONSTITUENTS

Analyte	Sample Collection Date	EPA Method	DL	RL	Background MW-1	Background MW-6	Downgradient MW-2	Downgradient MW-3S	Downgradient MW-3D	Downgradient MW-4	Downgradient MW-5	Blanks
Inorganic Compounds												
Antimony	30-Dec-09		1.2	6.0	---	ND	5.4 B	ND	ND	4.5 B	---	1.4 J
GWPS = 1.4 µg/L (10/23/07)	01-Jun-10		1.2	6.0	---	ND	ND	ND	ND	ND	---	3.9 J
GWPS = 1 µg/L (8/1/10)	29-Dec-10		2.6	6.0	---	ND	ND	ND	ND	ND	ND	ND
	29-Jun-11		5.0	6.0	---	ND	ND	ND	ND	ND	ND	ND
	01-Nov-11		5.0	6.0	---	ND	ND	ND	ND	ND	ND	ND
	01-May-12		5.0	6.0	---	ND	ND	ND	ND	ND	ND	ND
	07-Nov-12		0.48	6.0	---	---	ND	ND	ND	ND	---	ND
	09-May-13		5.0	6.0	---	ND	ND	ND	ND	ND	---	ND
	07-Nov-13		5.0	6.0	---	---	ND	ND	ND	ND	---	ND
	05-Jun-14	EPA 6010	5.0	6.0	---	ND	ND	ND	ND	ND	ND	ND
Arsenic	29-Jun-11		5.0	10.0	---	ND	ND	ND	ND	ND	6.2 J	ND
NC 2L = 50 µg/L (10/23/07)	01-Nov-11		5.0	10.0	---	ND	ND	ND	ND	ND	ND	ND
NC 2L = 10 µg/L (1/11/10)	01-May-12		5.0	10.0	---	ND	ND	ND	ND	ND	ND	ND
	07-Nov-12		0.094	10.0	---	---	1.43 B	1.42 B	0.87 B	1.04 B	---	1 J
	09-May-13		5.0	10.0	---	ND	ND	ND	ND	ND	---	ND
	07-Nov-13		5.0	10.0	---	---	ND	ND	ND	ND	---	ND
	05-Jun-14	EPA 6010	5.0	10.0	---	ND	ND	ND	ND	ND	ND	ND
Barium	30-Dec-09		1.1	100	---	74.1 J	496	178	18.2 J	89.0 J	---	3.6 J
NC 2L = 2000 µg/L (10/23/07)	01-Jun-10		1.1	100	---	58.1 J	326	187	22.2 J	94.9 J	---	2.0 J
NC 2L = 700 µg/L (1/11/10)	29-Dec-10		0.20	100	---	46.3 B	430	112	38.0 B	92.1 J	72.6 J	11.3 J
	29-Jun-11		5.0	100	---	77.7 J	370	128	41.2 J	98.4 J	113	ND
	01-Nov-11		5.0	100	---	125	413	132	41.7 J	111	72.1 J	ND
	01-May-12		5.0	100	---	78.8 J	323	121	40.0 J	99.7 J	66.1 J	ND
	07-Nov-12		0.39	100	---	---	369	127	41.0 B	98.7 J	---	12.2 J
	09-May-13		5.0	100	---	78.6 J	307	112	40.0 J	85.6 J	---	ND
	07-Nov-13		5.0	100	---	---	302	113	38.0 J	89.6 J	---	ND
	05-Jun-14	EPA 6010	5.0	100	---	60.3 J	285	117	39.2 J	80.3 J	75.0 J	ND
Beryllium	30-Dec-09		0.2	1.0	---	ND	0.5 J	ND	ND	ND	---	ND
GWPS = 4 µg/L (10/23/07)	01-Jun-10		0.2	1.0	---	0.6 J	0.7 J	ND	ND	ND	---	ND
	29-Dec-10		0.10	1.0	---	ND	ND	ND	ND	ND	0.48 J	ND
	29-Jun-11		1.0	1.0	---	ND	ND	ND	ND	ND	ND	ND
	01-Nov-11		1.0	1.0	---	ND	ND	ND	ND	ND	ND	ND
	01-May-12		1.0	1.0	---	ND	ND	ND	ND	ND	ND	ND
	07-Nov-12		0.049	1.0	---	---	0.34 J	ND	ND	0.099 J	---	ND
	09-May-13		1.0	1.0	---	ND	ND	ND	ND	ND	---	ND
	07-Nov-13		1.0	1.0	---	---	ND	ND	ND	ND	---	ND
	05-Jun-14	EPA 6010	1.0	1.0	---	ND	ND	ND	ND	ND	ND	ND
Cadmium	30-Dec-09		0.2	1.0	---	ND	0.5 J	**5.6**	ND	ND	---	ND
NC 2L = 1.75 µg/L (10/23/07)	01-Jun-10		0.2	1.0	---	**2.9**	1.0 B	**5.3**	0.4 B	0.4 B	---	0.4 J
NC 2L = 2 µg/L (1/11/10)	29-Dec-10		0.50	1.0	---	ND	ND	ND	ND	ND	ND	ND
	29-Jun-11		1.0	1.0	---	ND	ND	ND	ND	ND	ND	ND
	01-Nov-11		1.0	1.0	---	ND	ND	ND	ND	ND	ND	ND
	01-May-12		1.0	1.0	---	ND	ND	ND	ND	ND	ND	ND
	07-Nov-12		0.026	1.0	---	---	0.15 J	ND	ND	0.043 J	---	ND
	09-May-13		1.0	1.0	---	ND	ND	ND	ND	ND	---	ND
	07-Nov-13		1.0	1.0	---	---	ND	ND	ND	ND	---	ND
	05-Jun-14	EPA 6010	1.0	1.0	---	ND	ND	ND	ND	ND	ND	ND
Chromium	30-Dec-09		0.7	10.0	---	ND	2.7 J	9.7 J	ND	3.1 J	---	ND
NC 2L = 50 µg/L (10/23/07)	01-Jun-10		0.7	10.0	---	3.5 J	1.6 J	**12.4**	1.2 J	3.2 J	---	ND
NC 2L = 10 µg/L (1/11/10)	29-Dec-10		0.40	10.0	---	0.48 J	1.3 J	0.57 J	ND	5.5 J	3.8 J	ND
	29-Jun-11		5.0	10.0	---	ND	ND	ND	ND	ND	ND	ND
	01-Nov-11		5.0	10.0	---	ND	ND	ND	ND	**10.3**	ND	ND
	01-May-12		5.0	10.0	---	ND	ND	ND	ND	5.8 J	ND	ND
	07-Nov-12		0.030	10.0	---	---	0.71 J	0.12 B	0.094 B	7.31 J	---	0.099 J
	09-May-13		5.0	10.0	---	ND	ND	ND	ND	ND	---	ND
	07-Nov-13		5.0	10.0	---	---	ND	ND	ND	ND	---	ND
	05-Jun-14	EPA 6010	5.0	10.0	---	ND	ND	ND	ND	ND	ND	ND
Cobalt	30-Dec-09		0.7	10.0	---	ND	6.4 J	11.2	ND	1.8 J	---	ND
GWPS = 70 µg/L (10/23/07)	01-Jun-10		0.7	10.0	---	1.8 J	2.5 J	8.5 J	ND	1.7 J	---	ND
GWPS = 1 µg/L (10/1/10)	29-Dec-10		0.60	10.0	---	ND	4.9 J	1.7 J	ND	1.6 J	**10.2**	ND
	29-Jun-11		5.0	10.0	---	ND	ND	ND	ND	ND	9.9 J	ND
	01-Nov-11		5.0	10.0	---	ND	ND	ND	ND	ND	5.2 J	ND
	01-May-12		5.0	10.0	---	ND	ND	ND	ND	ND	**13.9**	ND
	07-Nov-12		0.053	10.0	---	---	1.98 J	3.89 J	0.43 B	2.02 J	---	0.24 J
	09-May-13		5.0	10.0	---	ND	ND	ND	ND	ND	---	ND
	07-Nov-13		5.0	10.0	---	---	ND	ND	ND	ND	---	ND
	05-Jun-14	EPA 6010	5.0	10.0	---	ND	ND	ND	ND	ND	**12.0**	ND

TABLE 4:
HISTORICAL GROUNDWATER CONSTITUENTS

Analyte	Sample Collection Date	EPA Method	DL	RL	Background MW-1	Background MW-6	Downgradient MW-2	Downgradient MW-3S	Downgradient MW-3D	Downgradient MW-4	Downgradient MW-5	Blanks
Copper	30-Dec-09		2.0	10.0	---	ND	ND	10.6	ND	1.5 J	---	ND
NC 2L = 1,000 µg/L (10/23/07)	01-Jun-10		2.0	10.0	---	12.2 B	3.3 B	33.2	3.9 B	6.8 B	---	4.8 J
	29-Dec-10		0.30	10.0	---	ND	ND	0.49 J	0.59 J	1.5 J	7.9 J	ND
	29-Jun-11		5.0	10.0	---	ND	ND	ND	ND	ND	16.6	ND
	01-Nov-11		5.0	10.0	---	ND	ND	ND	ND	5.4 J	ND	ND
	01-May-12		5.0	10.0	---	ND	ND	ND	ND	ND	ND	ND
	07-Nov-12		0.093	10.0	---	---	3.56 B	0.54 B	0.98 B	1.83 B	---	1.23 J
	09-May-13		5.0	10.0	---	ND	ND	ND	ND	ND	---	ND
	07-Nov-13		5.0	10.0	---	---	ND	ND	ND	ND	---	ND
	05-Jun-14	EPA 6010	5.0	10.0	---	ND	ND	ND	ND	ND	6.1 J	ND
Lead	30-Dec-09		2.0	10.0	---	ND	ND	10.2	ND	ND	---	ND
NC 2L = 15 µg/L (10/23/07)	01-Jun-10		2.0	10.0	---	9.1 B	8.2 B	8.7 B	3.0 B	3.9 B	---	3.2 J
	29-Dec-10		4.0	10.0	---	ND	ND	ND	ND	ND	6.5 J	ND
	29-Jun-11		5.0	10.0	---	ND	ND	ND	ND	ND	**19.9**	ND
	01-Nov-11		5.0	10.0	---	5.5 J	ND	ND	ND	ND	ND	ND
	01-May-12		5.0	10.0	---	ND	ND	ND	ND	ND	ND	ND
	07-Nov-12		0.025	10.0	---	---	1.00 B	0.091 B	0.066 B	1.12 B	---	0.58 J
	09-May-13		5.0	10.0	---	ND	ND	ND	ND	ND	---	ND
	07-Nov-13		5.0	10.0	---	---	ND	ND	ND	ND	---	ND
	05-Jun-14	EPA 6010	5.0	10.0	---	ND	ND	ND	ND	ND	ND	ND
Nickel	30-Dec-09		0.6	50.0	---	ND	ND	8.1 J	1.8 J	1.6 J	---	ND
NC 2L = 100 µg/L (10/23/07)	01-Jun-10		0.6	50.0	---	ND	ND	6.0 J	ND	0.9 J	---	ND
	29-Dec-10		1.7	50.0	---	ND	ND	ND	ND	ND	2.0 B	3.1 J
	29-Jun-11		5.0	50.0	---	ND	ND	ND	ND	ND	ND	ND
	01-Nov-11		5.0	50.0	---	ND	ND	ND	ND	ND	ND	ND
	01-May-12		5.0	50.0	---	ND	ND	ND	ND	ND	ND	ND
	07-Nov-12		0.26	50.0	---	---	0.73 B	1.19 B	0.65 B	5.57 J	---	0.84 J
	09-May-13		5.0	50.0	---	ND	ND	ND	ND	ND	---	ND
	07-Nov-13		5.0	50.0	---	---	ND	ND	ND	ND	---	ND
	05-Jun-14	EPA 6010	5.0	50.0	---	ND	ND	ND	ND	ND	ND	ND
Selenium	30-Dec-09		6.3	10.0	---	ND	ND	8.4 J	ND	ND	---	ND
NC 2L = 20 µg/L (1/11/10)	01-Jun-10		6.3	10.0	---	ND	ND	6.3 J	ND	ND	---	ND
	29-Dec-10		3.8	10.0	---	ND	ND	ND	ND	ND	ND	ND
	29-Jun-11		10.0	10.0	---	ND	ND	ND	ND	ND	ND	ND
	01-Nov-11		10.0	10.0	---	ND	ND	ND	ND	ND	ND	ND
	01-May-12		10.0	10.0	---	ND	ND	ND	ND	ND	ND	ND
	07-Nov-12		0.11	10.0	---	---	0.16 J	0.38 J	0.20 J	0.25 J	---	ND
	09-May-13		10.0	10.0	---	ND	ND	ND	ND	ND	---	ND
	07-Nov-13		10.0	10.0	---	---	ND	ND	ND	ND	---	ND
	05-Jun-14	EPA 6010	10.0	10.0	---	ND	ND	ND	ND	ND	ND	ND
Silver	30-Dec-09		1.1	10.0	---	ND	1.7 B	2.2 B	ND	ND	---	1.9 J
NC 2L = 20 µg/L (1/11/10)	01-Jun-10		1.1	10.0	---	ND	ND	ND	ND	ND	---	ND
	29-Dec-10		0.10	10.0	---	ND	1.8 J	0.36 J	0.19 J	0.23 J	ND	ND
	29-Jun-11		5.0	10.0	---	ND	ND	ND	ND	ND	ND	ND
	01-Nov-11		5.0	10.0	---	ND	ND	ND	ND	ND	ND	ND
	01-May-12		5.0	10.0	---	ND	ND	ND	ND	ND	ND	ND
	07-Nov-12		0.017	10.0	---	---	0.18 J	ND	ND	0.078 J	---	ND
	09-May-13		5.0	10.0	---	ND	ND	ND	ND	ND	---	ND
	07-Nov-13		5.0	10.0	---	---	ND	ND	ND	ND	---	ND
	05-Jun-14	EPA 6010	5.0	10.0	---	ND	ND	ND	ND	ND	ND	ND
Thallium	30-Dec-09		2.7	5.5	---	ND	ND	ND	ND	ND	---	3.7 J
GWPS = 0.28 µg/L (10/23/07)	01-Jun-10		2.7	5.5	---	ND	ND	ND	ND	ND	---	ND
GWPS = 0.2 µg/L (10/1/10)	29-Dec-10		3.0	5.5	---	ND	3.2 J	ND	ND	4.8 J	ND	ND
	29-Jun-11		5.4	5.5	---	ND	ND	ND	ND	ND	ND	ND
	01-Nov-11		5.4	5.5	---	ND	ND	ND	ND	ND	ND	ND
	01-May-12		5.4	5.5	---	ND	ND	ND	ND	ND	ND	ND
	07-Nov-12		0.060	5.50	---	---	0.16 J	ND	ND	0.76 J	---	ND
	09-May-13		5.4	5.5	---	ND	ND	ND	ND	ND	---	ND
	07-Nov-13		5.4	5.5	---	---	ND	ND	ND	ND	---	ND
	05-Jun-14	EPA 6010	5.4	5.5	---	ND	ND	ND	ND	ND	ND	ND
Vanadium	30-Dec-09		0.4	25.0	---	ND	1.4 J	**37.4**	1.5 J	4.3 J	---	ND
GWPS = 3.5 µg/L (10/23/07)	01-Jun-10		0.4	25.0	---	1.2 J	3.4 J	**84.2**	1.4 J	4.8 J	---	ND
GWPS = 0.3 µg/L (10/1/10)	29-Dec-10		0.20	25.0	---	1.2 B	2.8 J	2.3 J	1.6 J	5.5 J	14.5 J	0.26 J
	29-Jun-11		5.0	25.0	---	ND	ND	ND	ND	ND	22.0 J	ND
	01-Nov-11		5.0	25.0	---	7.2 J	ND	ND	ND	12.0 J	7.2 J	ND
	01-May-12		5.0	25.0	---	ND	ND	ND	ND	7.2 J	7.6 J	ND
	07-Nov-12		0.085	25.0	---	---	2.48 J	2.02 J	2.35 J	4.55 J	---	ND
	09-May-13		5.0	25.0	---	ND	ND	ND	ND	ND	---	ND
	07-Nov-13		5.0	25.0	---	---	ND	ND	ND	ND	---	ND
	05-Jun-14	EPA 6010	5.0	25.0	---	ND	ND	11.4 J	ND	ND	ND	ND

TABLE 4:
HISTORICAL GROUNDWATER CONSTITUENTS

Analyte	Sample Collection Date	EPA Method	DL	RL	Background MW-1	Background MW-6	Downgradient MW-2	Downgradient MW-3S	Downgradient MW-3D	Downgradient MW-4	Downgradient MW-5	Blanks
Zinc	30-Dec-09		2.7	10.0	---	ND	10.1 B	204	15.9 B	24.8 B	---	5.8 J
NC 2L = 1,050 µg/L (10/23/07)	01-Jun-10		2.7	10.0	---	16.2	13.5	415	8.5 J	22.2	---	ND
NC 2L = 1,000 µg/L (1/11/10)	29-Dec-10		0.40	10.0	---	12.2 B	15.8 B	8.9 B	ND	4.6 B	38.1 B	12.5
	29-Jun-11		10.0	10.0	---	ND	23.6 B	22.3 B	ND	15.5 B	91.2	10.5
	01-Nov-11		10.0	10.0	---	16.6	ND	40.0	ND	16.2	31.4	ND
	01-May-12		10.0	10.0	---	ND	ND	13.5	ND	10.2	12.0	ND
	07-Nov-12		1.31	10.0	---	---	8.61 J	5.20 J	3.98 J	4.65 J	---	ND
	09-May-13		10.0	10.0	---	ND	ND	ND	ND	ND	---	ND
	07-Nov-13		10.0	10.0	---	---	13.8	10.4	ND	ND	---	ND
	05-Jun-14	EPA 6010	10.0	10.0	---	ND	ND	89.0	ND	ND	19.4	ND
Organic Compounds												
Acetone	29-Jun-11		2.2	100	---	ND	2.3 B	2.4 B	3.9 B	ND	3.8 B	5.3 J
NC 2L = 700 µg/L (10/23/07)	01-Nov-11		2.2	100	---	ND	ND	ND	ND	ND	ND	14.6 J
NC 2L = 6,000 µg/L (1/11/10)	01-May-12		2.2	100	---	ND	ND	ND	ND	ND	ND	ND
	07-Nov-12		0.193	100	---	---	ND	ND	ND	ND	---	ND
	09-May-13		10.0	100	---	ND	ND	ND	ND	ND	---	12.0 J
	07-Nov-13		10.0	100	---	---	ND	ND	ND	ND	---	ND
	05-Jun-14	EPA 8260	10.0	100	---	ND	ND	ND	ND	ND	ND	ND
Benzene	30-Dec-09		0.1	1.0	---	ND	**8.4**	0.3 J	0.4 J	0.3 J	---	ND
NC 2L = 1 µg/L (10/23/07)	01-Jun-10		0.1	1.0	---	ND	**2.9**	ND	ND	ND	---	ND
	29-Dec-10		0.25	1.0	---	ND	**8.1**	ND	ND	ND	ND	ND
	29-Jun-11		0.25	1.0	---	ND	**7.2**	0.38 J	0.45 J	0.42 J	ND	ND
	01-Nov-11		0.25	1.0	---	ND	**8.6**	ND	ND	ND	ND	ND
	01-May-12		0.25	1.0	---	ND	**6.7**	0.36 J	0.45 J	0.42 J	ND	ND
	07-Nov-12		0.111	1.0	---	---	**8.63**	0.430 J	0.504 J	0.478 J	---	ND
	09-May-13		0.25	1.0	---	ND	**5.2**	0.27 J	0.32 J	0.30 J	---	ND
	07-Nov-13		0.25	1.0	---	---	**6.9**	0.33 J	0.38 J	0.39 J	---	ND
	05-Jun-14	EPA 8260	0.25	1.0	---	ND	**6.0**	ND	0.42 J	0.40 J	ND	ND
Bromoform	09-May-13		0.26	3.0	---	ND	ND	0.37 B	ND	ND	---	0.37 J
NC 2L = µg/L 4 (10/23/07)	07-Nov-13		0.26	3.0	---	---	ND	ND	ND	ND	---	ND
	05-Jun-14	EPA 8260	0.26	3.0	---	ND	ND	ND	ND	ND	ND	ND
Chlorobenzene	30-Dec-09		0.1	3.0	---	ND	0.5 J	0.6 J	ND	ND	---	ND
NC 2L = 50 µg/L (10/23/07)	01-Jun-10		0.1	3.0	---	ND	ND	ND	ND	ND	---	ND
	29-Dec-10		0.23	3.0	---	ND	0.61 J	ND	ND	ND	ND	ND
	29-Jun-11		0.23	3.0	---	ND	0.46 J	1.0 J	0.37 J	ND	ND	ND
	01-Nov-11		0.23	3.0	---	ND	0.59 J	1.1 J	0.37 J	ND	ND	ND
	01-May-12		0.23	3.0	---	ND	{0.42} J	0.94 B	0.38 B	ND	ND	0.30 {ND} J
	07-Nov-12		0.083	3.00	---	---	0.468 J	1.30 J	0.476 J	ND	---	ND
	09-May-13		0.23	3.0	---	ND	0.27 J	0.72 J	0.27 J	ND	---	ND
	07-Nov-13		0.23	3.0	---	---	0.42 J	0.97 J	0.38 J	ND	---	ND
	05-Jun-14	EPA 8260	0.23	3.0	---	ND	0.30 J	0.78 J	0.33 J	ND	ND	ND
Chloroethane	30-Dec-09		0.1	10.0	---	ND	ND	0.5 J	0.5 J	ND	---	0.1 J
NC 2L = 2,800 µg/L (10/23/07)	01-Jun-10		0.1	10.0	---	ND	ND	0.4 J	ND	ND	---	ND
NC 2L = 3,000 µg/L (1/11/10)	29-Dec-10		0.54	10.0	---	ND	ND	ND	ND	ND	ND	ND
	29-Jun-11		0.54	10.0	---	ND	ND	0.77 J	ND	0.57 J	ND	ND
	01-Nov-11		0.54	10.0	---	ND	ND	0.79 J	ND	ND	ND	ND
	01-May-12		0.54	10.0	---	ND	ND	ND	ND	ND	ND	ND
	07-Nov-12		0.235	10.0	---	---	ND	ND	ND	ND	---	ND
	09-May-13		0.54	10.0	---	ND	ND	ND	ND	ND	---	ND
	07-Nov-13		0.54	10.0	---	---	ND	ND	ND	ND	---	ND
	05-Jun-14	EPA 8260	0.54	10.0	---	ND	ND	ND	ND	ND	ND	ND
1,4-Dichlorobenzene	30-Dec-09		0.1	1.0	---	ND	**3.8**	**2.2**	**2.3**	**3.1**	---	ND
NC 2L = 1.4 µg/L (10/23/07)	01-Jun-10		0.1	1.0	---	ND	1.2	0.9 J	ND	1.2	---	ND
NC 2L = 6 µg/L (1/11/10)	29-Dec-10		0.33	1.0	---	ND	3.9	1.1	2.3	1.9	ND	ND
	29-Jun-11		0.33	1.0	---	ND	3.8	2.8	3.6	3.2	ND	ND
	01-Nov-11		0.33	1.0	---	ND	4.7	4.1	4.1	3.5	ND	ND
	01-May-12		0.33	1.0	---	ND	4.0	2.7	4.1	3.2	ND	ND
	07-Nov-12		0.083	1.00	---	---	5.12	2.93	4.08	3.64	---	ND
	09-May-13		0.33	1.0	---	ND	3.6	2.0	3.1	2.3	---	ND
	07-Nov-13		0.33	1.0	---	---	5.4	2.5	4.2	3.2	---	ND
	05-Jun-14	EPA 8260	0.33	1.0	---	ND	5.0	1.9	4.0	2.7	ND	ND
1,1-Dichloroethane	30-Dec-09		0.2	5.0	---	ND	**22.8**	1.9 J	4.0 J	2.4 J	---	ND
NC 2L =70 µg/L (10/23/07)	01-Jun-10		0.2	5.0	---	ND	**11.0**	1.1 J	ND	1.2 J	---	ND
NC 2L = 6 µg/L (1/11/10)	29-Dec-10		0.32	5.0	---	ND	**28.2**	2.4 J	4.1 J	2.6 J	ND	ND
	29-Jun-11		0.32	5.0	---	ND	**25.0**	2.5 J	3.9 J	2.6 J	ND	ND
	01-Nov-11		0.32	5.0	---	ND	**27.2**	2.3 J	4.0 J	2.3 J	ND	ND
	01-May-12		0.32	5.0	---	ND	**22.6**	2.0 J	3.8 J	2.0 J	ND	ND
	07-Nov-12		0.208	5.0	---	---	**28.1**	2.06 J	4.08 J	ND	---	ND
	09-May-13		0.32	5.0	---	ND	**18.7**	1.4 J	3.0 J	1.6 J	---	ND
	07-Nov-13		0.32	5.0	---	---	**26.6**	1.7 J	4.2 J	2.2 J	---	ND
	05-Jun-14	EPA 8260	0.32	5.0	---	ND	**21.9**	1.4 J	3.9 J	1.9 J	ND	ND

TABLE 4:
HISTORICAL GROUNDWATER CONSTITUENTS

Analyte	Sample Collection Date	EPA Method	DL	RL	Background MW-1	Background MW-6	Downgradient MW-2	Downgradient MW-3S	Downgradient MW-3D	Downgradient MW-4	Downgradient MW-5	Blanks
1,2-Dichloroethane	30-Dec-09		0.1	1.0	---	ND	**1.2**	0.7 J	**1.2**	ND	---	ND
NC 2L = 0.38 µg/L (10/23/07)	01-Jun-10		0.1	1.0	---	ND	ND	ND	ND	ND	---	ND
NC 2L = 0.4 µg/L (1/11/10)	29-Dec-10		0.12	1.0	---	ND	ND	0.82 J	**1.1**	ND	ND	ND
	29-Jun-11		0.12	1.0	---	ND	0.76 J	0.86 J	**1.3**	ND	ND	ND
	01-Nov-11		0.12	1.0	---	ND	0.95 J	ND	**1.3**	ND	ND	ND
	01-May-12		0.12	1.0	---	ND	0.71 J	0.70 J	**1.1**	ND	ND	ND
	07-Nov-12		0.171	1.0	---	---	ND	ND	ND	ND	---	ND
	09-May-13		0.12	1.0	---	ND	0.50 J	0.49 J	0.81 J	ND	---	ND
	07-Nov-13		0.12	1.0	---	---	0.93 J	0.66 J	**1.3**	ND	---	ND
	05-Jun-14	EPA 8260	0.12	1.0	---	ND	0.76 J	0.52 J	0.99 J	ND	ND	ND
1,1-Dichloroethylene	30-Dec-09		0.1	5.0	---	ND	0.4 J	ND	ND	ND	---	ND
NC 2L = 7 µg/L (10/23/07)	01-Jun-10		0.1	5.0	---	ND	ND	ND	ND	ND	---	ND
	29-Dec-10		0.56	5.0	---	ND	ND	ND	ND	ND	ND	ND
	29-Jun-11		0.56	5.0	---	ND	ND	ND	ND	ND	ND	ND
	01-Nov-11		0.56	5.0	---	ND	ND	ND	ND	ND	ND	ND
	01-May-12		0.56	5.0	---	ND	ND	ND	ND	ND	ND	ND
	07-Nov-12		0.208	5.0	---	---	ND	ND	ND	ND	---	ND
NC 2L = 350 µg/L (04/01/2013)	09-May-13		0.56	5.0	---	ND	ND	ND	ND	ND	---	ND
	07-Nov-13		0.56	5.0	---	---	ND	ND	ND	ND	---	ND
	05-Jun-14	EPA 8260	0.56	5.0	---	ND	4.7 J	ND	ND	ND	ND	ND
cis-1,2-Dichloroethylene	30-Dec-09		0.1	5.0	---	ND	68.2	11.0	51.0	21.8	---	ND
NC 2L = 70 µg/L (10/23/07)	01-Jun-10		0.1	5.0	---	ND	23.0	7.6	ND	10.2	---	ND
	29-Dec-10		0.19	5.0	---	ND	66.7	16.8	56.7	24.1	ND	ND
	29-Jun-11		0.19	5.0	---	ND	55.1	16.5	62.7	25.1	ND	ND
	01-Nov-11		0.19	5.0	---	ND	59.4	15.2	59.3	23.2	ND	ND
	01-May-12		0.19	5.0	---	ND	{48.7}	14.2	59.5	22.1	ND	0.21 {ND} J
	07-Nov-12		0.103	5.0	---	---	59.7	13.6	**71.3**	26.4	---	ND
	09-May-13		0.19	5.0	---	ND	39.9	10.9	49.7	17.4	---	ND
	07-Nov-13		0.19	5.0	---	---	53.9	10.7	67.1	21.8	---	ND
	05-Jun-14	EPA 8260	0.19	5.0	---	ND	47.0	11.2	58.1	20.0	ND	ND
Trans-1,2-Dichloroethylene	30-Dec-09		0.1	5.0	---	ND	1.4 J	ND	0.2 J	0.2 J	---	ND
NC 2L = 100 µg/L (10/23/07)	01-Jun-10		0.1	5.0	---	ND	0.6 J	ND	ND	ND	---	ND
	29-Dec-10		0.49	5.0	---	ND	1.7 J	ND	ND	ND	ND	ND
	29-Jun-11		0.49	5.0	---	ND	1.5 J	ND	ND	ND	ND	ND
	01-Nov-11		0.49	5.0	---	ND	1.6 J	ND	ND	ND	ND	ND
	01-May-12		0.49	5.0	---	ND	1.4 J	ND	ND	ND	ND	ND
	07-Nov-12		0.077	5.0	---	---	1.59 J	ND	ND	ND	---	ND
	09-May-13		0.49	5.0	---	ND	1.1 J	ND	ND	ND	---	ND
	07-Nov-13		0.49	5.0	---	---	1.6 J	ND	ND	ND	---	ND
	05-Jun-14	EPA 8260	0.49	5.0	---	ND	1.4 J	ND	ND	ND	ND	ND
1,2-Dichloropropane	30-Dec-09		0.1	1.0	---	ND	**5.7**	0.6 J	1.1	0.7 J	---	ND
NC 2L = 0.51 µg/L (10/23/07)	01-Jun-10		0.1	1.0	---	ND	**1.9**	ND	ND	ND	---	ND
NC 2L = 0.6 µg/L (1/11/10)	29-Dec-10		0.27	1.0	---	ND	**5.3**	ND	ND	ND	ND	ND
	29-Jun-11		0.27	1.0	---	ND	**4.8**	0.90 J	**1.3**	0.73 J	ND	ND
	01-Nov-11		0.27	1.0	---	ND	**4.9**	0.76 J	**1.3**	ND	ND	ND
	01-May-12		0.27	1.0	---	ND	**4.4**	0.76 J	**1.4**	0.62 J	ND	ND
	07-Nov-12		0.150	1.0	---	---	**4.93**	ND	**1.66**	ND	---	ND
	09-May-13		0.27	1.0	---	ND	**3.3**	0.51 J	0.96 J	0.45 J	---	ND
	07-Nov-13		0.27	1.0	---	---	**4.4**	0.63 J	**1.3**	0.57 J	---	ND
	05-Jun-14	EPA 8260	0.27	1.0	---	ND	**4.0**	0.51 J	ND	0.41 J	ND	ND
Ethylbenzene	30-Dec-09		0.1	1.0	---	ND	ND	ND	0.4 J	ND	---	ND
NC 2L = 600 µg/L (10/23/07)	01-Jun-10		0.1	1.0	---	ND	ND	ND	ND	ND	---	ND
	29-Dec-10		0.30	1.0	---	ND	ND	ND	ND	ND	ND	ND
	29-Jun-11		0.30	1.0	---	ND	ND	ND	ND	ND	ND	ND
	01-Nov-11		0.30	1.0	---	ND	ND	ND	ND	ND	ND	ND
	01-May-12		0.30	1.0	---	ND	ND	ND	ND	ND	ND	ND
	07-Nov-12		0.109	1.0	---	---	ND	ND	ND	ND	---	ND
	09-May-13		0.30	1.0	---	ND	ND	ND	ND	ND	---	ND
	07-Nov-13		0.30	1.0	---	---	ND	ND	ND	ND	---	ND
	05-Jun-14	EPA 8260	0.30	1.0	---	ND	ND	ND	ND	ND	ND	ND
Tetrachloroethylene	30-Dec-09		0.2	1.0	---	ND	**1.2**	ND	ND	ND	---	ND
NC 2L = 0.7 µg/L (10/23/07)	01-Jun-10		0.2	1.0	---	ND	**1.4**	ND	ND	ND	---	ND
	29-Dec-10		0.46	1.0	---	ND	**2.8**	ND	ND	ND	ND	ND
	29-Jun-11		0.46	1.0	---	ND	**3.6**	ND	ND	ND	ND	ND
	01-Nov-11		0.46	1.0	---	ND	**2.9**	ND	ND	ND	ND	ND
	01-May-12		0.46	1.0	---	ND	**3.0**	ND	ND	ND	ND	ND
	07-Nov-12		0.193	1.0	---	---	**2.52**	ND	ND	ND	---	ND
	09-May-13		0.46	1.0	---	ND	**1.9**	ND	ND	ND	---	ND
	07-Nov-13		0.46	1.0	---	---	**1.8**	ND	ND	ND	---	ND
	05-Jun-14	EPA 8260	0.46	1.0	---	ND	**2.3**	ND	ND	ND	ND	ND

TABLE 4:
HISTORICAL GROUNDWATER CONSTITUENTS

Analyte	Sample Collection Date	EPA Method	DL	RL	Background MW-1	Background MW-6	Downgradient MW-2	Downgradient MW-3S	Downgradient MW-3D	Downgradient MW-4	Downgradient MW-5	Blanks
Toluene	29-Jun-11		0.26	1.0	---	ND	ND	ND	ND	ND	0.76 J	ND
NC 2L = 1000 µg/L (10/23/07)	01-Nov-11		0.26	1.0	---	ND	ND	ND	ND	ND	ND	ND
NC 2L = 600 µg/L (1/11/10)	01-May-12		0.26	1.0	---	ND	ND	ND	ND	ND	ND	ND
	07-Nov-12		0.122	1.0	---	---	ND	ND	ND	ND	---	ND
	09-May-13		0.26	1.0	---	ND	ND	ND	ND	ND	---	ND
	07-Nov-13		0.26	1.0	---	---	ND	ND	ND	ND	---	ND
	05-Jun-14	EPA 8260	0.26	1.0	---	ND	ND	ND	ND	ND	ND	ND
Trichloroethylene	30-Dec-09		0.1	1.0	---	ND	**8.0**	ND	ND	0.2 J	---	ND
NC 2L = 2.8 µg/L (10/23/07)	01-Jun-10		0.1	1.0	---	ND	**6.4**	ND	ND	ND	---	ND
NC 2L = 3 µg/L (1/11/10)	29-Dec-10		0.47	1.0	---	ND	**10.1**	ND	ND	ND	ND	ND
	29-Jun-11		0.47	1.0	---	ND	**14.6**	ND	ND	ND	ND	ND
	01-Nov-11		0.47	1.0	---	ND	**10.2**	ND	ND	ND	ND	ND
	01-May-12		0.47	1.0	---	ND	**11.6**	ND	ND	ND	ND	ND
	07-Nov-12		0.161	1.0	---	---	**9.97**	ND	ND	ND	---	ND
	09-May-13		0.47	1.0	---	ND	**8.4**	ND	ND	ND	---	ND
	07-Nov-13		0.47	1.0	---	---	**8.0**	ND	ND	ND	---	ND
	05-Jun-14	EPA 8260	0.47	1.0	---	ND	**8.9**	ND	ND	ND	ND	ND
Trichlorofluoromethane	29-Jun-11		0.20	1.0	---	ND	0.95 J	ND	ND	ND	ND	ND
NC 2L = 2100 µg/L (10/23/07)	01-Nov-11		0.20	1.0	---	ND	ND	ND	ND	ND	ND	ND
NC 2L = 2000 µg/L (1/11/10)	01-May-12		0.20	1.0	---	ND	ND	ND	ND	ND	ND	ND
	07-Nov-12		0.157	1.0	---	---	ND	ND	ND	ND	---	ND
	09-May-13		0.20	1.0	---	ND	0.66 J	ND	ND	ND	---	ND
	07-Nov-13		0.20	1.0	---	---	ND	ND	ND	ND	---	ND
	05-Jun-14	EPA 8260	0.20	1.0	---	ND	ND	ND	ND	ND	ND	ND
Vinyl chloride	30-Dec-09		0.1	1.0	---	ND	**4.0**	**2.8**	**4.1**	**26.2**	---	ND
NC 2L = 0.015µg/L (10/23/07)	01-Jun-10		0.1	1.0	---	ND	**2.2**	**3.0**	ND	**26.7**	---	ND
NC 2L = 0.03 µg/L (1/11/10)	29-Dec-10		0.62	1.0	---	ND	**3.5**	**2.4**	**4.7**	**25.6**	ND	ND
	29-Jun-11		0.62	1.0	---	ND	**2.8**	**2.8**	**4.6**	**28.7**	ND	ND
	01-Nov-11		0.62	1.0	---	ND	**5.1**	**2.6**	**6.9**	**24.0**	ND	ND
	01-May-12		0.62	1.0	---	ND	**3.5**	**2.0**	**4.8**	**21.8**	ND	ND
	07-Nov-12		0.127	1.0	---	---	**7.94**	**2.73**	**6.99**	**29.9**	---	ND
	09-May-13		0.62	1.0	---	ND	**2.8**	**1.9**	**4.2**	**18.6**	---	ND
	07-Nov-13		0.62	1.0	---	---	**6.3**	**2.1**	**6.0**	**21.9**	---	ND
	05-Jun-14	EPA 8260	0.62	1.0	---	ND	**7.1**	**5.6**	**8.9**	**21.9**	ND	ND
Xylene (Total)	30-Dec-09		0.3	4.0	---	ND	ND	ND	3.5 J	ND	---	ND
NC 2L = 530 µg/L (10/23/07)	01-Jun-10		0.3	4.0	---	ND	ND	ND	ND	ND	---	ND
NC 2L = 500 µg/L (1/11/10)	29-Dec-10		0.66	2.0	---	ND	ND	ND	ND	ND	ND	ND
	29-Jun-11		0.66	2.0	---	ND	ND	ND	ND	ND	ND	ND
	01-Nov-11		0.66	2.0	---	ND	ND	ND	ND	ND	ND	ND
	01-May-12		0.66	2.0	---	ND	0.89 J	ND	ND	ND	ND	ND
	07-Nov-12		0.179	5.0	---	---	ND	ND	ND	ND	---	ND
	09-May-13		0.66	5.0	---	ND	ND	ND	ND	ND	---	ND
	07-Nov-13		0.66	5.0	---	---	ND	ND	ND	ND	---	ND
	05-Jun-14	EPA 8260	0.66	5.0	---	ND	ND	ND	ND	ND	ND	ND

Notes:
All concentrations are in micrograms per liter (µg/L).
RL = Reporting limit (NC SWSL).
DL = Method Detection Limit.
ND = Not detected at the laboratory's method detection limit.
J = Estimated value less than the RL but greater than the DL.
B = Blank-qualified - Detected concentration is within five times the concentration reported in an associated quality control blank (probable field and/or laboratory contamination).
NC 2L = Groundwater quality standard established in 15A NCAC 2L.0202.
GWPS = Groundwater Protection Standard establisjed by the DENR-SWS (GWPS is used when the NC 2L Standard has not been established.)
Blanks = Quality control blanks, including trip, field, and/or laboratory method blanks.
--- = Monitoring well was not sampled.
Bold values are greater than the NC 2L Standard or GWPS

TABLE 5:
HISTORICAL SURFACE WATER CONSTITUENTS

Analyte	Sample Collection Date	EPA Method	DL	QL	SW-1		SW-2		SW-3		Blanks	
Inorganic Compounds												
Antimony	30-Dec-09		1.2	6.0	1.5	B	6.4	B	NS		1.4	J
NC 2B = NE (05/01/07)	01-Jun-10		1.2	6.0	6.7	B	2.5	B	NS		3.9	J
	29-Dec-10		2.6	6.0	ND		ND		ND		ND	
	29-Jun-11		5.0	6.0	ND		ND		ND		ND	
	01-Nov-11		5.0	6.0	ND		ND		ND		ND	
	01-May-12		5.0	6.0	ND		ND		ND		ND	
	07-Nov-12		0.48	6.0	ND		ND		ND		ND	
	09-May-13		5.0	6.0	ND		ND		ND		ND	
	07-Nov-13		5.0	6.0	ND		ND		ND		ND	
	05-Jun-14	EPA 6010	5.0	6.0	ND		ND		ND		ND	
Arsenic	07-Nov-12		0.094	10.0	0.17	B	0.26	B	0.24	B	1.0	J
NC 2B = 50 µg/L (05/01/07)	09-May-13		5.0	10.0	ND		ND		ND		ND	
	07-Nov-13		5.0	10.0	ND		ND		ND		ND	
	05-Jun-14	EPA 6010	5.0	10.0	ND		ND		ND		ND	
Barium	30-Dec-09		1.1	100	25.1	J	34	J	NS		3.4	J
NC 2B = NE (05/01/07)	01-Jun-10		1.1	100	28.8	J	31.5	J	NS		2.0	J
	29-Dec-10		0.20	100	22.3	B	27.8	B	27.9	B	11.3	J
	29-Jun-11		5.0	100	40.0	J	39.4	J	39.3	J	ND	
	01-Nov-11		5.0	100	30.1	J	35.2	J	34.3	J	ND	
	01-May-12		5.0	100	66.1	J	35.4	J	33.3	J	ND	
	07-Nov-12		0.39	100	27.6	B	31.5	B	29.9	B	12.2	J
	09-May-13		5.0	100	33.6	J	33.8	J	32.6	J	ND	
	07-Nov-13		5.0	100	36.6	J	32.0	J	29.8	J	ND	
	05-Jun-14	EPA 6010	5.0	100	31.2	J	35.8	J	33.6	J	ND	
Cadmium	30-Dec-09		0.2	1.0	ND		ND		NS		ND	
NC 2B = 2 µg/L (05/01/07)	01-Jun-10		0.2	1.0	0.9	B	0.4	B	NS		0.4	J
	29-Dec-10		0.50	1.0	ND		ND		ND		ND	
	29-Jun-11		1.0	1.0	ND		ND		ND		ND	
	01-Nov-11		1.0	1.0	ND		ND		ND		ND	
	01-May-12		1.0	1.0	ND		ND		ND		ND	
	07-Nov-12		0.026	1.000	ND		ND		ND		ND	
	09-May-13		1.0	1.0	ND		ND		ND		ND	
	07-Nov-13		1.0	1.0	ND		ND		ND		ND	
	05-Jun-14	EPA 6010	1.0	1.0	ND		ND		ND		ND	
Chromium	30-Dec-09		0.7	10.0	ND		ND		NS		ND	
NC 2B = 50 µg/L (05/01/07)	01-Jun-10		0.7	10.0	1.7	J	1.2	J	NS		ND	
	29-Dec-10		0.40	10.0	0.69	J	0.53	J	0.41	J	ND	
	29-Jun-11		5.0	10.0	ND		ND		ND		ND	
	01-Nov-11		5.0	10.0	ND		ND		ND		ND	
	01-May-12		5.0	10.0	ND		ND		ND		ND	
	07-Nov-12		0.030	10.0	0.29	B	0.13	B	0.11	B	0.099	J
	09-May-13		5.0	10.0	ND		ND		ND		ND	
	07-Nov-13		5.0	10.0	ND		ND		ND		ND	
	05-Jun-14	EPA 6010	5.0	10.0	ND		ND		ND		ND	

TABLE 5:
HISTORICAL SURFACE WATER CONSTITUENTS

Analyte	Sample Collection Date	EPA Method	DL	QL	SW-1		SW-2		SW-3		Blanks	
Cobalt	30-Dec-09		0.7	10.0	ND		ND		NS		ND	
NC 2B = NE µg/L (05/01/07)	01-Jun-10		0.7	10.0	ND		ND		NS		ND	
	29-Dec-10		0.60	10.0	ND		1.8	J	1.9	J	ND	
	29-Jun-11		5.0	10.0	ND		ND		ND		ND	
	01-Nov-11		5.0	10.0	ND		ND		ND		ND	
	01-May-12		5.0	10.0	ND		ND		ND		ND	
	07-Nov-12		0.053	10.0	0.34	B	0.76	B	0.76	B	0.24	J
	09-May-13		5.0	10.0	ND		ND		ND		ND	
	07-Nov-13		5.0	10.0	ND		ND		ND		ND	
	05-Jun-14	EPA 6010	5.0	10.0	ND		ND		ND		ND	
Copper	30-Dec-09		2.0	10.0	ND		ND		NS		ND	
NC 2B = 7 µg/L (05/01/07)	01-Jun-10		2.0	10.0	6.9	B	5.8	B	NS		4.8	J
	29-Dec-10		0.30	10.0	0.38	J	ND		ND		ND	
	29-Jun-11		5.0	10.0	ND		ND		ND		ND	
	01-Nov-11		5.0	10.0	ND		ND		ND		ND	
	01-May-12		5.0	10.0	ND		ND		ND		ND	
	07-Nov-12		0.093	10.0	0.27	B	0.38	B	0.38	B	1.23	J
	09-May-13		5.0	10.0	ND		ND		ND		ND	
	07-Nov-13		5.0	10.0	ND		ND		ND		ND	
	05-Jun-14	EPA 6010	5.0	10.0	ND		ND		ND		ND	
Lead	30-Dec-09		2.0	10.0	ND		ND		NS		ND	
NC 2B = 25 µg/L (05/01/07)	01-Jun-10		2.0	10.0	2.7	B	2.8	B	NS		3.2	J
	29-Dec-10		4.0	10.0	ND		ND		ND		ND	
	29-Jun-11		5.0	10.0	ND		ND		ND		ND	
	01-Nov-11		5.0	10.0	ND		ND		ND		ND	
	01-May-12		5.0	10.0	ND		ND		ND		ND	
	07-Nov-12		0.025	10.0	0.071	B	0.049	B	0.060	B	0.58	J
	09-May-13		5.0	10.0	ND		ND		ND		ND	
	07-Nov-13		5.0	10.0	ND		ND		ND		ND	
	05-Jun-14	EPA 6010	5.0	10.0	ND		ND		ND		ND	
Nickel	07-Nov-12		0.26	50.0	0.46	B	0.39	B	0.35	B	0.84	J
NC 2B = 88 µg/L (05/01/07)	09-May-13		5.0	50.0	ND		ND		ND		ND	
	07-Nov-13		5.0	50.0	ND		ND		ND		ND	
	05-Jun-14	EPA 6010	5.0	50.0	ND		ND		ND		ND	
Vanadium	30-Dec-09		0.4	25.0	2.0	J	0.8	J	NS		ND	
NC 2B = NE µg/L (05/01/07)	01-Jun-10		0.4	25.0	2.2	J	2.4	J	NS		ND	
	29-Dec-10		0.20	25.0	0.67	B	0.37	B	0.62	B	0.26	J
	29-Jun-11		5.0	25.0	ND		ND		ND		ND	
	01-Nov-11		5.0	25.0	ND		ND		ND		ND	
	01-May-12		5.0	25.0	ND		ND		ND		ND	
	07-Nov-12		0.085	25.0	0.63	J	0.44	J	0.52	J	ND	
	09-May-13		5.0	25.0	7.8	J	9.1	J	9.4	J	ND	
	07-Nov-13		5.0	25.0	ND		ND		ND		ND	
	05-Jun-14	EPA 6010	5.0	25.0	ND		ND		ND		ND	
Zinc	30-Dec-09		2.7	10.0	6.7	B	ND		NS		4.7	J
NC 2B = 50 µg/L (05/01/07)	01-Jun-10		2.7	10.0	6.7	J	8.7	J	NS		ND	
	29-Dec-10		0.40	10.0	ND		1.2	B	1.2	B	12.5	
	29-Jun-11		10.0	10.0	ND		ND		ND		10.5	
	01-Nov-11		10.0	10.0	ND		ND		ND		ND	
	01-May-12		10.0	10.0	ND		ND		ND		ND	
	07-Nov-12		1.31	10.0	ND		ND		1.56	J	ND	
	09-May-13		10.0	10.0	ND		ND		ND		ND	
	07-Nov-13		10.0	10.0	ND		ND		ND		ND	
	05-Jun-14	EPA 6010	10.0	10.0	ND		ND		ND		ND	

TABLE 5:
HISTORICAL SURFACE WATER CONSTITUENTS

Analyte	Sample Collection Date	EPA Method	DL	QL	SW-1		SW-2		SW-3		Blanks	
Organic Compounds												
Acetone	29-Jun-11		2.2	100	2.8	B	3.3	B	4.4	B	5.3	J
NC 2B = NE µg/L (05/01/07)	01-Nov-11		2.2	100	ND		ND		ND		14.6	J
	01-May-12		2.2	100	ND		ND		ND		ND	
	07-Nov-12		0.193	100	ND		ND		ND		ND	
	09-May-13		10.0	100	ND		ND		ND		12.0	J
	07-Nov-13		10.0	100	ND		ND		ND		ND	
	05-Jun-14	EPA 8260	10.0	100	ND		ND		ND		ND	
cis-1,2-Dichloroethylene	30-Dec-09		0.1	5.0	ND		ND		NS		ND	
NC 2B = NE µg/L (05/01/07)	01-Jun-10		0.1	5.0	ND		ND		NS		ND	
	29-Dec-10		0.19	5.0	ND		0.39	J	ND		ND	
	29-Jun-11		0.19	5.0	0.26	J	0.30	J	0.33	J	ND	
	01-Nov-11		0.19	5.0	ND		ND		ND		ND	
	01-May-12		0.19	5.0	0.31	B	ND		ND		0.21 (ND)	J
	07-Nov-12		0.103	5.0	ND		ND		ND		ND	
	09-May-13		0.19	5.0	ND		ND		ND		ND	
	07-Nov-13		0.19	5.0	ND		0.38	J	ND		ND	
	05-Jun-14	EPA 8260	0.19	5.0	ND		0.33	J	ND		ND	

Notes:
All concentrations are in micrograms per liter (µg/L).
RL = Reporting limit (NC SWSL).
DL = Method Detection Limit.
ND = Not detected at the laboratory's method detection limit.
J = Estimated value less than the RL but greater than the DL.
B = Blank-qualified - Detected concentration is within five times the concentration reported in an associated quality control blank (probable field and/or laboratory contamination).
NC 2B = Surface water quality standard esablished in 15A NCAC 2B.
Surface water classification for this site is "Freshwater Aquatic Life."
NE = Not established.
Blanks = Quality control blanks, including trip, field, and/or laboratory method blanks.

TABLE 6: Monitored Natural Attenuation Parameters

(Samples collected on June 5, 2014)

LABORATORY PARAMETERS	Units	DL	RL	MW-2	MW-3D	MW-3S	MW-4	MW-6
Alkalinity, Total as $CaCO_3$	mg/L	1.0	5.0	148	160	147	186	4.6 J
Nitrogen, Nitrate	mg/L	0.02	10	0.056 J	ND	ND	ND	0.072 J
Sulfate	mg/L	2.0	250	ND	ND	ND	ND	6.5 J
Sulfide	mg/L	0.10	1.0	ND	ND	ND	ND	ND
Chloride	µg/L	1,000	1,000	11,200	16,800	25,900	15,600	2,220
Total Organic Carbon (TOC)	mg/L	1.0	1.0	10.6	1.5	8.3	8.2	3.1
Chemical Oxygen Demand (COD)	mg/L	25	25	ND	ND	ND	ND	ND
Biological Oxygen Demand (BOD), 5 day	mg/L	2.0	2.0	ND	ND	ND	ND	ND
Dissolved Methane	µg/L	3.3	6.6	5530	242	254	515	ND
Dissolved Ethane	µg/L	3.1	6.2	ND	ND	ND	ND	ND
Dissolved Ethene	µg/L	3.1	6.2	ND	ND	ND	ND	ND
Dissolved Hydrogen	nM	0.13	0.6	1.5	120	1.2	3.5	---
*Acetic Acid	µg/L	810	5,000	ND	ND	ND	ND	ND
*Butyric Acid	µg/L	700	5,000	ND	ND	ND	ND	ND
*Lactic Acid	µg/L	2,500	25,000	ND	ND	ND	ND	ND
*Propionic Acid	µg/L	660	5,000	ND	ND	ND	ND	ND
*Pyruvic Acid	µg/L	770	10,000	ND	ND	ND	ND	ND
**Total BTEX	µg/L	---	---	6.0	0.42	ND	ND	0.00
FIELD PARAMETERS								
pH	S.U.	---	---	5.6	6.1	6.6	6.4	6.5
Temperature	ºC	---	---	15.2	16.5	18.7	17.4	18.1
Conductivity	µS/cm	---	---	269	315	335	348	44
Turbididty	NTU	---	---	13	8	12	4	104
Dissolved Oxygen (D.O.)	mg/L	---	---	2	1	2	17	3
Oxidation-Reduction Potential (ORP)	mV	---	---	93	15	66	38	99
Ferrous Iron (Fe^{+2})	mg/L	---	---	---	0	0	1	0
Dissolved Carbon Dioxide (CO_2)	mg/L	---	---	---	80	55	115	60

Notes:

DL = Method Detection Limit.
RL = Reporting Limit.
ND = Not detected above the DL.
J = Estimated concentration below the RL.
--- = No data or not applicable.
* Volatile Fatty Acids
** Total BTEX = Sum of benzene, toluene, ethylbenzene, and xylenes concentrations.

Units:

mg/L = milligrams per liter.
µg/L = micrograms per liter.
S.U. = Standard Units (for pH).
NTU = Nephelometric Turbidity Units.
µS/cm= microsiemens per centimeter.
mV = Millivolts.

TABLE 7:
EPA Biodegradation Screening Matrix

Parameter	Concentration in Plume	Interpretation	Possible Points	Points Awarded with DP points	Points Awarded without DP points
Oxygen	< 0.5 mg/L	Tolerated, suppresses the reductive pathway at higher	3		
		concentrations		0	0
	> 5 mg/L	Not tolerated; however, vinyl chloride may be oxidized	-3		
		aerobically			
Nitrate	< 1 mg/L	At higher concentrations may compete with reductive	2	2	2
		pathway			
Iron II (Ferrous Iron)	> 1 mg/L	Reductive pathway possible; vinyl chloride may be	3	0	
		oxidized under Fe (III) - reducing conditions			
Sulfate	< 20 mg/L	At higher concentrations may compete with reductive	2	2	2
		pathway			
Sulfide	> 1 mg/L	Reductive pathway possible	3	0	0
Methane	< 0.5 mg/L	Vinyl chloride oxidizes	0		0
	> 0.5 mg/L	Ultimate reductive daughter product, vinyl chloride	3	3	
		accumulates			
Oxidation Reduction	< 50 mV	Reductive pathway possible	1	0	0
Potential	< -100 mV	Reductive pathway likely	2		
pH	5 < pH < 9	Optimal range for reductive pathway	0	0	0
	5 > pH > 9	Outside optimal range for reductive pathway	-2		
TOC	> 20 mg/L	Carbon and energy source; drives dechlorination; can	2	0	0
		be natural or anthropogenic			
Temperature	>20° C	At T > 20°C biochemical process is accelerated	1	0	0
Carbon Dioxide	> 2x background	Ultimate oxidative daughter product	1	0	0
Alkalinity	> 2x background	Results from interaction between CO_2 and	1	1	1
		aquifer minerals			
Chloride	> 2x background	Daughter product of organic chlorine	2	2	2
Hydrogen	> 1 nM	Reductive pathway possible	3	3	3
	< 1 nM	Vinyl chloride oxidizes	0		
Volatile Fatty Acids	> 0.1 mg/L	Intermediates resulting from biodegradation of more	2	0	0
		complex compounds; carbon and energy source			
BTEX	> 0.1 mg/L	Carbon and energy source; drives dechlorination	2	0	0
Tetrachloroethene (PCE)	---	Material released	0	0	0
Trichloroethene (TCE)	---	Material released	0		0
	---	Daughter product of PCE	2	2	
Dichloroethenes (DCE)	---	Material released	0		0
		Daughter product of TCE	2	2	
Dichloroethene, cis-1,2,	---	Material released	0		0
	---	Daughter product of trichlorethene	2	2	
Vinyl Chloride (VC)	---	Material released	0		0
	---	Daughter product of DCE	2	2	
1,1,1-Trichloroethane (TCA)	---	Material released	0		0
				0	
1,1-Dichloroethane (DCA)	---	Material released	0		0
		Daughter product of TCA	2	2	
Chloroethane	---	Daughter product of dichloroethane or vinyl chloride			
		under reducing conditions	2	0	0
Ethene/Ethane	> 0.01 mg/L	Daughter products of vinyl chloride/ethene	2	0	0
	> 0.1 mg/L		3		
Chloroform	---	Material released	0		0
	---	Daughter product of carbon tetrachloride	2	0	
Dichloromethane (MC)	---	Material released	0		0
(Methylene Chloride)	---	Daughter product of chloroform	2	0	
Based on data collected on June 5, 2014.			**Total Points Awarded :**	**23**	**10**

mg/L = miligrams per liter
mV = millivolts
nM = Nanometer
C = Celcius
NA = Not Analyzed
BTEX = Sum of Benzene, Toluene, Ethylbenzene, and Total Xylenes

NOTE: Chloroethane, Methane, TCE, DCE, cis-1,2-DCE, MC, VC, DCA, and CO_2 may be present in the plume; however, it is uncertain whether these are primary leachate constituents or daughter products (DPs); therefore, we have two calculation columns. The first column assumes all of these are daughter products, and the second column assumes none of them are. The true score is probably between the two.

This screening matrix is prepared in general accordance with the United Stated Environmental Protection Agency's (EPA's) Table 2.3 *Analytical Parameters and Weighted for Preliminary Screening for Anaerobic Biodegradation Process* presented in the EPA's *Technical Protocol for Evaluating Natural Attenuation of Chlorinated Solvents in Groundwater*, September 1988.

SCORE:	Evid. of Nat. Atten.
< 5	inadequate
6-14	limited
15-19	adequate
> 20	strong

TABLE 8: CORRECTIVE ACTION IMPLIMENTATION SCHEDULE

Item/Activity	Timeframe
Implementation of Corrective Action Plan (CAP)	Upon approval of the CAP by the NC-DENR Solid Waste Section (SWS)
Construction/Installation of corrective action system	None required - Remedy is already in place
First semiannual MNA baseline monitoring event	Concurrent with the first regularly-scheduled semiannual compliance monitoring event scheduled more than 30 days after approval of the CAP by the SWS
Subsequent MNA monitoring events	Concurrent with each subsequent semiannual compliance monitoring event
First Annual Phytoremediation Tree Evaluation	During the second or third quarter of the calendar year following approval of the CAP by the SWS
Subsequent Phytoremediation Tree Evaluations	During the second or third quarter of each succeeding calendar year.
First Corrective Action Evaluation Report (CAER)	To be submitted to SWS within 120 days of the last (4th) semiannual MNA baseline sampling event.
Subsequent CAERs	Every five years after the first CAER
Completion of Corrective Action Program	After all contaminant concentrations are below established GPS for three consecutive years

CHART

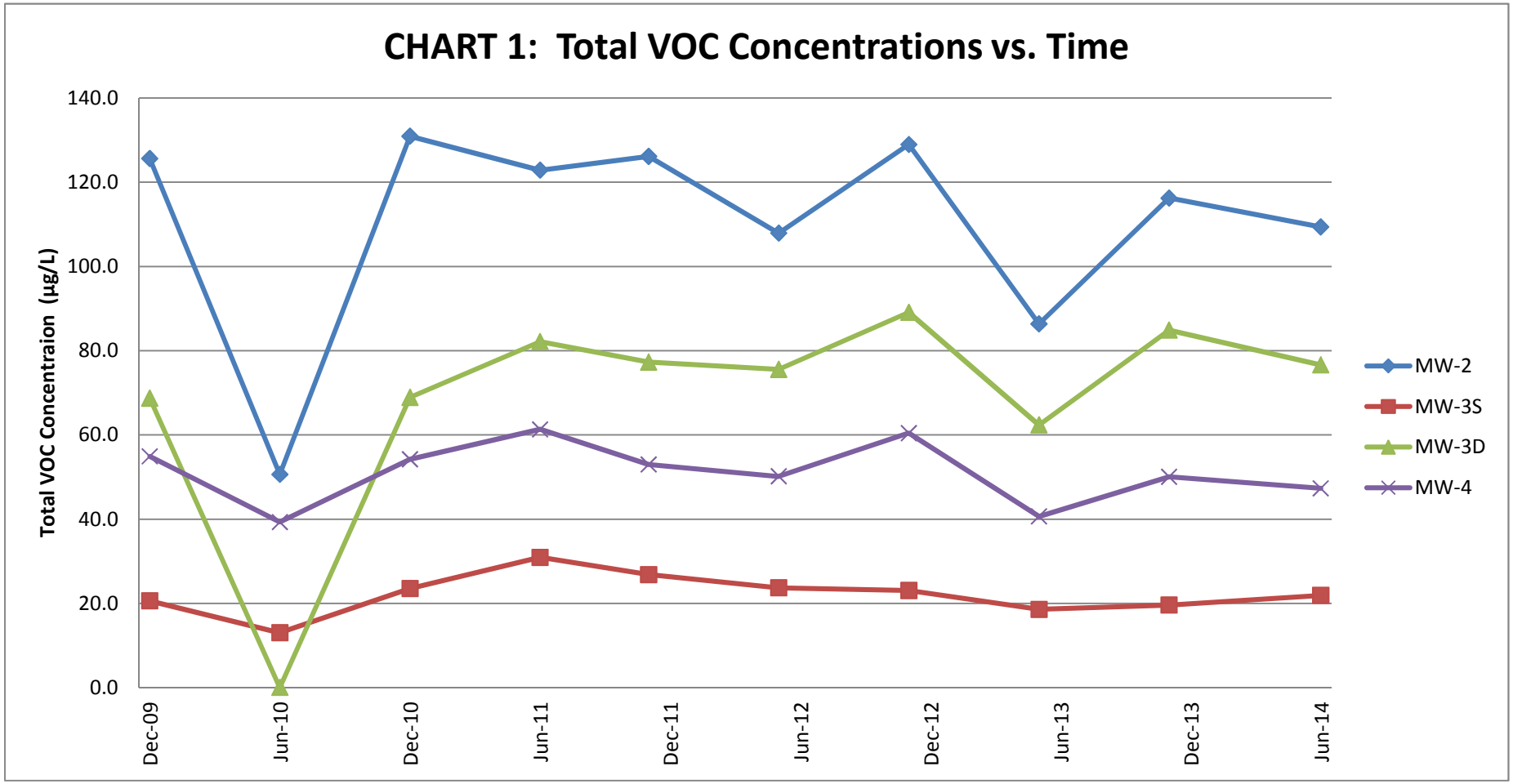
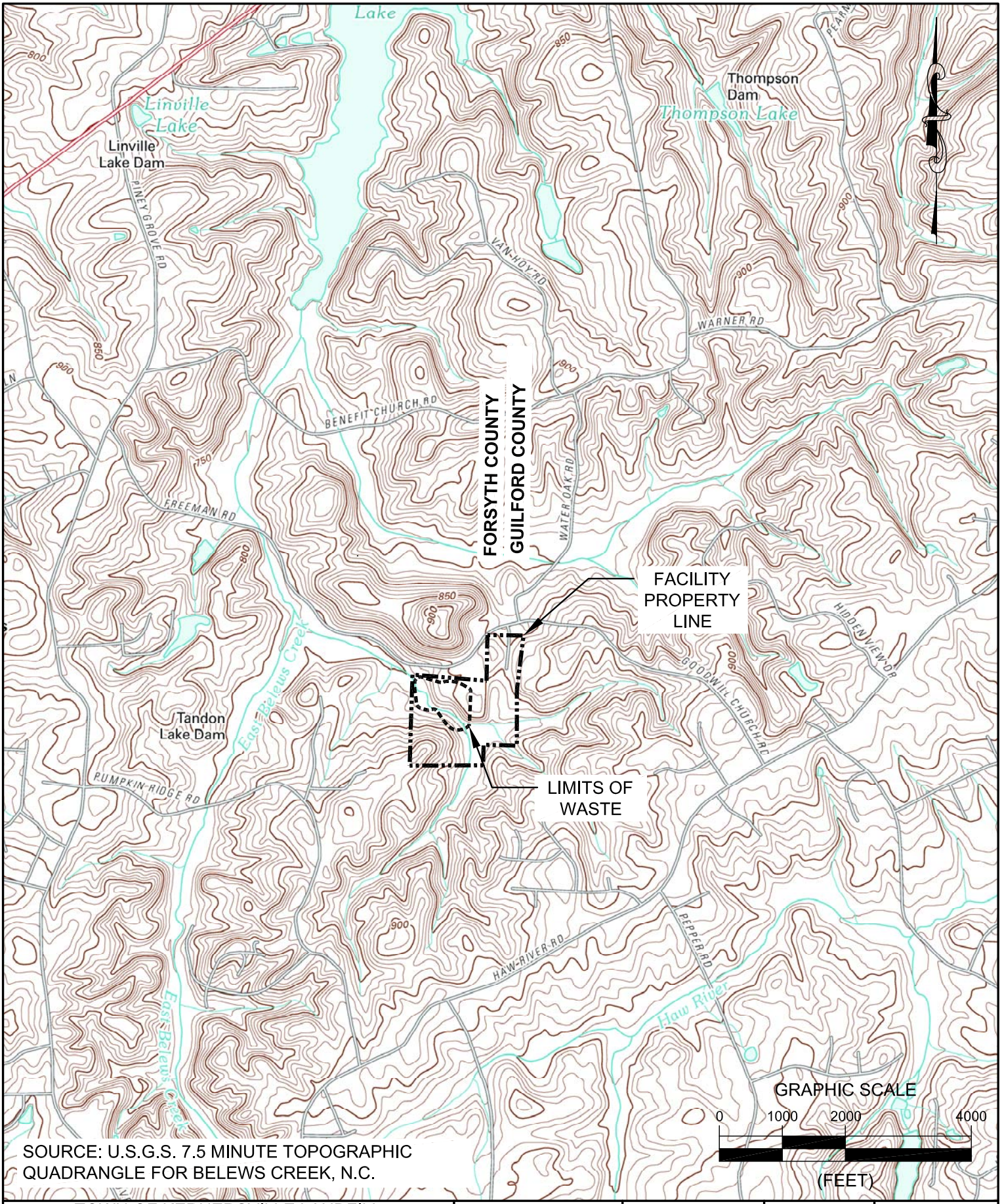


CHART 1: Total VOC Concentrations vs. Time
Total VOC Concentraion (µg/L)
140.0
120.0
100.0
80.0
60.0
40.0
20.0
0.0
Dec-09
Jun-10
Dec-10
Jun-11
Dec-11
Jun-12
Dec-12
Jun-13
Dec-13
Jun-14
MW-2
MW-3S
MW-3D
MW-4

FIGURES



SOURCE: U.S.G.S. 7.5 MINUTE TOPOGRAPHIC QUADRANGLE FOR BELEWS CREEK, N.C.

TOWN OF KERNERSVILLE LANDFILL FORSYTH COUNTY, NORTH CAROLINA	JOYCE ENGINEERING 2211 W. MEADOWVIEW ROAD GREENSBORO, NC 27407 PHONE: (336) 323-0092	DESIGNED HRW DRAWN HRW CHECKED TLH APPROVED TLH DATE 07/07/14	SCALE AS SHOWN	PROJECT NO. 838
SITE LOCATION MAP		© 2014 Joyce Engineering, Inc. All rights reserved.	NC CORP LIC: C-0782	FIGURE NO. 1

L:\KERNERSVILLE\, SITE LOCATION MAP.dwg

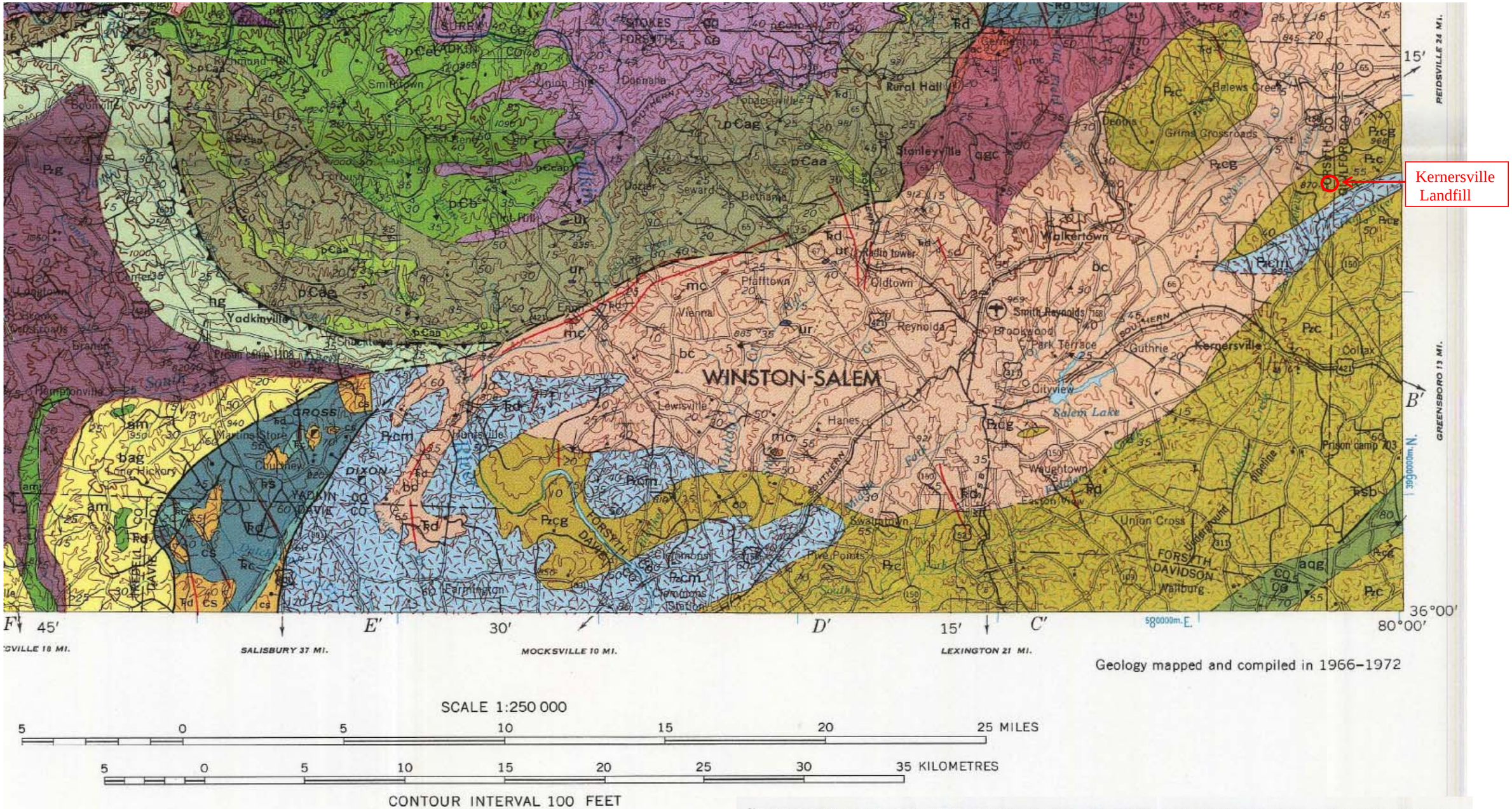


Figure 2: Geologic Map
(Excerpt from Geologic Map of the East Half of the Winston-Salem Quadrangle)

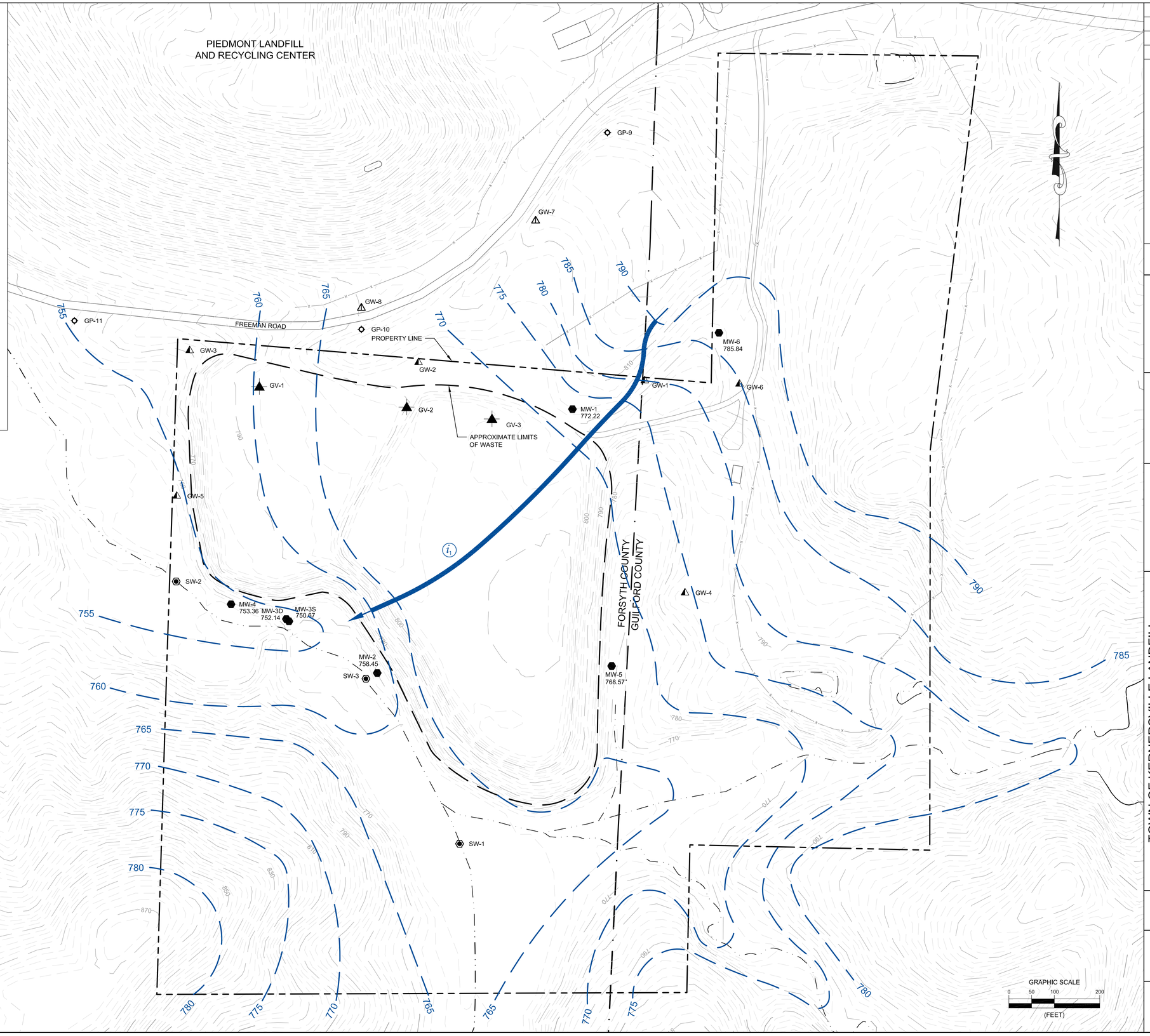
DRAWINGS

LEGEND

—800—	EXISTING 10' TOPOGRAPHIC CONTOUR
	EXISTING 2' TOPOGRAPHIC CONTOUR
	PROPERTY LINE
	EXISTING ROAD
	APPROXIMATE LIMITS OF WASTE
	CENTERLINE OF STREAM
770	GROUNDWATER CONTOUR AND ELEVATION
SW-1	APPROXIMATE SURFACE WATER SAMPLING POINT LOCATION AND IDENTIFICATION
MW-1 771.46	MONITORING WELL IDENTIFICATION AND WATER LEVEL READING
	GROUNDWATER FLOW DIRECTION WITH GRADIENT CALCULATION SEGMENT
i_1	SEGMENT USED FOR GRADIENT CALCULATIONS
GW- 1	LANDFILL GAS WELL - TOWN OF KERNERSVILLE
GV-1	LANDFILL PASSIVE GAS VENT
GP- 1	LANDFILL GAS PROBE - WM PIEDMONT
NM	NOT MONITORED

SEGMENT FLOW LENGTH

i_1 = 922 LF



NO	BY	CK	APP	DATE	REVISIONS AND RECORD OF ISSUE

DESIGNED AC
DRAWN RWH
CHECKED ACE
APPROVED GVB
DATE 06/17/14

© 2014 Joyce Engineering
All rights reserved.

JOYCE ENGINEERING
2211 W. MEADOWVIEW ROAD
GREENSBORO, NC 27407
PHONE: (336) 323-0092
NC CORP LIC: C-0782

TOWN OF KERNERSVILLE LANDFILL
FORSYTH COUNTY, NORTH CAROLINA

POTENTIOMETRIC SURFACE CONTOUR MAP
JUNE 5, 2014

PROJECT NO.
838

SCALE
AS SHOWN

DRAWING NO.
1

L:\KERNERSVILLE\CORRECTIVE ACTION_ TREE SURVEY\GW Surface Contour Map JUNE 2014.dwg Layout=Layout1

LEGEND

—800—	EXISTING 10' TOPOGRAPHIC CONTOUR
	EXISTING 2' TOPOGRAPHIC CONTOUR
	PROPERTY LINE
	EXISTING ROAD
	APPROXIMATE LIMITS OF WASTE
	CENTERLINE OF STREAM
	TOTAL VOC ISOCONCENTRATION CONTOUR
SW-1	APPROXIMATE SURFACE WATER SAMPLING POINT LOCATION AND IDENTIFICATION
MW-1	MONITORING WELL IDENTIFICATION
GW- 1	EXISTING LANDFILL GAS WELL
GW- 6	PROPOSED LANDFILL GAS WELL
GP- 1	PROPOSED LANDFILL GAS PROBE

NOTES:

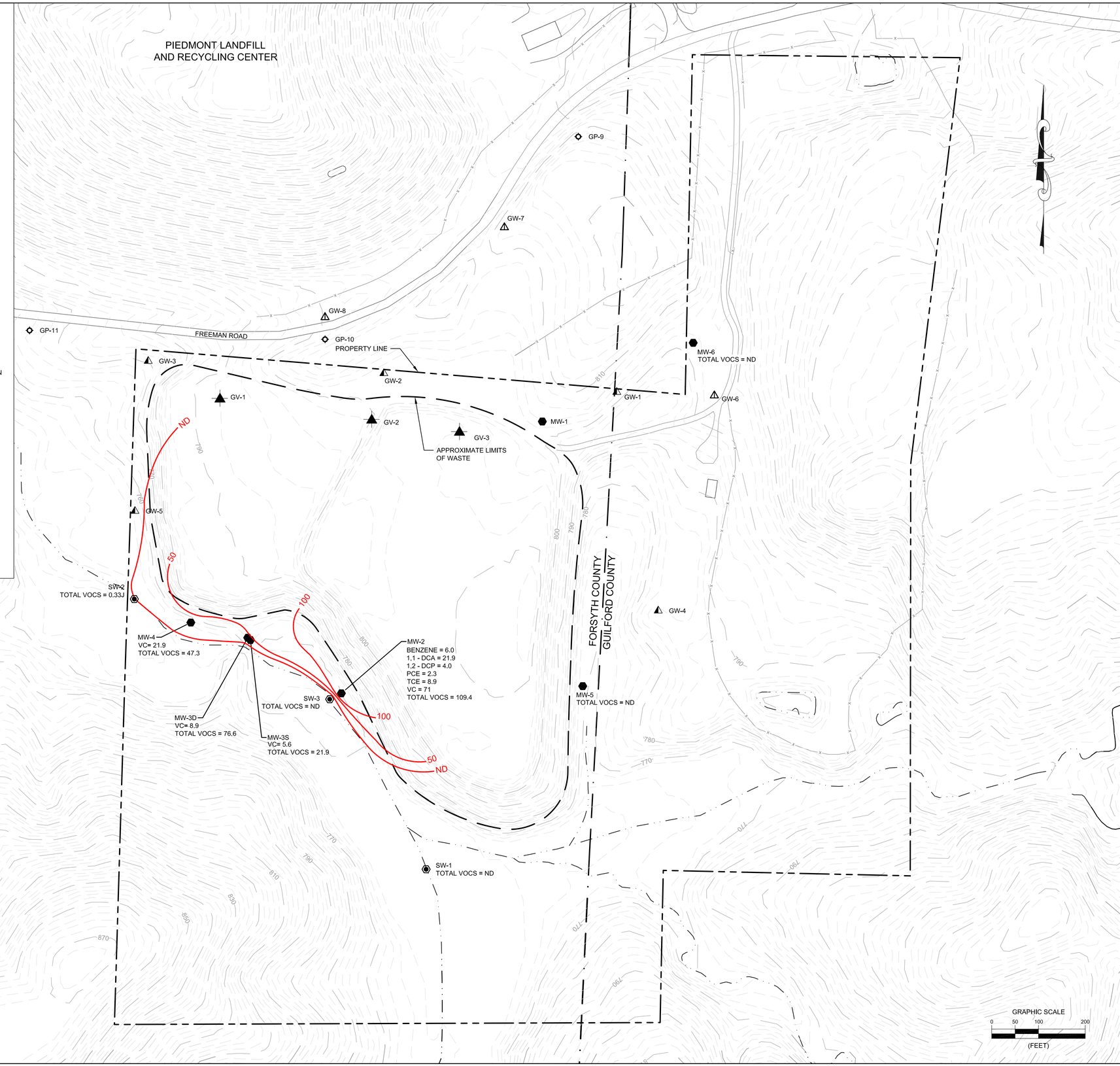
1. GIS SURVEY DATA FOR GUILFORD COUNTY DATED SEPTEMBER 2009, AND MARCH 2010.
2. GIS SURVEY DATA FOR FORSYTH COUNTY DATED OCTOBER, 2010.
3. STATIC WATER LINES MEASURED ON NOVEMBER 27, 2012.
4. GROUNDWATER CONTOURS BASED ON LINEAR INTERPOLATION BETWEEN AND EXTRAPOLATION FROM KNOWN DATA, TOPOGRAPHIC CONTOURS AND KNOWN FIELD CONDITIONS. THEREFORE, GROUNDWATER CONTOURS MAY NOT REFLECT ACTUAL GROUNDWATER CONDITIONS.
5. LIMITS OF WASTE ARE APPROXIMATE.

OCCURENCES ABOVE 2L STANDARDS DENOTED AS:

MW - #
COC (µg/L) - CONCENTRATION ON JUNE 5, 2014

CONSTITUENT ABBREVIATIONS:

COC = CONSTITUENT OF CONCERN
VOCs - VOLATILE ORGANIC COMPOUNDS
VC - VINYL CHLORIDE
1,1-DCA = 1,1-DICHLOROETHANE
1,2-DCP = 1,2-DICHLOROPROPANE
PCE = TETRACHLOROETHYLENE
TCE = TRICHLOROETHYLENE
ND = NO VOCs DETECTED



NO	BY	CK	APP	REVISIONS AND RECORD OF ISSUE	DATE

DESIGNED VB
DRAWN RWH
CHECKED VB
APPROVED VB
DATE 08/22/14

© 2014 Joyce Engineering
All rights reserved.

JOYCE ENGINEERING
2211 W. MEADOWVIEW ROAD
GREENSBORO, NC 27407
PHONE: (336) 323-0092
NC CORP LIC: C-0782

TOWN OF KERNERSVILLE LANDFILL
FORSYTH COUNTY, NORTH CAROLINA

TOTAL VOC ISOCONCENTRATION MAP
JUNE 5, 2014

PROJECT NO.
838

SCALE
AS SHOWN

DRAWING NO.
2

L:\KERNERSVILLE\CORRECTIVE ACTION _ TREE SURVEY\TOTAL VOC ISO MAP.dwg Layout=Layout1

TYPICAL OF AREA 3

TYPICAL OF AREA 3

LARGE WETLAND WITHIN AREA 1

TYPICAL OF AREA 1

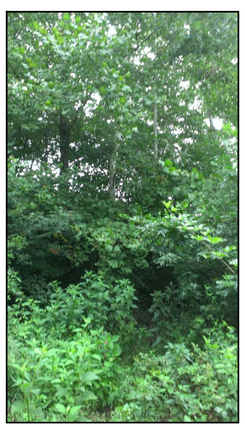
TYPICAL OF AREA 1

TREE COVERAGE SURVEY

AREA 1
1. YELLOWWOOD (FOLLOWS CREEK CHANNEL) 25%
2. AMERICAN ELM (8%)
3. TULIP POPLAR (20%)
4. SWEETGUM (30%)
5. AMERICAN SYCAMORE (5%)
6. MISC. COMBINATION OF WHITE/RED MAPLE, SHAGBARK HICKORY, LOBLOLLY PINE (12%)

AREA 2
1. AMERICAN SYCAMORE (40%)
2. SWEETGUM (10%)
2. TULIP POPLAR (15%)
3. LOBLOLLY PINE (3%)
4. BLACK WILLOW (10%)
5. AMERICAN ELM (5%)
6. BLACK MAPLE (4%)
7. MISC. COMBINATION OF WHITE/RED MAPLE, EASTERN COTTONWOOD (13%)

AREA 3
1. TULIP POPLAR (65%)
2. BLACK MAPLE (10%)
3. LOBLOLLY PINE (5%)
4. SWEETGUM (20%)



TYPICAL OF AREA 2

TYPICAL OF AREA 2

TYPICAL OF AREA 2

LEGEND

130	EXISTING 25' TOPOGRAPHIC CONTOUR
	PROPERTY LINE
	APPROXIMATE LIMITS OF WASTE
	EXISTING ROAD
	CENTERLINE OF STREAM
MW-2R	GROUNDWATER MONITORING WELL LOCATION AND IDENTIFICATION
SW-1	SURFACE WATER MONITORING POINT
GV-3	GAS MONITORING PROBE
GW-1	GAS VENT

NOTES

1. TOPOGRAPHIC CONTOUR INTERVAL = 10 FEET

DATE	REVISIONS AND RECORD OF ISSUE	NO	BY	CK	APP

DESIGNED RWH
DRAWN RWH
CHECKED GVB
APPROVED GVB
DATE 09/17/14

© 2014 Joyce Engineering
All rights reserved.

JOYCE ENGINEERING
2211 W. MEADOWVIEW ROAD
GREENSBORO, NC 27407
PHONE: (336) 323-0092
NC CORP LIC: C-0782

TOWN OF KERNERSVILLE LANDFILL
FORSYTH COUNTY, NORTH CAROLINA

TREE SURVEY
AUGUST 21, 2014

PROJECT NO.
838

SCALE
AS SHOWN

DRAWING NO.
3

APPENDIX A

NC Appendix I and II Constituents
With Groundwater Standards

North Carolina Appendix I, II, and C and D Constituents

NC App. I & II - Total Metals

Number	NC App. #	ANALYTE	CLASS	CAS RN	ANALYTICAL METHOD	GROUNDWATER			NOTES
						NC SWSL	NC 2L	GWP STD.	
1	App. I	**Antimony**	metal	7440-36-0	6010	**6**	**-**	**1**	(RCRA METAL)
2	App. I	**Arsenic**	metal	7440-38-2	6010	**10**	**10**	**-**	(RCRA METAL)
3	App. I	**Barium**	metal	7440-39-3	6010	**100**	**700**	**-**	
4	App. I	**Beryllium**	metal	7440-41-7	6010	**1**	**-**	**4**	(RCRA METAL)
5	App. I	**Cadmium**	metal	7440-43-9	6010	**1**	**2**	**-**	
6	App. I	**Chromium**	metal	7440-47-3	6010	**10**	**10**	**-**	(RCRA METAL)
7	App. I	**Cobalt**	metal	7440-48-4	6010	**10**	**-**	**1**	
8	App. I	**Copper**	metal	7440-50-8	6010	**10**	**1000**	**-**	EPA MCL is a secondary standard.
9	App. I	**Lead**	metal	7439-92-1	6010	**10**	**15**	**-**	EPA MCL is an action level. (RCRA METAL)
10	App. I	**Nickel**	metal	7440-02-0	6010	**50**	**100**	**-**	
11	App. I	**Selenium**	metal	7782-49-2	6010	**10**	**20**	**-**	(RCRA METAL)
12	App. I	**Silver**	metal	7440-22-4	6010	**10**	**20**	**-**	EPA MCL is a secondary standard. (RCRA METAL).
13	App. I	**Thallium**	metal	7440-28-0	6010	**5.5**	**-**	**0.2**	
14	App. I	**Vanadium**	metal	7440-62-2	6010	**25**	**-**	**0.3**	
15	App. I	**Zinc**	metal	7440-66-6	6010	**10**	**1000**	**-**	EPA MCL is a secondary standard. *(AL)* = NC2B Action Level
16	App. II	**Mercury**	metal	7439-97-6	7470	**0.2**	**1**	**-**	(RCRA METAL)
17	App. II	**Tin**	metal	7440-31-5	6010	**100**	**-**	**2000**	

NC App. II - Cyanide/ Sulfide

Number	NC App. #	ANALYTE	CLASS	CAS RN	ANALYTICAL METHOD	GROUNDWATER			NOTES
						NC SWSL	NC 2L	GWP STD.	
1	App. II	**Cyanide**	inorganic	57-12-5	9012A	**10**	**70**	**-**	
2	App. II	**Sulfide**	inorganic	18496-25-8	9030B	**1000**	**-**	**-**	

NC - Additional Constituents for C&D Landfills

Number	NC App. #	ANALYTE	CLASS	CAS RN	ANALYTICAL METHOD	GROUNDWATER			NOTES
						NC SWSL	NC 2L	GWP STD.	
1	C&D	**Alkalinity**	inorganic	SW337	SM 2320B	**-**	**-**	**-**	
2	C&D	**Chloride**	inorganic	SW301	SM 4500-Cl-E	**-**	**250000**	**-**	
3	C&D	**Iron**	metal	7439-89-6	6010	**300**	**300**	**-**	
4	C&D	**Manganese**	metal	7439-96-5	6010	**50**	**50**	**-**	
5	C&D	**Mercury**	metal	7439-97-6	7470	**0.2**	**1**	**-**	(RCRA Metal)
6	C&D	**Sulfate**	inorganic	14808-79-8	300.0	**250000**	**250000**	**-**	
7	C&D	**Total Dissolved Solids (TDS)**	inorganic	SW311	SM 2540C	**-**	**500000**	**-**	
8	C&D	**Tetrahydrofuran**	volatile		8260B	**-**	**-**	**-**	

NC App. I & II - Method 8260

Number	NC App. #	ANALYTE	CLASS	CAS RN	ANALYTICAL METHOD	GROUNDWATER			NOTES
						NC SWSL	NC 2L	GWP STD.	
1	App. I	**Acetone**	volatile	67-64-1	8260B	**100**	**6000**	**-**	
2	App. I	**Acrylonitrile**	volatile	107-13-1	8260B	**200**	**-**	**-**	
3	App. I	**Benzene**	volatile	71-43-2	8260B	**1**	**1**	**-**	
4	App. I	**Bromochloromethane**	volatile	74-97-5	8260B	**3**	**-**	**0.6**	
5	App. I	**Bromodichloromethane**	volatile	75-27-4	8260B	**1**	**0.6**	**-**	*MCL for total trihalomethanes
6	App. I	**Bromoform**	volatile	75-25-2	8260B	**3**	**4**	**-**	*MCL for total trihalomethanes
7	App. I	**Carbon disulfide**	volatile	75-15-0	8260B	**100**	**700**	**-**	
8	App. I	**Carbon tetrachloride**	volatile	56-23-5	8260B	**1**	**0.3**	**-**	
9	App. I	**Chlorobenzene**	volatile	108-90-7	8260B	**3**	**50**	**-**	
10	App. I	**Chloroethane**	volatile	75-00-3	8260B	**10**	**3000**	**-**	
11	App. I	**Chloroform**	volatile	67-66-3	8260B	**5**	**70**	**-**	*MCL for total trihalomethanes
12	App. I	**Dibromochloromethane**	volatile	124-48-1	8260B	**3**	**0.4**	**-**	*MCL for total trihalomethanes
13	App. I	**1,2-Dibromo-3-chloropropane (DBCP)**	volatile	96-12-8	8260B	**13**	**0.04**	**-**	
14	App. I	**1,2-Dibromoethane (EDB)**	volatile	106-93-4	8260B	**1**	**0.02**	**-**	
15	App. I	**o-Dichlorobenzene / 1,2-Dichlorobenzene**	volatile	95-50-1	8260B	**5**	**20**	**-**	
16	App. I	**p-Dichlorobenzene / 1,4-Dichlorobenzene**	volatile	106-46-7	8260B	**1**	**6**	**-**	
17	App. I	**trans-1,4-Dichloro-2-butene**	volatile	110-57-6	8260B	**100**	**-**	**-**	
18	App. I	**1,1-Dichloroethane**	volatile	75-34-3	8260B	**5**	**6**	**-**	
19	App. I	**1,2-Dichloroethane**	volatile	107-06-2	8260B	**1**	**0.4**	**-**	
20	App. I	**1,1-Dichloroethylene**	volatile	75-35-4	8260B	**5**	**7**	**-**	
21	App. I	**cis-1,2-Dichloroethylene**	volatile	156-59-2	8260B	**5**	**70**	**-**	
22	App. I	**trans-1,2-Dichloroethylene**	volatile	156-60-5	8260B	**5**	**100**	**-**	
23	App. I	**1,2-Dichloropropane**	volatile	78-87-5	8260B	**1**	**0.6**	**-**	
24	App. I	**cis-1,3-Dichloropropene**	volatile	10061-01-5	8260B	**1**	**0.4**	**-**	
25	App. I	**trans-1,3-Dichloropropene**	volatile	10061-02-6	8260B	**1**	**0.4**	**-**	
26	App. I	**Ethylbenzene**	volatile	100-41-4	8260B	**1**	**600**	**-**	
27	App. I	**2-Hexanone / Methyl butyl ketone (MBK)**	volatile	591-78-6	8260B	**50**	**-**	**280**	
28	App. I	**Methyl bromide / Bromomethane**	volatile	74-83-9	8260B	**10**	**-**	**10**	
29	App. I	**Methyl chloride / Chloromethane**	volatile	74-87-3	8260B	**1**	**3**	**-**	
30	App. I	**Methylene bromide / Dibromomethane**	volatile	74-95-3	8260B	**10**	**-**	**70**	
31	App. I	**Methylene chloride / Dichloromethane**	volatile	75-09-2	8260B	**1**	**5**	**-**	
32	App. I	**Methyl ethyl ketone / 2-Butanone (MEK)**	volatile	78-93-3	8260B	**100**	**4000**	**-**	
33	App. I	**Methyl iodide / Iodomethane**	volatile	74-88-4	8260B	**10**	**-**	**-**	
34	App. I	**4-Methyl-2-pentanone / Methyl isobutyl ketone**	volatile	108-10-1	8260B	**100**	**-**	**560**	
35	App. I	**Styrene**	volatile	100-42-5	8260B	**1**	**70**	**-**	
36	App. I	**1,1,1,2-Tetrachloroethane**	volatile	630-20-6	8260B	**5**	**-**	**1**	
37	App. I	**1,1,2,2-Tetrachloroethane**	volatile	79-34-5	8260B	**3**	**0.2**	**-**	
38	App. I	**Tetrachloroethylene (PCE)**	volatile	127-18-4	8260B	**1**	**0.7**	**-**	
39	App. I	**Toluene**	volatile	108-88-3	8260B	**1**	**600**	**-**	
40	App. I	**1,1,1-Trichloroethane**	volatile	71-55-6	8260B	**1**	**200**	**-**	
41	App. I	**1,1,2-Trichloroethane**	volatile	79-00-5	8260B	**1**	**-**	**0.6**	
42	App. I	**Trichloroethylene**	volatile	79-01-6	8260B	**1**	**3**	**-**	
43	App. I	**Trichlorofluoromethane (CFC-11)**	volatile	75-69-4	8260B	**1**	**2000**	**-**	
44	App. I	**1,2,3-Trichloropropane**	volatile	96-18-4	8260B	**1**	**0.005**	**-**	
45	App. I	**Vinyl acetate**	volatile	108-05-4	8260B	**50**	**-**	**88**	
46	App. I	**Vinyl chloride**	volatile	75-01-4	8260B	**1**	**0.03**	**-**	
47	App. I	**Xylenes (total)**	volatile	see note	8260B	**5**	**500**	**-**	Includes o-xylene, p-xylene, and unspecified xylenes [dimethyl benzenes (CAS RN 1330-20-7].

NC App. II - Method 8260

Number	NC App. #	ANALYTE	CLASS	CAS RN	ANALYTICAL METHOD	GROUNDWATER			NOTES
						NC SWSL	NC 2L	GWP STD.	
48	App. II	**Acetonitrile (methyl cyanide)**	volatile	75-05-8	8260B	**55**	**-**	**42**	
49	App. II	**Acrolein**	volatile	107-02-8	8260B	**53**	**-**	**4**	
50	App. II	**Allyl chloride (3-chloroprene)**	volatile	107-05-1	8260B	**10**	**-**	**-**	
51	App. II	**Chloroprene**	volatile	126-99-8	8260B	**20**	**-**	**-**	
52	App. II	**m-Dichlorobenzene / 1,3-Dichlorobenzene**	volatile	541-73-1	8260B	**5**	**200**	**-**	
53	App. II	**Dichlorodifluoromethane**	volatile	75-71-8	8260B	**5**	**1000**	**-**	
54	App. II	**1,3-Dichloropropane**	volatile	142-28-9	8260B	**1**	**-**	**-**	
55	App. II	**2,2-Dichloropropane**	volatile	594-20-7	8260B	**15**	**-**	**-**	
56	App. II	**1,1-Dichloropropene**	volatile	563-58-6	8260B	**5**	**-**	**-**	
57	App. II	**Isobutyl alcohol**	volatile	78-83-1	8260B	**100**	**-**	**-**	
58	App. II	**Methacrylonitrile**	volatile	126-98-7	8260B	**100**	**-**	**-**	
59	App. II	**Methyl methacrylate**	volatile	80-62-6	8260B	**30**	**-**	**25**	
60	App. II	**Propionitrile**	volatile	107-12-0	8260B	**150**	**-**	**-**	
61	App. II	**1,2,4-Trichlorobenzene**	volatile	120-82-1	8260B	**10**	**70**	**70**	
62	App. II	**Naphthalene**	volatile	91-20-3	8260B or 8270C	**10**	**6**	**-**	
63	App. II	**Hexachlorobutadiene**	semi-volatile	87-68-3	8270C or 8260B	**10**	**0.4**	**0.44**	
64	App. II	**Ethyl methacrylate**	semi-volatile	97-63-2	8270C or 8260B	**10**	**-**	**-**	

North Carolina Appendix I, II, and C and D Constituents

NC App. II - Method 8270

Number	NC App. #	ANALYTE	CLASS	CAS RN	ANALYTICAL METHOD	GROUNDWATER			NOTES
						NC SWSL	NC 2L	GWP STD.	
1	App. II	**Acenaphthene**	semi-volatile	83-32-9	8270C	**10**	**80**	**-**	
2	App. II	**Acenaphthylene**	semi-volatile	208-96-8	8270C	**10**	**200**	**-**	
3	App. II	**Acetophenone**	semi-volatile	98-86-2	8270C	**10**	**-**	**700**	
4	App. II	**2-Acetylaminofluorene**	semi-volatile	53-96-3	8270C	**20**	**-**	**-**	
5	App. II	**4-Aminobiphenyl**	semi-volatile	92-67-1	8270C	**20**	**-**	**-**	
6	App. II	**Anthracene**	PAH	120-12-7	8270C	**10**	**2000**	**-**	
7	App. II	**Benz[a]anthracene; Benzanthracene**	PAH	56-55-3	8270C	**10**	**0.05**	**-**	
8	App. II	**Benzo[b]fluoranthene**	PAH	205-99-2	8270C	**10**	**0.05**	**-**	
9	App. II	**Benzo[k]fluoranthene**	PAH	207-08-9	8270C	**10**	**0.5**	**-**	
10	App. II	**Benzo[g,h,i]perylene**	PAH	191-24-2	8270C	**10**	**200**	**-**	
11	App. II	**Benzo[a]pyrene**	PAH	50-32-8	8270C	**10**	**0.005**	**-**	
12	App. II	**Benzyl alchohol**	semi-volatile	100-51-6	8270C	**20**	**-**	**700**	
13	App. II	**Bis(2-chloroethoxy)methane**	semi-volatile	111-91-1	8270C	**10**	**-**	**-**	
14	App. II	**Bis(2-chloroethyl)ether**	semi-volatile	111-44-4	8270C	**10**	**-**	**0.031**	
15	App. II	**Bis(2-chloro-1-methylethyl)ether**	semi-volatile	108-60-1	8270C	**10**	**-**	**-**	Bis (2-chloroisopropyl) ether
16	App. II	**Bis(2-ethylhexyl)phthalate**	semi-volatile	117-81-7	8270C	**15**	**3**	**-**	
17	App. II	**4-Bromophenyl phenyl ether**	semi-volatile	101-55-3	8270C	**10**	**-**	**-**	
18	App. II	**Butyl benzyl phthalate**	semi-volatile	85-68-7	8270C	**10**	**1000**	**-**	
19	App. II	**p-Chloroaniline (4-Chloroaniline)**	semi-volatile	106-47-8	8270C	**20**	**-**	**-**	
20	App. II	**Chlorobenzilate**	semi-volatile	510-15-6	8270C	**10**	**-**	**-**	
21	App. II	**p-Chloro-m-cresol (4-chloro-3-methylphenol)**	semi-volatile	59-50-7	8270C	**20**	**-**	**-**	
22	App. II	**2-Chloronaphthalene**	semi-volatile	91-58-7	8270C	**10**	**-**	**-**	
23	App. II	**2-Chlorophenol**	semi-volatile	95-57-8	8270C	**10**	**0.4**	**-**	
24	App. II	**4-Chlorophenyl phenyl ether**	semi-volatile	7005-72-3	8270C	**10**	**-**	**-**	
25	App. II	**Chrysene**	PAH	218-01-9	8270C	**10**	**5**	**-**	
26	App. II	**m-Cresol (3-Methylphenol)**	semi-volatile	108-39-4	8270C	**10**	**400**	**-**	
27	App. II	**o-Cresol**	semi-volatile	95-48-7	8270C	**10**	**-**	**35**	
28	App. II	**p-Cresol (4-Methylphenol)**	semi-volatile	106-44-5	8270C	**10**	**40**	**-**	
29	App. II	**Diallate**	semi-volatile	2303-16-4	8270C	**10**	**-**	**-**	
30	App. II	**Dibenz[a,h]anthracene**	PAH	53-70-3	8270C	**10**	**0.005**	**-**	
31	App. II	**Dibenzofuran**	semi-volatile	132-64-9	8270C	**10**	**-**	**28**	
32	App. II	**Di-n-butyl phthalate**	semi-volatile	84-74-2	8270C	**10**	**700**	**-**	
33	App. II	**3,3'-Dichlorobenzidine**	semi-volatile	91-94-1	8270C	**20**	**-**	**-**	
34	App. II	**2,4-Dichlorophenol**	semi-volatile	120-83-2	8270C	**10**	**-**	**0.98**	
35	App. II	**2,6-Dichlorophenol**	semi-volatile	87-65-0	8270C	**10**	**-**	**-**	
36	App. II	**Diethyl phthalate**	semi-volatile	84-66-2	8270C	**6000**	**6000**	**-**	
37	App. II	**O,O-Diethyl O-2-pyrazinyl phosphorothioate**	OP pesticide	297-97-2	8270C	**20**	**-**	**-**	Thionazine
38	App. II	**Dimethoate**	OP pesticide	60-51-5	8270C	**20**	**-**	**-**	
39	App. II	**p-(Dimethylamino)azobenzene**	semi-volatile	60-11-7	8270C	**10**	**-**	**-**	
40	App. II	**7,12-Dimethylbenz[a]anthracene**	semi-volatile	57-97-6	8270C	**10**	**-**	**-**	
41	App. II	**3,3'-Dimethylbenzidine**	semi-volatile	119-93-7	8270C	**10**	**-**	**-**	
42	App. II	**2,4-Dimethylphenol (M-xylenol)**	semi-volatile	105-67-9	8270C	**10**	**100**	**-**	
43	App. II	**Dimethyl phthalate**	semi-volatile	131-11-3	8270C	**10**	**-**	**-**	
44	App. II	**m-Dinitrobenzene**	semi-volatile	99-65-0	8270C	**20**	**-**	**-**	
45	App. II	**4,6-Dinitro-o-cresol (2-methyl 4,6-dinitrolphenol)**	semi-volatile	534-52-1	8270C	**50**	**-**	**-**	
46	App. II	**2,4-Dinitrophenol**	semi-volatile	51-28-5	8270C	**50**	**-**	**-**	
47	App. II	**2,4-Dinitrotoluene**	semi-volatile	121-14-2	8270C	**10**	**-**	**-**	
48	App. II	**2,6-Dinitrotoluene**	semi-volatile	606-20-2	8270C	**10**	**-**	**-**	
49	App. II	**Di-n-octyl phthalate**	semi-volatile	117-84-0	8270C	**10**	**100**	**-**	
50	App. II	**Diphenylamine**	semi-volatile	122-39-4	8270C	**10**	**-**	**-**	
51	App. II	**Disulfoton**	OP pesticide	298-04-4	8270C	**10**	**0.3**	**-**	
52	App. II	**Ethyl methanesulfonate**	semi-volatile	62-50-0	8270C	**20**	**-**	**-**	
53	App. II	**Famphur**	semi-volatile	52-85-7	8270C	**20**	**-**	**-**	
54	App. II	**Fluoranthene**	PAH	206-44-0	8270C	**10**	**300**	**-**	
55	App. II	**Fluorene**	PAH	86-73-7	8270C	**10**	**300**	**-**	

NC App. II - Method 8270

Number	NC App. #	ANALYTE	CLASS	CAS RN	ANALYTICAL METHOD	GROUNDWATER			NOTES
						NC SWSL	NC 2L	GWP STD.	
56	App. II	**Hexachlorobenzene**	semi-volatile	118-74-1	8270C	**10**	**0.02**	**-**	
57	App. II	**Hexachlorocylopentadiene**	semi-volatile	77-47-4	8270C	**10**	**-**	**50**	
58	App. II	**Hexachloroethane**	semi-volatile	67-72-1	8270C	**10**	**-**	**2.5**	
59	App. II	**Hexachloropropene**	semi-volatile	1888-71-7	8270C	**10**	**-**	**-**	
60	App. II	**Indeno[1,2,3-cd]pyrene**	PAH	193-39-5	8270C	**10**	**0.05**	**-**	
61	App. II	**Isodrin**	semi-volatile	465-73-6	8270C	**20**	**-**	**-**	
62	App. II	**Isophorone**	semi-volatile	78-59-1	8270C	**10**	**40**	**-**	
63	App. II	**Isosafrole**	semi-volatile	120-58-1	8270C	**10**	**-**	**-**	
64	App. II	**Kepone**	pesticide	143-50-0	8270C	**20**	**-**	**-**	
65	App. II	**Methapyrilene**	semi-volatile	91-80-5	8270C	**100**	**-**	**-**	
66	App. II	**3-Methylcholanthrene**	semi-volatile	56-49-5	8270C	**10**	**-**	**-**	
67	App. II	**Methyl methanesulfonate**	semi-volatile	66-27-3	8270C	**10**	**-**	**-**	
68	App. II	**2-Methylnaphthalene**	semi-volatile	91-57-6	8270C	**10**	**30**	**-**	
69	App. II	**Methyl parathion**	semi-volatile	298-00-0	8270C	**10**	**-**	**-**	
70	App. II	**1,4-Naphthoquinone**	semi-volatile	130-15-4	8270C	**10**	**-**	**-**	
71	App. II	**1-Naphthylamine**	semi-volatile	134-32-7	8270C	**10**	**-**	**-**	
72	App. II	**2-Naphthylamine**	semi-volatile	91-59-8	8270C	**10**	**-**	**-**	
73	App. II	**o-Nitroaniline (2-Nitroaniline)**	semi-volatile	88-74-4	8270C	**50**	**-**	**-**	
74	App. II	**m-Nitroaniline (3-Nitroaniline)**	semi-volatile	99-09-2	8270C	**50**	**-**	**-**	
75	App. II	**p-Nitroaniline (4-Nitroaniline)**	semi-volatile	100-01-6	8270C	**20**	**-**	**-**	
76	App. II	**Nitrobenzene**	semi-volatile	98-95-3	8270C	**10**	**-**	**-**	
77	App. II	**5-Nitro-o-toluidine**	semi-volatile	99-55-8	8270C	**10**	**-**	**-**	
78	App. II	**o-Nitrophenol (2-Nitrophenol)**	semi-volatile	88-75-5	8270C	**10**	**-**	**-**	
79	App. II	**p-Nitrophenol (4-Nitrophenol)**	semi-volatile	100-02-7	8270C	**50**	**-**	**-**	
80	App. II	**N-Nitrosodiethylamine**	semi-volatile	55-18-5	8270C	**20**	**-**	**-**	
81	App. II	**N-Nitrosodimethylamine**	semi-volatile	62-75-9	8270C	**10**	**0.0007**	**-**	
82	App. II	**N-Nitrosodi-n-butylamine**	semi-volatile	924-16-3	8270C	**10**	**-**	**-**	
83	App. II	**N-Nitrosodiphenylamine**	semi-volatile	86-30-6	8270C	**10**	**-**	**-**	
84	App. II	**N-Nitrosodipropylamine**	semi-volatile	621-64-7	8270C	**10**	**-**	**-**	
85	App. II	**N-Nitrosomethylethylamine**	semi-volatile	10595-95-6	8270C	**10**	**-**	**-**	
86	App. II	**N-Nitrosopiperidine**	semi-volatile	100-75-4	8270C	**20**	**-**	**-**	
87	App. II	**N-Nitrosopyrrolidine**	semi-volatile	930-55-2	8270C	**10**	**-**	**-**	
88	App. II	**Parathion**	OP pesticide	56-38-2	8270C	**10**	**-**	**-**	
89	App. II	**Pentachlorobenzene**	semi-volatile	608-93-5	8270C	**10**	**-**	**-**	
90	App. II	**Pentachloronitrobenzene**	semi-volatile	82-68-8	8270C	**20**	**-**	**-**	
91	App. II	**Phenacetin**	semi-volatile	62-44-2	8270C	**20**	**-**	**-**	
92	App. II	**Phenanthrene**	PAH	85-01-8	8270C	**10**	**200**	**-**	
93	App. II	**Phenol**	semi-volatile	108-95-2	8270C	**10**	**30**	**-**	
94	App. II	**p-Phenylenediamine**	semi-volatile	106-50-3	8270C	**10**	**-**	**-**	
95	App. II	**Phorate**	OP pesticide	298-02-2	8270C	**10**	**1**	**-**	
96	App. II	**Pronamide**	semi-volatile	23950-58-5	8270C	**10**	**-**	**-**	
97	App. II	**Pyrene**	PAH	129-00-0	8270C	**10**	**200**	**-**	
98	App. II	**Safrole**	semi-volatile	94-59-7	8270C	**10**	**-**	**-**	
99	App. II	**1,2,4,5-Tetrachlorobenzene**	semi-volatile	95-94-3	8270C	**10**	**-**	**2**	
100	App. II	**2,3,4,6-Tetrachlorophenol**	semi-volatile	58-90-2	8270C	**10**	**200**	**-**	
101	App. II	**o-Toluidine**	semi-volatile	95-53-4	8270C	**10**	**-**	**-**	
102	App. II	**2,4,5-Trichlorophenol**	semi-volatile	95-95-4	8270C	**10**	**-**	**63**	
103	App. II	**2,4,6-Trichlorophenol**	semi-volatile	88-06-2	8270C	**10**	**-**	**4**	
104	App. II	**O,O,O-Triethyl phosphorothioate**	semi-volatile	126-68-1	8270C	**10**	**-**	**-**	
105	App. II	**1,3,5-Trinitrobenzene**	semi-volatile	99-35-4	8270C	**10**	**400**	**-**	
106	App. II	**Hexachlorobutadiene**	semi-volatile	87-68-3	8270C or 8260	**10**	**0.4**	**-**	
107	App. II	**Ethyl methacrylate**	semi-volatile	97-63-2	8270C or 8270	**10**	**-**	**-**	
108	App. II	**Naphthalene**	volatile	91-20-3	8260B or 8270	**10**	**6**	**-**	
109	App. II	**Pentachlorophenol**	herbicide	87-86-5	8151 or 8270	**25**	**0.3**	**-**	

North Carolina Appendix I, II, and C and D Constituents

NC App. II - Pesticides Method 8081

Number	NC App. #	ANALYTE	CLASS	CAS RN	ANALYTICAL METHOD	GROUNDWATER			NOTES
						NC SWSL	NC 2L	GWP STD.	
1	App. II	**Aldrin**	pesticide	309-00-2	8081A	**0.05**	**-**	**0.002**	
2	App. II	**alpha-BHC**	pesticide	319-84-6	8081A	**0.05**	**-**	**0.006**	
3	App. II	**beta-BHC**	pesticide	319-85-7	8081A	**0.05**	**-**	**0.019**	
4	App. II	**delta-BHC**	pesticide	319-86-8	8081A	**0.05**	**-**	**0.019**	
5	App. II	**gamma-BHC (Lindane)**	pesticide	58-89-9	8081A	**0.05**	**0.03**	**-**	
6	App. II	**Chlordane**	pesticide	see note	8081A	**0.5**	**0.1**	**-**	This entry includes alpha-chlordane (CAS RN 5103-71-9), beta chlordane (CAS RN 5103-74-2), gamma-chlordane (CAS RN 566-34-7), and constituents of chlordane (CAS RN 57-74-9 and 12672-29-6).
7	App. II	**4,4'-DDD**	pesticide	72-54-8	8081A	**0.1**	**0.1**	**-**	
8	App. II	**4,4'-DDE**	pesticide	72-55-9	8081A	**0.1**	**-**	**-**	
9	App. II	**4-4'-DDT**	pesticide	50-29-3	8081A	**0.1**	**0.1**	**-**	
10	App. II	**Dieldrin**	pesticide	60-57-1	8081A	**0.002**	**0.002**	**-**	
11	App. II	**Endosulfan I**	pesticide	959-96-8	8081A	**0.1**	**40**	**-**	
12	App. II	**Endosulfan II**	pesticide	33213-65-9	8081A	**0.1**	**42**	**-**	
13	App. II	**Endosulfan sulfate**	pesticide	1031-07-8	8081A	**0.1**	**-**	**-**	
14	App. II	**Endrin**	pesticide	72-20-8	8081A	**0.1**	**2**	**-**	
15	App. II	**Endrin aldehyde**	pesticide	7421-93-4	8081A	**0.1**	**2**	**-**	
16	App. II	**Heptachlor**	pesticide	76-44-8	8081A	**0.05**	**0.008**	**-**	
17	App. II	**Heptachlor epoxide**	pesticide	1024-57-3	8081A	**0.075**	**0.004**	**-**	
18	App. II	**Methoxychlor**	pesticide	72-43-5	8081A	**1**	**40**	**-**	
19	App. II	**Toxaphene**	pesticide	see note	8081A	**1.5**	**0.03**	**-**	Includes congener chemicals contained in technical toxaphene (CAS RN 8001-35-2) such as chlorinated camphene.

NC App. II - PCB's Method 8082

Number	NC App. #	ANALYTE	CLASS	CAS RN	ANALYTICAL METHOD	GROUNDWATER			NOTES
						NC SWSL	NC 2L	GWP STD.	
1-6	App. II	**Polychlorinated Biphenyls (PCBs)**	PCB	see note	8082	**2**	**-**	**0.09**	This category contains congener chemicals, including constituents of Aroclor 1016 (CAS RN 12674-11-2), Aroclor 1221 (CAS RN 11104-28-2), Aroclor 1232 (CAS RN 11141-16-5), Aroclor 1242 (CAS RN 53469-21-9), Aroclor 1248 (CAS RN 12672-29-6), Aroclor 1254 (CAS RN 11097-69-1)). Value given for the NC 2L Standard is the GWP for the Solid Waste Section.

NC App. II - Herbicides 8151

Number	NC App. #	ANALYTE	CLASS	CAS RN	ANALYTICAL METHOD	GROUNDWATER			NOTES
						NC SWSL	NC 2L	GWP STD.	
1	App. II	**2,4-Dichlorophenoxyacetic acid (2,4-D)**	herbicide	94-75-7	8151A	**2**	**70**	**-**	
2	App. II	**Dinoseb (DNBP); 2-sec-Butyl-4,6-dinitrophenol**	herbicide	86-85-7	8151A	**1**	**-**	**7**	
3	App. II	**Silvex (2,4,5-TP)**	herbicide	93-72-1	8151A	**2**	**50**	**-**	
4	App. II	**2,4,5-Trichlorophenoxyacetic acid (2,4,5-T)**	herbicide	93-76-5	8151A	**2**	**-**	**-**	
5	App. II	**Pentachlorophenol**	herbicide	87-86-5	8151 or 8270	**25**	**0.3**	**-**	

Notes:

Color denotes NC App. I Constituents

Color denotes remaining NC App. II Constituents

Color denotes C&D Constituents

Color denotes constituents that can be analyzed by more than one method

1. CAS RN: Chemical Abstracts Service Registry Number. Where 'Total' is entered, all species that contain the element are included.
2. Class: General type of compound
3. OP = orthophosphate
4. PAH = polynuclear aromatic hydrocarbon.
5. Volatile EQL of 1 ug/L is based on a 25-mL purge per SW-846, Final Update III, Revision 2, December 1996, page 8260B-35 (most recent revision to method 8260 in SW-846).
6. " - " = not available/not applicable
7. Referenced from North Carolina Dvision of Waste Management website (http://www.wastenotnc.org/sw/swenvmonitoringlist.asp)

APPENDIX B

NC-2B Surface Water Standards

Disclaimer: This table is intended to provide summary information only. It does not substitute for any written regulation, nor is it a regulation itself. **May 1, 2007**

The following standards, criteria, or toxic concentrations are adopted per 15A NCAC 2B. See last page for appropriate use information.

Pollutant	CAS #	Freshwater Aquatic Life	Saltwater Aquatic Life	Water Supply (WS)[1]	Human Health (HH)[2]	Trout Waters (Tr)	High Quality Waters (HQW)	Swamp Waters (Sw)	Synonyms & Other Info	Carcinogen
		ug/l (unless noted)	ug/l (unless noted)	ug/l (unless noted)	ug/l (unless noted)	ug/l (unless noted)	ug/l (unless noted)			
Aldrin	309-00-2	0.002	0.003	0.05 ng/L	0.05 ng/L					y
Arsenic	7440-38-2	50	50	10	10					y
Barium	7440-39-3			1.0 mg/L						n
Bacterial Indicators	*see enterococcus and fecal coliform*									NA
Benzene	71-43-2			1.19	51					y
Beryllium	7440-41-7	6.5								n
Cadmium	7440-43-9	2 (N)	5 (N)			0.4 (N)				n
Carbon Tetrachloride	56-23-5			0.254	1.6				Benzinoform; Carbon Chloride	y
Chlordane	57-74-9	0.004	0.004	0.8 ng/L	0.8 ng/L					y
Chloride	16887-00-6	230 mg/L (AL)		250 mg/L						n
Chlorine (TRC)	7782-50-5	17								n
Chlorinated Benzenes				488						y
Chlorinated Phenols				1.0 (N)						NA
Chlorophyll -a, corrected		40(N)	40(N)			15(N)				NA
Chromium		50	20							NA
Copper	7440-50-8	7 (AL)	3 (AL)							n
Cyanide	57-12-5	5 (N)	1							n
D, 2,4-	94-75-7			100					2,4-Dichlorophenoxy acetic acid	n
DDT, 4,4'-	50-29-3	0.001	0.001	0.2 ng/L	0.2 ng/L				4,4'-Dichlorodiphenyltrichloroethane	y
Demeton	8065-48-3	0.1	0.1							n
Dieldrin	60-57-1	0.002	0.002	0.05 ng/L	0.05 ng/L					y
Dioxin (2,3,7,8-TCDD)	1746-01-6			0.000005 ng/L	0.000005 ng/L				2,3,7,8-Tetrachlorodibenzo-p-dioxin	y
Dissolved Gases		110% sat (N)	110% sat (N)							NA

The following standards, criteria, or toxic concentrations are adopted per 15A NCAC 2B. See last page for appropriate use information.

Pollutant	CAS #	Freshwater Aquatic Life	Saltwater Aquatic Life	Water Supply (WS)[1]	Human Health (HH)[2]	Trout Waters (Tr)	High Quality Waters (HQW)	Swamp Waters (Sw)	Synonyms & Other Info	Carcinogen
		ug/l (unless noted)	ug/l (unless noted)	ug/l (unless noted)	ug/l (unless noted)	ug/l (unless noted)	ug/l (unless noted)			
Dissolved Oxygen		not less than 5.0 mg/L (N)	not less than 5.0 mg/L (N)			not less than 6.0 mg/L (N)	not less than 6.0 mg/L (E)	(N)		NA
Endosulfan	115-29-7	0.05	0.009						Same values apply to Endosulfan Sulfate, alpha-Endosulfan, and beta-Endosulfan	n
Endrin	72-20-8	0.002	0.002							n
Enterococcus					geomean of 35 organisms/100 mL (applicable to class SA, SB, and SC Saltwaters) (N)					NA
Fecal Coliform (MFTCC/100mL)[3]					geomean of 200 organisms/100 mL in Class C Freshwaters (N); and a geomean of 14 organisms/100 mL in class SA Saltwaters (N)					NA
Fluoride		1.8 mg/L								NA
Guthion	86-50-0	0.01	0.01							NA
Hardness, Total				100 mg/L Calcium Carbonate						NA
Heptachlor	76-44-8	0.004	0.004	0.08 ng/L	0.08 ng/L					y
Hexachlorobutadiene	87-68-3			0.44	18				HCBD	y
Iron	7439-89-6	1.0 mg/L (AL)								n
Lead	7439-92-1	25 (N)	25 (N)							n
Lindane	58-89-9	0.01	0.004						gamma-BHC, g-HCH	c
Manganese	7439-96-5			200						n
MBAS[4]				500 (N)					Methylene-blue-active substances (see note)	NA

The following standards, criteria, or toxic concentrations are adopted per 15A NCAC 2B. See last page for appropriate use information.

Pollutant	CAS #	Freshwater Aquatic Life	Saltwater Aquatic Life	Water Supply (WS)[1]	Human Health (HH)[2]	Trout Waters (Tr)	High Quality Waters (HQW)	Swamp Waters (Sw)	Synonyms & Other Info	Carcinogen
		ug/l (unless noted)	ug/l (unless noted)	ug/l (unless noted)	ug/l (unless noted)	ug/l (unless noted)	ug/l (unless noted)			
Mercury	7439-97-6	0.012	0.025							n
Methoxychlor	72-43-5	0.03	0.03							n
Mirex	2385-85-5	0.001	0.001							c
Nickel	7440-02-0	88 (N)	8.3 (N)	25						n
Nitrate (as N)	14797-55-8			10.0 mg/L					Total nitrogen may be regulated in NSW waters. See 2B .0200s for further info	n
Oil and Grease		(N)	(N)							NA
Parathion	56-38-2	0.013	0.178							n
PCB, total		0.001 (N)	0.001 (N)		0.064 ng/L (N)				polychlorinated biphenyls / (Total of all identified PCBs)	y
pH		6.0-9.0 (N)	6.8-8.5 (N)					(N)	Freshwater and Saltwater Aquatic Life Standards are listed as acceptable pH ranges	NA
Phenolic Compounds		(N)	(N)		(N)				(phenolic compounds: no fish flesh tainting)	NA
Polynuclear aromatic hydrocarbons (PAH's)[5]				0.0028 Total PAH's	0.0311 Total PAH's					y
Radioactive Substances		(N)	(N)		(N)					NA
Salinity			(N)							NA
Selenium	7782-49-2	5	71							n
Sewage		(N)	(N)	(N)						NA
Silver	7440-22-4	0.06 (AL)	0.1 (AL)							n
Silvex	93-72-1			10					2,4,5-TP; 2,4,5-Trichlorophenoxypropionoic Acid	n
Solids, settleable		(N)	(N)						also includes floating solids and sludge deposits	NA
Solids, total dissolved				500 mg/L						NA
Solids, total suspended		(N)				HQW=10 mg/L (E)	20 mg/L (E)			NA
Sulfates				250 mg/L						n
Temperature		(N)	(N)		(N)					NA
Tetrachloroethane, 1,1,2,2-	79-34-5			0.17	4				acetosol; acetylene tetrachloride	y
Tetrachloroethylene (PERC)	127-18-4			0.7	3.3				PERC; PCE; perchloroethylene	y

The following standards, criteria, or toxic concentrations are adopted per 15A NCAC 2B. See last page for appropriate use information.

Pollutant	CAS #	Freshwater Aquatic Life	Saltwater Aquatic Life	Water Supply (WS)[1]	Human Health (HH)[2]	Trout Waters (Tr)	High Quality Waters (HQW)	Swamp Waters (Sw)	Synonyms & Other Info	Carcinogen
		ug/l (unless noted)	ug/l (unless noted)	ug/l (unless noted)	ug/l (unless noted)	ug/l (unless noted)	ug/l (unless noted)			
Toluene	108-88-3	11				0.36			methyl benzene; phenyl methane	n
Toxaphene	8001-35-2	0.2 ng/L	0.2 ng/L							y
Trialkyltin		0.07	0.007							n
Tributyltin (TBT)	56573-85-4	0.07	0.007							n
Trichloroethylene	79-01-6			2.5	30				TCE	y
Turbidity		50/25 NTU (N)	25 NTU (N)			10 NTU (N)				NA
Vinyl Chloride	75-01-4			0.025	2.4				chloroethylene	y
Zinc	7440-66-6	50 (AL)	86 (AL)							n

Footnotes, Codes, and Additional Information with Reference to Classifications and Standards

*To determine the appropriate standard, use the most stringent of all applicable columns.For Class C, use the most stringent of freshwater (or, if applicable, saltwater) column and the Human Health column.

* For a WS water, use the most stringent of Freshwater, WS & Human Health. Trout Waters & High Quality Waters likewise must adhere to the most stingent of all applicable standards

* All metal criteria are as total recoverable metals.

(AL) Action Level Standard - See 2B .0211 for additional information

(E) For effluent limits only. See 2B .0224

(HQW) High Quality Waters - see 02B .0101 and .0201

(N) = Narrative standard See 2B .0211 and for WS: .0212, 0214,.0215, .0216 and.0218

(NTU) Nephelometric Turbidity Units

(Sw) Swamp Waters - as defined by 02B .0101

(Tr) Trout Waters - as defined by 02B .0101 and 0301

1 WS standards are applicable to *all* Water Supply Classifications. WS standards are based on the consumption of fish and water. See 2B .0208 for equation.

2 Human Health Standards are based on the consumption of fish only unless dermal contact studies are available. See 2B .0208 for applicable equations.

3 MFTCC/100 mL = Membrane Filter Total Coliform Count per 100 mL of sample

4 MBAS: additional narrative language is located in 02B .0212, .0214, .0215, .0216, .0218

5 PAH=Applies to total PAHs present and includes the following: benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dibenz(a,h)anthracene and indeno(1,2,3-cd)pyrene

Carcinogenicity Color Key:	
Known to cause cancer in humans (y)	**Blue**
Not known to cause cancer in humans (n)	**Green**
Possible human carcinogen (c)	**Yellow**
Carcinogenicity not assessed or Does Not Apply (NA)	**No Color**

Unit Conversions: 1.0 mg/L = 1000.0 ug/L = 1000000.0 ng/L
1.0 ng/L = 0.001 ug/L = 0.000001 mg/L

APPENDIX C

Laboratory Report, Chain-of-Custody,
and Field Data Logs
June 2014 MNA Sampling Event

Pace Analytical Services, Inc.
9800 Kincey Ave. Suite 100
Huntersville, NC 28078
(704)875-9092

June 27, 2014

Mr. Alex Everhart
Joyce Engineering-NC
2211 W. Meadowview Road
Suite 101
Greensboro, NC 27407

RE: Project: TOWN OF KERNERSVILLE MNA
Pace Project No.: 92204346

Dear Mr. Everhart:
Enclosed are the analytical results for sample(s) received by the laboratory on June 06, 2014. The results relate only to the samples included in this report. Results reported herein conform to the most current TNI standards and the laboratory's Quality Assurance Manual, where applicable, unless otherwise noted in the body of the report.

Analyses were performed at the Pace Analytical Services location indicated on the sample analyte page for analysis unless otherwise footnoted.

Some analyses have been subcontracted outside of the Pace Network. The subcontracted laboratory report has been attached.

If you have any questions concerning this report, please feel free to contact me.

Sincerely,

Kevin Godwin
kevin.godwin@pacelabs.com
Project Manager

Enclosures

This report shall not be reproduced, except in full,
without the written consent of Pace Analytical Services, Inc..

Pace Analytical Services, Inc.
9800 Kincey Ave. Suite 100
Huntersville, NC 28078
(704)875-9092

cc: Mr. Van Burbach, Joyce Engineering-NC
Alex Everhart, Joyce Engineering-NC

This report shall not be reproduced, except in full,
without the written consent of Pace Analytical Services, Inc..

Pace Analytical Services, Inc.
9800 Kincey Ave. Suite 100
Huntersville, NC 28078
(704)875-9092

CERTIFICATIONS

Project: TOWN OF KERNERSVILLE MNA
Pace Project No.: 92204346

Minnesota Certification IDs
1700 Elm Street SE Suite 200, Minneapolis, MN 55414
A2LA Certification #: 2926.01
Alabama Certification #40770
Alabama Certification #40770
Alaska Certification #: UST-078
Alaska Certification #MN00064
Arizona Certification #: AZ-0014
Arkansas Certification #: 88-0680
California Certification #: 01155CA
Colorado Certification #Pace
Connecticut Certification #: PH-0256
EPA Region 8 Certification #: 8TMS-L
Florida/NELAP Certification #: E87605
Guam Certification #: Pace
Georgia Certification #: 959
Idaho Certification #: MN00064
Hawaii Certification #MN00064
Illinois Certification #: 200011
Indiana Certification#C-MN-01
Iowa Certification #: 368
Kansas Certification #: E-10167
Kentucky Dept of Envi. Protection - DW #90062
Kentucky Dept of Envi. Protection - WW #:90062
Louisiana DEQ Certification #: 3086
Louisiana DHH #: LA140001
Maine Certification #: 2013011
Maryland Certification #: 322
Michigan DEPH Certification #: 9909
Minnesota Certification #: 027-053-137
Mississippi Certification #: Pace
Montana Certification #: MT0092
Nebraska Certification #: Pace
New Jersey Certification #: MN-002
New Jersey Certification #: MN-002
New York Certification #: 11647
North Carolina Certification #: 530
North Carolina State Public Health #: 27700
North Dakota Certification #: R-036
Ohio EPA #: 4150
Ohio VAP Certification #: CL101
Oklahoma Certification #: 9507
Oregon Certification #: MN200001
Oregon Certification #: MN300001
Pennsylvania Certification #: 68-00563
Puerto Rico Certification
Saipan (CNMI) #:MP0003
South Carolina #:74003001
Texas Certification #: T104704192
Tennessee Certification #: 02818
Utah Certification #: MN000642013-4
Virginia DGS Certification #: 251
Virginia/VELAP Certification #: Pace
Washington Certification #: C486
Wisconsin Certification #: 999407970
West Virginia Certification #: 382
West Virginia TO-15 Approval
West Virginia DHHR #:9952C

Asheville Certification IDs
2225 Riverside Dr., Asheville, NC 28804
Florida/NELAP Certification #: E87648
Massachusetts Certification #: M-NC030
North Carolina Drinking Water Certification #: 37712
North Carolina Wastewater Certification #: 40
South Carolina Certification #: 99030001
West Virginia Certification #: 356
Virginia/VELAP Certification #: 460222

This report shall not be reproduced, except in full,
without the written consent of Pace Analytical Services, Inc..

Pace Analytical Services, Inc.
9800 Kincey Ave. Suite 100
Huntersville, NC 28078
(704)875-9092

SAMPLE SUMMARY

Project: TOWN OF KERNERSVILLE MNA
Pace Project No.: 92204346

Lab ID	Sample ID	Matrix	Date Collected	Date Received
92204346001	**3404-MW2**	Water	06/05/14 09:45	06/06/14 10:10
92204346002	**3404-MW3S**	Water	06/05/14 12:45	06/06/14 10:10
92204346003	**3404-MW3D**	Water	06/05/14 11:05	06/06/14 10:10
92204346004	**3404-MW4**	Water	06/05/14 14:10	06/06/14 10:10
92204346005	**3404-MW6**	Water	06/05/14 15:25	06/06/14 10:10

This report shall not be reproduced, except in full,
without the written consent of Pace Analytical Services, Inc..

Pace Analytical Services, Inc.
9800 Kincey Ave. Suite 100
Huntersville, NC 28078
(704)875-9092

SAMPLE ANALYTE COUNT

Project: TOWN OF KERNERSVILLE MNA
Pace Project No.: 92204346

Lab ID	Sample ID	Method	Analysts	Analytes Reported	Laboratory
92204346001	**3404-MW2**	RSK 175	JRB	3	PASI-M
		SM 2320B	MDW	1	PASI-A
		SM 4500-S2D	SAE	1	PASI-A
		SM 5210B	JTJ	1	PASI-A
		EPA 300.0	SAE	1	PASI-A
		EPA 353.2	EWS	1	PASI-A
		SM 4500-Cl-E	SMW	1	PASI-A
		SM 5220D	DMN	1	PASI-A
		SM 5310B	SAE	1	PASI-A
92204346002	**3404-MW3S**	RSK 175	JRB	3	PASI-M
		SM 2320B	MDW	1	PASI-A
		SM 4500-S2D	SAE	1	PASI-A
		SM 5210B	JTJ	1	PASI-A
		EPA 300.0	SAE	1	PASI-A
		EPA 353.2	EWS	1	PASI-A
		SM 4500-Cl-E	SMW	1	PASI-A
		SM 5220D	DMN	1	PASI-A
		SM 5310B	SAE	1	PASI-A
92204346003	**3404-MW3D**	RSK 175	JRB	3	PASI-M
		SM 2320B	MDW	1	PASI-A
		SM 4500-S2D	SAE	1	PASI-A
		SM 5210B	JTJ	1	PASI-A
		EPA 300.0	SAE	1	PASI-A
		EPA 353.2	EWS	1	PASI-A
		SM 4500-Cl-E	SMW	1	PASI-A
		SM 5220D	DMN	1	PASI-A
		SM 5310B	SAE	1	PASI-A
92204346004	**3404-MW4**	RSK 175	JRB	3	PASI-M
		SM 2320B	MDW	1	PASI-A
		SM 4500-S2D	SAE	1	PASI-A
		SM 5210B	JTJ	1	PASI-A
		EPA 300.0	SAE	1	PASI-A
		EPA 353.2	EWS	1	PASI-A
		SM 4500-Cl-E	SMW	1	PASI-A
		SM 5220D	DMN	1	PASI-A
		SM 5310B	SAE	1	PASI-A
92204346005	**3404-MW6**	RSK 175	JRB	3	PASI-M

This report shall not be reproduced, except in full,
without the written consent of Pace Analytical Services, Inc..

Pace Analytical Services, Inc.
9800 Kincey Ave. Suite 100
Huntersville, NC 28078
(704)875-9092

SAMPLE ANALYTE COUNT

Project: TOWN OF KERNERSVILLE MNA
Pace Project No.: 92204346

Lab ID	Sample ID	Method	Analysts	Analytes Reported	Laboratory
		SM 2320B	MDW	1	PASI-A
		SM 4500-S2D	SAE	1	PASI-A
		SM 5210B	JTJ	1	PASI-A
		EPA 300.0	SAE	1	PASI-A
		EPA 353.2	EWS	1	PASI-A
		SM 4500-Cl-E	SMW	1	PASI-A
		SM 5220D	DMN	1	PASI-A
		SM 5310B	SAE	1	PASI-A

This report shall not be reproduced, except in full,
without the written consent of Pace Analytical Services, Inc..

Pace Analytical Services, Inc.
9800 Kincey Ave. Suite 100
Huntersville, NC 28078
(704)875-9092

SUMMARY OF DETECTION

Project: TOWN OF KERNERSVILLE MNA
Pace Project No.: 92204346

Lab Sample ID / Method	Client Sample ID / Parameters	Result	Units	Report Limit	Analyzed	Qualifiers
92204346001	**3404-MW2**					
RSK 175	Methane	5530	ug/L	6.6	06/12/14 13:45	
SM 2320B	Alkalinity, Total as CaCO3	148	mg/L	5.0	06/12/14 16:15	
EPA 353.2	Nitrogen, Nitrate	0.056J	mg/L	10.0	06/06/14 19:08	
SM 4500-Cl-E	Chloride	11200	ug/L	1000	06/16/14 18:17	
SM 5310B	Total Organic Carbon	10.6	mg/L	1.0	06/13/14 16:47	
92204346002	**3404-MW3S**					
RSK 175	Methane	254	ug/L	6.6	06/12/14 13:56	
SM 2320B	Alkalinity, Total as CaCO3	147	mg/L	5.0	06/12/14 16:28	
SM 4500-Cl-E	Chloride	25900	ug/L	1000	06/16/14 18:18	
SM 5310B	Total Organic Carbon	8.3	mg/L	1.0	06/13/14 16:57	
92204346003	**3404-MW3D**					
RSK 175	Methane	242	ug/L	6.6	06/12/14 14:08	
SM 2320B	Alkalinity, Total as CaCO3	160	mg/L	5.0	06/12/14 16:41	
SM 4500-Cl-E	Chloride	16800	ug/L	1000	06/16/14 18:19	
SM 5310B	Total Organic Carbon	1.5	mg/L	1.0	06/16/14 13:01	
92204346004	**3404-MW4**					
RSK 175	Methane	515	ug/L	6.6	06/12/14 14:19	
SM 2320B	Alkalinity, Total as CaCO3	186	mg/L	5.0	06/12/14 17:12	M1
SM 4500-Cl-E	Chloride	15600	ug/L	1000	06/16/14 16:20	
SM 5310B	Total Organic Carbon	8.2	mg/L	1.0	06/16/14 13:12	
92204346005	**3404-MW6**					
SM 2320B	Alkalinity, Total as CaCO3	4.6J	mg/L	5.0	06/12/14 17:52	
EPA 300.0	Sulfate	6.5J	mg/L	250	06/12/14 16:32	
EPA 353.2	Nitrogen, Nitrate	0.072J	mg/L	10.0	06/06/14 19:25	
SM 4500-Cl-E	Chloride	2220	ug/L	1000	06/16/14 18:20	
SM 5310B	Total Organic Carbon	3.1	mg/L	1.0	06/16/14 13:22	

This report shall not be reproduced, except in full,
without the written consent of Pace Analytical Services, Inc..

Pace Analytical Services, Inc.
9800 Kincey Ave. Suite 100
Huntersville, NC 28078
(704)875-9092

ANALYTICAL RESULTS

Project: TOWN OF KERNERSVILLE MNA
Pace Project No.: 92204346

Sample: 3404-MW2 **Lab ID: 92204346001** Collected: 06/05/14 09:45 Received: 06/06/14 10:10 Matrix: Water

Parameters	Results	Units	Report Limit	MDL	DF	Prepared	Analyzed	CAS No.	Qual
RSK 175 AIR Headspace	Analytical Method: RSK 175								
Ethane	ND	ug/L	6.2	3.1	1		06/12/14 13:45	74-84-0	
Ethene	ND	ug/L	6.2	3.1	1		06/12/14 13:45	74-85-1	
Methane	**5530**	ug/L	6.6	3.3	1		06/12/14 13:45	74-82-8	
2320B Alkalinity	Analytical Method: SM 2320B								
Alkalinity, Total as CaCO3	**148**	mg/L	5.0	1.0	1		06/12/14 16:15		
4500S2D Sulfide Water	Analytical Method: SM 4500-S2D								
Sulfide	ND	mg/L	1.0	0.10	1		06/12/14 11:30	18496-25-8	
5210B BOD, 5 day	Analytical Method: SM 5210B								
BOD, 5 day	ND	mg/L	2.0	2.0	1	06/06/14 17:02	06/11/14 16:17		
300.0 IC Anions 28 Days	Analytical Method: EPA 300.0								
Sulfate	ND	mg/L	250	2.0	1		06/12/14 15:38	14808-79-8	
353.2 Nitrogen, NO2/NO3 unpres	Analytical Method: EPA 353.2								
Nitrogen, Nitrate	**0.056J**	mg/L	10.0	0.020	1		06/06/14 19:08		
4500 Chloride	Analytical Method: SM 4500-Cl-E								
Chloride	**11200**	ug/L	1000	1000	1		06/16/14 18:17	16887-00-6	
5220D COD	Analytical Method: SM 5220D								
Chemical Oxygen Demand	ND	mg/L	25.0	25.0	1		06/18/14 14:30		
5310B TOC	Analytical Method: SM 5310B								
Total Organic Carbon	**10.6**	mg/L	1.0	1.0	1		06/13/14 16:47	7440-44-0	

This report shall not be reproduced, except in full,
without the written consent of Pace Analytical Services, Inc..

Pace Analytical Services, Inc.
9800 Kincey Ave. Suite 100
Huntersville, NC 28078
(704)875-9092

ANALYTICAL RESULTS

Project: TOWN OF KERNERSVILLE MNA
Pace Project No.: 92204346

Sample: 3404-MW3S **Lab ID: 92204346002** Collected: 06/05/14 12:45 Received: 06/06/14 10:10 Matrix: Water

Parameters	Results	Units	Report Limit	MDL	DF	Prepared	Analyzed	CAS No.	Qual
RSK 175 AIR Headspace	Analytical Method: RSK 175								
Ethane	ND	ug/L	6.2	3.1	1		06/12/14 13:56	74-84-0	
Ethene	ND	ug/L	6.2	3.1	1		06/12/14 13:56	74-85-1	
Methane	**254**	ug/L	6.6	3.3	1		06/12/14 13:56	74-82-8	
2320B Alkalinity	Analytical Method: SM 2320B								
Alkalinity, Total as CaCO3	**147**	mg/L	5.0	1.0	1		06/12/14 16:28		
4500S2D Sulfide Water	Analytical Method: SM 4500-S2D								
Sulfide	ND	mg/L	1.0	0.10	1		06/12/14 11:30	18496-25-8	
5210B BOD, 5 day	Analytical Method: SM 5210B								
BOD, 5 day	ND	mg/L	2.0	2.0	1	06/06/14 17:02	06/11/14 16:17		
300.0 IC Anions 28 Days	Analytical Method: EPA 300.0								
Sulfate	ND	mg/L	250	2.0	1		06/12/14 15:51	14808-79-8	
353.2 Nitrogen, NO2/NO3 unpres	Analytical Method: EPA 353.2								
Nitrogen, Nitrate	ND	mg/L	10.0	0.020	1		06/06/14 19:23		
4500 Chloride	Analytical Method: SM 4500-Cl-E								
Chloride	**25900**	ug/L	1000	1000	1		06/16/14 18:18	16887-00-6	
5220D COD	Analytical Method: SM 5220D								
Chemical Oxygen Demand	ND	mg/L	25.0	25.0	1		06/18/14 14:30		
5310B TOC	Analytical Method: SM 5310B								
Total Organic Carbon	**8.3**	mg/L	1.0	1.0	1		06/13/14 16:57	7440-44-0	

This report shall not be reproduced, except in full,
without the written consent of Pace Analytical Services, Inc..

Pace Analytical Services, Inc.
9800 Kincey Ave. Suite 100
Huntersville, NC 28078
(704)875-9092

ANALYTICAL RESULTS

Project: TOWN OF KERNERSVILLE MNA
Pace Project No.: 92204346

Sample: 3404-MW3D **Lab ID: 92204346003** Collected: 06/05/14 11:05 Received: 06/06/14 10:10 Matrix: Water

Parameters	Results	Units	Report Limit	MDL	DF	Prepared	Analyzed	CAS No.	Qual
RSK 175 AIR Headspace	Analytical Method: RSK 175								
Ethane	ND	ug/L	6.2	3.1	1		06/12/14 14:08	74-84-0	
Ethene	ND	ug/L	6.2	3.1	1		06/12/14 14:08	74-85-1	
Methane	**242**	ug/L	6.6	3.3	1		06/12/14 14:08	74-82-8	
2320B Alkalinity	Analytical Method: SM 2320B								
Alkalinity, Total as CaCO3	**160**	mg/L	5.0	1.0	1		06/12/14 16:41		
4500S2D Sulfide Water	Analytical Method: SM 4500-S2D								
Sulfide	ND	mg/L	1.0	0.10	1		06/12/14 11:30	18496-25-8	
5210B BOD, 5 day	Analytical Method: SM 5210B								
BOD, 5 day	ND	mg/L	2.0	2.0	1	06/06/14 17:02	06/11/14 16:17		
300.0 IC Anions 28 Days	Analytical Method: EPA 300.0								
Sulfate	ND	mg/L	250	2.0	1		06/12/14 16:05	14808-79-8	
353.2 Nitrogen, NO2/NO3 unpres	Analytical Method: EPA 353.2								
Nitrogen, Nitrate	ND	mg/L	10.0	0.020	1		06/06/14 19:22		
4500 Chloride	Analytical Method: SM 4500-Cl-E								
Chloride	**16800**	ug/L	1000	1000	1		06/16/14 18:19	16887-00-6	
5220D COD	Analytical Method: SM 5220D								
Chemical Oxygen Demand	ND	mg/L	25.0	25.0	1		06/18/14 14:30		
5310B TOC	Analytical Method: SM 5310B								
Total Organic Carbon	**1.5**	mg/L	1.0	1.0	1		06/16/14 13:01	7440-44-0	

This report shall not be reproduced, except in full,
without the written consent of Pace Analytical Services, Inc..

Pace Analytical Services, Inc.
9800 Kincey Ave. Suite 100
Huntersville, NC 28078
(704)875-9092

ANALYTICAL RESULTS

Project: TOWN OF KERNERSVILLE MNA
Pace Project No.: 92204346

Sample: 3404-MW4 **Lab ID: 92204346004** Collected: 06/05/14 14:10 Received: 06/06/14 10:10 Matrix: Water

Parameters	Results	Units	Report Limit	MDL	DF	Prepared	Analyzed	CAS No.	Qual
RSK 175 AIR Headspace	Analytical Method: RSK 175								
Ethane	ND	ug/L	6.2	3.1	1		06/12/14 14:19	74-84-0	
Ethene	ND	ug/L	6.2	3.1	1		06/12/14 14:19	74-85-1	
Methane	**515**	ug/L	6.6	3.3	1		06/12/14 14:19	74-82-8	
2320B Alkalinity	Analytical Method: SM 2320B								
Alkalinity, Total as CaCO3	**186**	mg/L	5.0	1.0	1		06/12/14 17:12		M1
4500S2D Sulfide Water	Analytical Method: SM 4500-S2D								
Sulfide	ND	mg/L	1.0	0.10	1		06/12/14 11:30	18496-25-8	
5210B BOD, 5 day	Analytical Method: SM 5210B								
BOD, 5 day	ND	mg/L	2.0	2.0	1	06/06/14 17:02	06/11/14 16:17		
300.0 IC Anions 28 Days	Analytical Method: EPA 300.0								
Sulfate	ND	mg/L	250	2.0	1		06/12/14 16:19	14808-79-8	
353.2 Nitrogen, NO2/NO3 unpres	Analytical Method: EPA 353.2								
Nitrogen, Nitrate	ND	mg/L	10.0	0.020	1		06/06/14 19:24		
4500 Chloride	Analytical Method: SM 4500-Cl-E								
Chloride	**15600**	ug/L	1000	1000	1		06/16/14 16:20	16887-00-6	
5220D COD	Analytical Method: SM 5220D								
Chemical Oxygen Demand	ND	mg/L	25.0	25.0	1		06/18/14 14:30		
5310B TOC	Analytical Method: SM 5310B								
Total Organic Carbon	**8.2**	mg/L	1.0	1.0	1		06/16/14 13:12	7440-44-0	

This report shall not be reproduced, except in full,
without the written consent of Pace Analytical Services, Inc..

Pace Analytical Services, Inc.
9800 Kincey Ave. Suite 100
Huntersville, NC 28078
(704)875-9092

ANALYTICAL RESULTS

Project: TOWN OF KERNERSVILLE MNA
Pace Project No.: 92204346

Sample: 3404-MW6 **Lab ID: 92204346005** Collected: 06/05/14 15:25 Received: 06/06/14 10:10 Matrix: Water

Parameters	Results	Units	Report Limit	MDL	DF	Prepared	Analyzed	CAS No.	Qual
RSK 175 AIR Headspace	Analytical Method: RSK 175								
Ethane	ND	ug/L	6.2	3.1	1		06/12/14 14:30	74-84-0	
Ethene	ND	ug/L	6.2	3.1	1		06/12/14 14:30	74-85-1	
Methane	ND	ug/L	6.6	3.3	1		06/12/14 14:30	74-82-8	
2320B Alkalinity	Analytical Method: SM 2320B								
Alkalinity, Total as CaCO3	**4.6J**	mg/L	5.0	1.0	1		06/12/14 17:52		
4500S2D Sulfide Water	Analytical Method: SM 4500-S2D								
Sulfide	ND	mg/L	1.0	0.10	1		06/12/14 11:30	18496-25-8	
5210B BOD, 5 day	Analytical Method: SM 5210B								
BOD, 5 day	ND	mg/L	2.0	2.0	1	06/06/14 17:02	06/11/14 16:17		
300.0 IC Anions 28 Days	Analytical Method: EPA 300.0								
Sulfate	**6.5J**	mg/L	250	2.0	1		06/12/14 16:32	14808-79-8	
353.2 Nitrogen, NO2/NO3 unpres	Analytical Method: EPA 353.2								
Nitrogen, Nitrate	**0.072J**	mg/L	10.0	0.020	1		06/06/14 19:25		
4500 Chloride	Analytical Method: SM 4500-Cl-E								
Chloride	**2220**	ug/L	1000	1000	1		06/16/14 18:20	16887-00-6	
5220D COD	Analytical Method: SM 5220D								
Chemical Oxygen Demand	ND	mg/L	25.0	25.0	1		06/18/14 14:30		
5310B TOC	Analytical Method: SM 5310B								
Total Organic Carbon	**3.1**	mg/L	1.0	1.0	1		06/16/14 13:22	7440-44-0	

This report shall not be reproduced, except in full,
without the written consent of Pace Analytical Services, Inc..

Pace Analytical Services, Inc.
9800 Kincey Ave. Suite 100
Huntersville, NC 28078
(704)875-9092

QUALITY CONTROL DATA

Project: TOWN OF KERNERSVILLE MNA
Pace Project No.: 92204346

QC Batch: AIR/20510 Analysis Method: RSK 175
QC Batch Method: RSK 175 Analysis Description: RSK 175 AIR HEADSPACE
Associated Lab Samples: 92204346001, 92204346002, 92204346003, 92204346004, 92204346005

METHOD BLANK: 1705609 Matrix: Water
Associated Lab Samples: 92204346001, 92204346002, 92204346003, 92204346004, 92204346005

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
Ethane	ug/L	ND	6.2	06/12/14 08:36	
Ethene	ug/L	ND	6.2	06/12/14 08:36	
Methane	ug/L	ND	6.6	06/12/14 08:36	

LABORATORY CONTROL SAMPLE & LCSD: 1705610 1705611

Parameter	Units	Spike Conc.	LCS Result	LCSD Result	LCS % Rec	LCSD % Rec	% Rec Limits	RPD	Max RPD	Qualifiers
Ethane	ug/L	114	108	116	95	102	85-115	7	20	
Ethene	ug/L	106	100	108	95	101	85-115	7	20	
Methane	ug/L	60.7	56.1	61.0	92	101	85-115	8	20	

SAMPLE DUPLICATE: 1705612

Parameter	Units	10269765003 Result	Dup Result	RPD	Max RPD	Qualifiers
Ethane	ug/L	ND	ND		20	
Ethene	ug/L	ND	ND		20	
Methane	ug/L	ND	ND		20	

SAMPLE DUPLICATE: 1705613

Parameter	Units	10270012005 Result	Dup Result	RPD	Max RPD	Qualifiers
Ethane	ug/L	ND	ND		20	
Ethene	ug/L	ND	ND		20	
Methane	ug/L	24.6	20.1	20	20	

Results presented on this page are in the units indicated by the "Units" column except where an alternate unit is presented to the right of the result.

REPORT OF LABORATORY ANALYSIS

This report shall not be reproduced, except in full,
without the written consent of Pace Analytical Services, Inc..

Pace Analytical Services, Inc.
9800 Kincey Ave. Suite 100
Huntersville, NC 28078
(704)875-9092

QUALITY CONTROL DATA

Project: TOWN OF KERNERSVILLE MNA
Pace Project No.: 92204346

QC Batch: WET/31528 Analysis Method: SM 2320B
QC Batch Method: SM 2320B Analysis Description: 2320B Alkalinity
Associated Lab Samples: 92204346001, 92204346002, 92204346003, 92204346004, 92204346005

METHOD BLANK: 1219647 Matrix: Water
Associated Lab Samples: 92204346001, 92204346002, 92204346003, 92204346004, 92204346005

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
Alkalinity, Total as CaCO3	mg/L	ND	5.0	06/12/14 13:32	

LABORATORY CONTROL SAMPLE: 1219648

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Alkalinity, Total as CaCO3	mg/L	50	47.5	95	90-110	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 1219649 1219650

Parameter	Units	92204473007 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Max RPD	Qual
Alkalinity, Total as CaCO3	mg/L	144	50	50	189	187	90	86	75-125	1	20	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 1219651 1219652

Parameter	Units	92204346004 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Max RPD	Qual
Alkalinity, Total as CaCO3	mg/L	186	50	50	221	221	71	70	75-125	0	20	M1

Results presented on this page are in the units indicated by the "Units" column except where an alternate unit is presented to the right of the result.

This report shall not be reproduced, except in full,
without the written consent of Pace Analytical Services, Inc..

Pace Analytical Services, Inc.
9800 Kincey Ave. Suite 100
Huntersville, NC 28078
(704)875-9092

QUALITY CONTROL DATA

Project: TOWN OF KERNERSVILLE MNA
Pace Project No.: 92204346

QC Batch: WET/31512 — Analysis Method: SM 4500-S2D
QC Batch Method: SM 4500-S2D — Analysis Description: 4500S2D Sulfide Water
Associated Lab Samples: 92204346001, 92204346002, 92204346003, 92204346004, 92204346005

METHOD BLANK: 1219045 — Matrix: Water
Associated Lab Samples: 92204346001, 92204346002, 92204346003, 92204346004, 92204346005

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
Sulfide	mg/L	ND	1.0	06/12/14 11:30	

LABORATORY CONTROL SAMPLE: 1219046

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Sulfide	mg/L	.5	0.52J	105	90-110	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 1219047 — 1219048

Parameter	Units	92204473007 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Max RPD	Qual
Sulfide	mg/L	ND	.5	.5	ND	ND	13	13	75-125		20	M1

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 1219049 — 1219050

Parameter	Units	92204810003 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Max RPD	Qual
Sulfide	mg/L	ND	.5	.5	0.55J	0.55J	110	110	75-125	0	20	

Results presented on this page are in the units indicated by the "Units" column except where an alternate unit is presented to the right of the result.

This report shall not be reproduced, except in full,
without the written consent of Pace Analytical Services, Inc..

Pace Analytical Services, Inc.
9800 Kincey Ave. Suite 100
Huntersville, NC 28078
(704)875-9092

QUALITY CONTROL DATA

Project: TOWN OF KERNERSVILLE MNA
Pace Project No.: 92204346

QC Batch: WET/31429 Analysis Method: SM 5210B
QC Batch Method: SM 5210B Analysis Description: 5210B BOD, 5 day
Associated Lab Samples: 92204346001, 92204346002, 92204346003, 92204346004, 92204346005

METHOD BLANK: 1215983 Matrix: Water
Associated Lab Samples: 92204346001, 92204346002, 92204346003, 92204346004, 92204346005

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
BOD, 5 day	mg/L	ND	2.0	06/11/14 16:17	

LABORATORY CONTROL SAMPLE: 1215984

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
BOD, 5 day	mg/L	198	176	89	84.5-115.4	

SAMPLE DUPLICATE: 1215985

Parameter	Units	92204366001 Result	Dup Result	RPD	Max RPD	Qualifiers
BOD, 5 day	mg/L	24.8	23.6	5	20	

Results presented on this page are in the units indicated by the "Units" column except where an alternate unit is presented to the right of the result.

This report shall not be reproduced, except in full,
without the written consent of Pace Analytical Services, Inc..

Pace Analytical Services, Inc.
9800 Kincey Ave. Suite 100
Huntersville, NC 28078
(704)875-9092

QUALITY CONTROL DATA

Project: TOWN OF KERNERSVILLE MNA
Pace Project No.: 92204346

QC Batch: WETA/19262 Analysis Method: EPA 300.0
QC Batch Method: EPA 300.0 Analysis Description: 300.0 IC Anions
Associated Lab Samples: 92204346001, 92204346002, 92204346003, 92204346004, 92204346005

METHOD BLANK: 1217256 Matrix: Water
Associated Lab Samples: 92204346001, 92204346002, 92204346003, 92204346004, 92204346005

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
Sulfate	mg/L	ND	250	06/12/14 10:12	

LABORATORY CONTROL SAMPLE: 1217257

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Sulfate	mg/L	20	19.0J	95	90-110	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 1217258 1217259

Parameter	Units	92204473001 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Max RPD	Qual
Sulfate	mg/L	45.7	20	20	67.3J	65.8J	108	101	90-110	2	20	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 1217260 1217261

Parameter	Units	92203685003 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Max RPD	Qual
Sulfate	mg/L	5.9	20	20	26.0J	25.9J	100	100	90-110	0	20	

Results presented on this page are in the units indicated by the "Units" column except where an alternate unit is presented to the right of the result.

This report shall not be reproduced, except in full,
without the written consent of Pace Analytical Services, Inc..

Pace Analytical Services, Inc.
9800 Kincey Ave. Suite 100
Huntersville, NC 28078
(704)875-9092

QUALITY CONTROL DATA

Project: TOWN OF KERNERSVILLE MNA
Pace Project No.: 92204346

QC Batch: WETA/19241 Analysis Method: EPA 353.2
QC Batch Method: EPA 353.2 Analysis Description: 353.2 Nitrate + Nitrite, Unpres.
Associated Lab Samples: 92204346001, 92204346002, 92204346003, 92204346004, 92204346005

METHOD BLANK: 1216294 Matrix: Water
Associated Lab Samples: 92204346001, 92204346002, 92204346003, 92204346004, 92204346005

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
Nitrogen, Nitrate	mg/L	ND	10.0	06/06/14 19:03	

LABORATORY CONTROL SAMPLE: 1216295

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Nitrogen, Nitrate	mg/L	2.5	2.5J	102	90-110	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 1216296 1216297

Parameter	Units	92204346001 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Max RPD	Qual
Nitrogen, Nitrate	mg/L	0.056J	5	5	5.2J	5.2J	103	102	90-110	1	20	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 1217868 1217869

Parameter	Units	92204473007 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Max RPD	Qual
Nitrogen, Nitrate	mg/L	ND	5	5	5.1J	5.1J	102	101	90-110	1	20	

Results presented on this page are in the units indicated by the "Units" column except where an alternate unit is presented to the right of the result.

This report shall not be reproduced, except in full,
without the written consent of Pace Analytical Services, Inc..

Pace Analytical Services, Inc.
9800 Kincey Ave. Suite 100
Huntersville, NC 28078
(704)875-9092

QUALITY CONTROL DATA

Project: TOWN OF KERNERSVILLE MNA
Pace Project No.: 92204346

QC Batch: WETA/19320 Analysis Method: SM 4500-Cl-E
QC Batch Method: SM 4500-Cl-E Analysis Description: 4500 Chloride
Associated Lab Samples: 92204346001, 92204346002, 92204346003, 92204346004, 92204346005

METHOD BLANK: 1221878 Matrix: Water
Associated Lab Samples: 92204346001, 92204346002, 92204346003, 92204346004, 92204346005

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
Chloride	ug/L	ND	1000	06/16/14 18:00	

LABORATORY CONTROL SAMPLE: 1221879

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Chloride	ug/L	20000	20400	102	90-110	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 1221880 1221881

Parameter	Units	92203842001 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Max RPD	Qual
Chloride	ug/L	2840 mg/L	2000000	2000000	4680000	4630000	92	89	75-125	1	20	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 1221882 1221883

Parameter	Units	92204755003 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Max RPD	Qual
Chloride	ug/L	4.5 mg/L	20000	20000	25000	25200	103	104	75-125	1	20	

Results presented on this page are in the units indicated by the "Units" column except where an alternate unit is presented to the right of the result.

This report shall not be reproduced, except in full,
without the written consent of Pace Analytical Services, Inc..

Pace Analytical Services, Inc.
9800 Kincey Ave. Suite 100
Huntersville, NC 28078
(704)875-9092

QUALITY CONTROL DATA

Project: TOWN OF KERNERSVILLE MNA
Pace Project No.: 92204346

QC Batch: WETA/19340 Analysis Method: SM 5220D
QC Batch Method: SM 5220D Analysis Description: 5220D COD
Associated Lab Samples: 92204346001, 92204346002, 92204346003, 92204346004, 92204346005

METHOD BLANK: 1223558 Matrix: Water
Associated Lab Samples: 92204346001, 92204346002, 92204346003, 92204346004, 92204346005

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
Chemical Oxygen Demand	mg/L	ND	25.0	06/18/14 14:30	

LABORATORY CONTROL SAMPLE: 1223559

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Chemical Oxygen Demand	mg/L	750	759	101	90-110	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 1223560 1223561

Parameter	Units	92204578001 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Max RPD	Qual
Chemical Oxygen Demand	mg/L	570	750	750	1270	1270	93	93	75-125	0	20	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 1223562 1223563

Parameter	Units	92204323001 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Max RPD	Qual
Chemical Oxygen Demand	mg/L	479	750	750	1130	1130	87	87	75-125	0	20	

Results presented on this page are in the units indicated by the "Units" column except where an alternate unit is presented to the right of the result.

This report shall not be reproduced, except in full,
without the written consent of Pace Analytical Services, Inc..

Pace Analytical Services, Inc.
9800 Kincey Ave. Suite 100
Huntersville, NC 28078
(704)875-9092

QUALITY CONTROL DATA

Project: TOWN OF KERNERSVILLE MNA
Pace Project No.: 92204346

QC Batch: WETA/19290 Analysis Method: SM 5310B
QC Batch Method: SM 5310B Analysis Description: 5310B TOC
Associated Lab Samples: 92204346001, 92204346002, 92204346003, 92204346004, 92204346005

METHOD BLANK: 1219910 Matrix: Water
Associated Lab Samples: 92204346001, 92204346002, 92204346003, 92204346004, 92204346005

Parameter	Units	Blank Result	Reporting Limit	Analyzed	Qualifiers
Total Organic Carbon	mg/L	ND	1.0	06/13/14 15:12	

LABORATORY CONTROL SAMPLE: 1219911

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
Total Organic Carbon	mg/L	25	24.3	97	90-110	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 1219912 1219913

Parameter	Units	92204686001 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Max RPD	Qual
Total Organic Carbon	mg/L	12.0	25	25	35.8	36.1	96	96	75-125	1	20	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 1219914 1219915

Parameter	Units	92204859002 Result	MS Spike Conc.	MSD Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limits	RPD	Max RPD	Qual
Total Organic Carbon	mg/L	12.7	25	25	28.2	28.2	62	62	75-125	0	20	M1

Results presented on this page are in the units indicated by the "Units" column except where an alternate unit is presented to the right of the result.

This report shall not be reproduced, except in full,
without the written consent of Pace Analytical Services, Inc..

Pace Analytical Services, Inc.
9800 Kincey Ave. Suite 100
Huntersville, NC 28078
(704)875-9092

QUALIFIERS

Project: TOWN OF KERNERSVILLE MNA
Pace Project No.: 92204346

DEFINITIONS

DF - Dilution Factor, if reported, represents the factor applied to the reported data due to changes in sample preparation, dilution of the sample aliquot, or moisture content.

ND - Not Detected at or above adjusted reporting limit.

J - Estimated concentration above the adjusted method detection limit and below the adjusted reporting limit.

MDL - Adjusted Method Detection Limit.

PQL - Practical Quantitation Limit.

RL - Reporting Limit.

S - Surrogate

1,2-Diphenylhydrazine (8270 listed analyte) decomposes to Azobenzene.

Consistent with EPA guidelines, unrounded data are displayed and have been used to calculate % recovery and RPD values.

LCS(D) - Laboratory Control Sample (Duplicate)

MS(D) - Matrix Spike (Duplicate)

DUP - Sample Duplicate

RPD - Relative Percent Difference

NC - Not Calculable.

SG - Silica Gel - Clean-Up

U - Indicates the compound was analyzed for, but not detected.

N-Nitrosodiphenylamine decomposes and cannot be separated from Diphenylamine using Method 8270. The result reported for each analyte is a combined concentration.

Acid preservation may not be appropriate for 2-Chloroethylvinyl ether, Styrene, and Vinyl chloride.

LOD - Limit of Detection.

LOQ - Limit of Quantitation.

Pace Analytical is TNI accredited. Contact your Pace PM for the current list of accredited analytes.

TNI - The NELAC Institute.

LABORATORIES

PASI-A	Pace Analytical Services - Asheville
PASI-M	Pace Analytical Services - Minneapolis

ANALYTE QUALIFIERS

M1	Matrix spike recovery exceeded QC limits. Batch accepted based on laboratory control sample (LCS) recovery.

This report shall not be reproduced, except in full,
without the written consent of Pace Analytical Services, Inc..

Pace Analytical Services, Inc.
9800 Kincey Ave. Suite 100
Huntersville, NC 28078
(704)875-9092

QUALITY CONTROL DATA CROSS REFERENCE TABLE

Project: TOWN OF KERNERSVILLE MNA
Pace Project No.: 92204346

Lab ID	Sample ID	QC Batch Method	QC Batch	Analytical Method	Analytical Batch
92204346001	**3404-MW2**	RSK 175	AIR/20510		
92204346002	**3404-MW3S**	RSK 175	AIR/20510		
92204346003	**3404-MW3D**	RSK 175	AIR/20510		
92204346004	**3404-MW4**	RSK 175	AIR/20510		
92204346005	**3404-MW6**	RSK 175	AIR/20510		
92204346001	**3404-MW2**	SM 2320B	WET/31528		
92204346002	**3404-MW3S**	SM 2320B	WET/31528		
92204346003	**3404-MW3D**	SM 2320B	WET/31528		
92204346004	**3404-MW4**	SM 2320B	WET/31528		
92204346005	**3404-MW6**	SM 2320B	WET/31528		
92204346001	**3404-MW2**	SM 4500-S2D	WET/31512		
92204346002	**3404-MW3S**	SM 4500-S2D	WET/31512		
92204346003	**3404-MW3D**	SM 4500-S2D	WET/31512		
92204346004	**3404-MW4**	SM 4500-S2D	WET/31512		
92204346005	**3404-MW6**	SM 4500-S2D	WET/31512		
92204346001	**3404-MW2**	SM 5210B	WET/31429	SM 5210B	WET/31433
92204346002	**3404-MW3S**	SM 5210B	WET/31429	SM 5210B	WET/31433
92204346003	**3404-MW3D**	SM 5210B	WET/31429	SM 5210B	WET/31433
92204346004	**3404-MW4**	SM 5210B	WET/31429	SM 5210B	WET/31433
92204346005	**3404-MW6**	SM 5210B	WET/31429	SM 5210B	WET/31433
92204346001	**3404-MW2**	EPA 300.0	WETA/19262		
92204346002	**3404-MW3S**	EPA 300.0	WETA/19262		
92204346003	**3404-MW3D**	EPA 300.0	WETA/19262		
92204346004	**3404-MW4**	EPA 300.0	WETA/19262		
92204346005	**3404-MW6**	EPA 300.0	WETA/19262		
92204346001	**3404-MW2**	EPA 353.2	WETA/19241		
92204346002	**3404-MW3S**	EPA 353.2	WETA/19241		
92204346003	**3404-MW3D**	EPA 353.2	WETA/19241		
92204346004	**3404-MW4**	EPA 353.2	WETA/19241		
92204346005	**3404-MW6**	EPA 353.2	WETA/19241		
92204346001	**3404-MW2**	SM 4500-Cl-E	WETA/19320		
92204346002	**3404-MW3S**	SM 4500-Cl-E	WETA/19320		
92204346003	**3404-MW3D**	SM 4500-Cl-E	WETA/19320		
92204346004	**3404-MW4**	SM 4500-Cl-E	WETA/19320		
92204346005	**3404-MW6**	SM 4500-Cl-E	WETA/19320		
92204346001	**3404-MW2**	SM 5220D	WETA/19340		
92204346002	**3404-MW3S**	SM 5220D	WETA/19340		
92204346003	**3404-MW3D**	SM 5220D	WETA/19340		
92204346004	**3404-MW4**	SM 5220D	WETA/19340		
92204346005	**3404-MW6**	SM 5220D	WETA/19340		
92204346001	**3404-MW2**	SM 5310B	WETA/19290		
92204346002	**3404-MW3S**	SM 5310B	WETA/19290		
92204346003	**3404-MW3D**	SM 5310B	WETA/19290		
92204346004	**3404-MW4**	SM 5310B	WETA/19290		
92204346005	**3404-MW6**	SM 5310B	WETA/19290		

This report shall not be reproduced, except in full,
without the written consent of Pace Analytical Services, Inc..

Pace Analytical Services, Inc.
9800 Kincey Ave. Suite 100
Huntersville, NC 28078
(704)875-9092

QUALITY CONTROL DATA CROSS REFERENCE TABLE

Project: TOWN OF KERNERSVILLE MNA
Pace Project No.: 92204346

Lab ID	Sample ID	QC Batch Method	QC Batch	Analytical Method	Analytical Batch

This report shall not be reproduced, except in full,
without the written consent of Pace Analytical Services, Inc..

Pace Analytical® www.pacelabs.com	Document Name: **Sample Condition Upon Receipt (SCUR)**	Document Revised: April 9, 2014 Page 1 of 2
	Document No.: F-ASV-CS-003-rev.13	Issuing Authorities: Pace Asheville Quality Office

Client Name: Joyce Eng.

Courier (Circle): Fed Ex UPS USPS Client Commercial Pace Other_____

Custody Seal on Cooler/Box Present: ☐ yes ☑ no Seals intact: ☐ yes ☐ no

Packing Material: ☑ Bubble Wrap ☑ Bubble Bags ☐ None ☐ Other_____

Thermometer Used: IR Gun#3 -130265963 Type of Ice: Wet Blue None ☑ Samples on ice, cooling process has begun

Other:_____

Temp Correction Factor: Add / Subtract _____C

Corrected Cooler Temp.: 4.1 C Biological Tissue is Frozen: Yes No N/A

Temp should be above freezing to 6°C

Date and Initials of person examining contents: 6/6/14 J.S.

		Comments:
Chain of Custody Present:	☑Yes ☐No ☐N/A	1.
Chain of Custody Filled Out:	☑Yes ☐No ☐N/A	2.
Chain of Custody Relinquished:	☑Yes ☐No ☐N/A	3.
Sampler Name & Signature on COC:	☑Yes ☐No ☐N/A	4.
Samples Arrived within Hold Time:	☑Yes ☐No ☐N/A	5.
Short Hold Time Analysis (<72hr):	☑Yes ☐No ☐N/A	6. Nitrate, BOD
Rush Turn Around Time Requested:	☑Yes ☐No ☐N/A	7. 10 day
Sufficient Volume:	☑Yes ☐No ☐N/A	8.
Correct Containers Used:	☐Yes ☑No ☐N/A	9.
-Pace Containers Used:	☐Yes ☑No ☐N/A	
Containers Intact:	☑Yes ☐No ☐N/A	10.
Filtered volume received for Dissolved tests	☐Yes ☑No ☑N/A	11.
Sample Labels match COC:	☑Yes ☐No ☐N/A	12.
-Includes date/time/ID/Analysis Matrix: Water		
All containers needing preservation have been checked.	☑Yes ☐No ☐N/A	13.
All containers needing preservation are found to be in compliance with EPA recommendation.	☑Yes ☐No ☐N/A	
exceptions: VOA, coliform, TOC, O&G, WI-DRO (water)	☑Yes ☐No	
Samples checked for dechlorination:	☑Yes ☑No ☐N/A	14.
Headspace in VOA Vials (>6mm):	☑Yes ☐No ☑N/A	15.
Trip Blank Present:	☐Yes ☑No ☐N/A	16.
Trip Blank Custody Seals Present	☐Yes ☐No ☑N/A	
Pace Trip Blank Lot # (if purchased):_____		

Client Notification/ Resolution: Field Data Required? Y / N

Person Contacted: _____ Date/Time: _____

Comments/ Resolution: _____

SCURF Review: JM **Date:** 6/6/14

SRF Review: TMD **Date:** 6/6/14

Note: Whenever there is a discrepancy affecting North Carolina compliance samples, a copy of this form will be sent to the North Carolina DEHNR Certification Office (i.e out of hold, incorrect preservative, out of temp, incorrect containers)

Place label here

OR

Handwrite project number (if no label available)

92204346

CHAIN-OF-CUSTODY / Analytical Request Document

The Chain-of-Custody is a LEGAL DOCUMENT. All relevant fields must be completed accurately.

Page : 1 Of 1

Section A
Required Client Information:

Company: Joyce Engineering
Address: 2211 West Meadowview Rd
Greensboro, NC 27407
Email To: aeverhart@joyceengineering.com
Phone: (336) 323-0092 Fax:
Requested Due Date/TAT: 10 Day (Default)

Section B
Required Project Information:

Report To: Alex Everhart
Copy To:
Purchase Order No.
Client Project ID: Town of Kernersville MNA
Container Order Number:

Section C
Invoice Information:

Attention: Lecia Jones
Company Name: Joyce Engineering
Address: 1604 Ownby Lane, Richmond, VA 23220

Regulatory Agency
State / Location: North Carolina

Pre-Preserved as Labeled

ITEM#	SAMPLE ID (One Character per box. (A-Z, 0-9 / , -) Sample Ids must be unique)	MATRIX CODE (see valid codes to left)	SAMPLE TYPE (G=GRAB C=COMP)	COLLECTED START DATE	COLLECTED START TIME	COLLECTED END DATE	COLLECTED END TIME	SAMPLE TEMP AT COLLECTION	# OF CONTAINERS	Unpreserved	H2SO4	HNO3	HCl	NaOH	Na2S2O3	Methanol	Other	Analyses Test	Nitrate	Sulfate	Chloride	Sulfide	Alkalinity	TOC	Methane, Ethane, Ethene	Volatile Fatty Acids	Dissolved Hydrogen	BOD	COD	Residual Chlorine (Y/N)	
1	3404-MW2	WT	G			6/5/14	0945		16																						922473416
2	3404-MW3S	WT	G				1245		16										X	X	X	X	X	X	X	X	X	X	X		001
3	3404-MW3D	WT	G				1105		14										X	X	X	X	X	X	X	X	X	X	X		002
4	3404-MW4	WT	G				1410		16										X	X	X	X	X	X	X	X	X	X	X		003
5	3404-MW6	WT	G				1525		16										X	X	X	X	X	X	X	X	X	X	X		004
6																			X	X	X	X	X	X	X	X	X	X	X		005
7																															
8																															
9																															
10																															
11																															
12																															

ADDITIONAL COMMENTS	RELINQUISHED BY / AFFILIATION	DATE	TIME	ACCEPTED BY / AFFILIATION	DATE	TIME	SAMPLE CONDITIONS			
Insufficient volume to sample MW-6 for Dissolved H_2	[signature]	6/5/14	1630	[signature]	6/6/14	1010	4.1	Y	N	Y
							TEMP in C	Received on Ice (Y/N)	Custody Sealed Cooler (Y/N)	Samples Intact (Y/N)

SAMPLER NAME AND SIGNATURE
PRINT Name of SAMPLER: Randy Freeman / Dan Girdner
SIGNATURE of SAMPLER: [signature] DATE Signed: 6/5/14

Microseeps/Pace Analytical Energy Services, LLC
220 William Pitt Way
Pittsburgh, PA 15238
Phone: (412) 826-5245
Fax: (412) 826-3433

June 26, 2014

Kevin Godwin
Pace Analytical Services, Inc.
9800 Kincey Avenue
Suite 100
Huntersville, NC 28078

RE: **TOWN OF KERNERSVILLE /92204346**

Microseeps Workorder: 12383

Dear Kevin Godwin:

Enclosed are the analytical results for sample(s) received by the laboratory on Monday, June 09, 2014. Results reported herein conform to the most current NELAC standards, where applicable, unless otherwise narrated in the body of the report.

If you have any questions concerning this report, please feel free to contact me.

Sincerely,

Robbin Robl 06/26/2014
rrobl@microseeps.com

Customer Service Representative

Enclosures

As a valued client we would appreciate your comments on our service.
Please email info@microseeps.com.

Total Number of Pages 22

CERTIFICATE OF ANALYSIS

This report shall not be reproduced, except in full,
without the written consent of Microseeps/Pace Analytical Energy Services, LLC.

Microseeps/Pace Analytical Energy Services, LLC
220 William Pitt Way
Pittsburgh, PA 15238
Phone: (412) 826-5245
Fax: (412) 826-3433

LABORATORY ACCREDITATIONS & CERTIFICATIONS

Accreditor:	Pennsylvania Department of Environmental Protection, Bureau of Laboratories
Accreditation ID:	02-00538
Scope:	NELAP Non-Potable Water and Solid & Hazardous Waste
Accreditor:	NELAP: State of Florida, Department of Health, Bureau of Laboratories
Accreditation ID:	E87832
Scope:	Clean Water Act (CWA) Resource Conservation and Recovery Act (RCRA)
Accreditor:	South Carolina Department of Health and Environmental Control, Office of Environmental Laboratory Certification
Accreditation ID:	89009003
Scope:	Clean Water Act (CWA); Resource Conservation and Recovery Act (RCRA)
Accreditor:	NELAP: State of Louisiana, Department of Environmental Quality
Accreditation ID:	04104
Scope:	Solid and Chemical Materials; Non-Potable Water
Accreditor:	NELAP: New Jersey, Department of Environmental Protection
Accreditation ID:	PA026
Scope:	Non-Potable Water; Solid and Chemical Materials
Accreditor:	NELAP: New York, Department of Health Wadsworth Center
Accreditation ID:	11815
Scope:	Non-Potable Water; Solid and Hazardous Waste
Accreditor:	State of Connecticut, Department of Public Health, Division of Environmental Health
Accreditation ID:	PH-0263
Scope:	Clean Water Act (CWA) Resource Conservation and Recovery Act (RCRA)
Accreditor:	NELAP: Texas, Commission on Environmental Quality
Accreditation ID:	T104704453-09-TX
Scope:	Non-Potable Water
Accreditor:	State of New Hampshire
Accreditation ID:	299409
Scope:	Non-potable water
Accreditor:	State of Georgia
Accreditation ID:	Chapter 391-3-26
Scope:	As per the Georgia EPD Rules and Regulations for Commercial Laboratories, Microseeps is accredited by the Pennsylvania Department of Environmental Protection Bureau of Laboratories under the National Environmental Laboratory Approval Program (NELAC).

CERTIFICATE OF ANALYSIS

This report shall not be reproduced, except in full,
without the written consent of Microseeps/Pace Analytical Energy Services, LLC.

Microseeps/Pace Analytical Energy Services, LLC
220 William Pitt Way
Pittsburgh, PA 15238
Phone: (412) 826-5245
Fax: (412) 826-3433

SAMPLE SUMMARY

Workorder: 12383 TOWN OF KERNERSVILLE /92204346

Lab ID	Sample ID	Matrix	Date Collected	Date Received
123830001	3404-MW2	Bubble Strip	6/5/2014 09:45	6/9/2014 08:00
123830002	3404-MW2	Water	6/5/2014 09:45	6/9/2014 08:00
123830003	3404-MW3S	Bubble Strip	6/5/2014 12:45	6/9/2014 08:00
123830004	3404-MW3S	Water	6/5/2014 12:45	6/9/2014 08:00
123830005	3404-MW3D	Bubble Strip	6/5/2014 11:05	6/9/2014 08:00
123830006	3404-MW3D	Water	6/5/2014 11:05	6/9/2014 08:00
123830007	3404-MW4	Bubble Strip	6/5/2014 14:10	6/9/2014 08:00
123830008	3404-MW4	Water	6/5/2014 14:10	6/9/2014 08:00
123830009	3404-MW6	Water	6/5/2014 15:25	6/9/2014 08:00

CERTIFICATE OF ANALYSIS

This report shall not be reproduced, except in full,
without the written consent of Microseeps/Pace Analytical Energy Services, LLC.

Microseeps/Pace Analytical Energy Services, LLC
220 William Pitt Way
Pittsburgh, PA 15238
Phone: (412) 826-5245
Fax: (412) 826-3433

PROJECT SUMMARY

Workorder: 12383 TOWN OF KERNERSVILLE /92204346

Workorder Comments

This report is being re-issued following corrections made to the identification of sample 123830009; changed from 3404-MW5 to 3404-MW6; 06/26/2014.

CERTIFICATE OF ANALYSIS

This report shall not be reproduced, except in full,
without the written consent of Microseeps/Pace Analytical Energy Services, LLC.

Microseeps/Pace Analytical Energy Services, LLC
220 William Pitt Way
Pittsburgh, PA 15238
Phone: (412) 826-5245
Fax: (412) 826-3433

ANALYTICAL RESULTS

Workorder: 12383 TOWN OF KERNERSVILLE /92204346

Lab ID: **123830001** Date Received: 6/9/2014 08:00 Matrix: Bubble Strip

Sample ID: **3404-MW2** Date Collected: 6/5/2014 09:45

Parameters	Results	Units	PQL	MDL	DF	Prepared	By	Analyzed	By	Qual
RISK - MICR										
Analysis Desc: AM20GAX			Analytical Method: AM20GAX							
Hydrogen	**1.5**	nM	0.60	0.13	1			6/13/2014 12:35	SL	

CERTIFICATE OF ANALYSIS

This report shall not be reproduced, except in full,
without the written consent of Microseeps/Pace Analytical Energy Services, LLC.

Microseeps/Pace Analytical Energy Services, LLC
220 William Pitt Way
Pittsburgh, PA 15238
Phone: (412) 826-5245
Fax: (412) 826-3433

ANALYTICAL RESULTS

Workorder: 12383 TOWN OF KERNERSVILLE /92204346

Lab ID: **123830002** Date Received: 6/9/2014 08:00 Matrix: Water

Sample ID: **3404-MW2** Date Collected: 6/5/2014 09:45

Parameters	Results	Units	PQL	MDL	DF	Prepared	By	Analyzed	By	Qual
EDonors - MICR										
Analysis Desc: AM21G			Analytical Method: AM21G							
Acetic Acid	**0.81U**	mg/l	5.0	0.81	1			6/12/2014 15:51	BW	
Propionic Acid	**0.66U**	mg/l	5.0	0.66	1			6/12/2014 15:51	BW	
Pyruvic Acid	**0.77U**	mg/l	10	0.77	1			6/12/2014 15:51	BW	
Butyric Acid	**0.70U**	mg/l	5.0	0.70	1			6/12/2014 15:51	BW	
Lactic Acid	**2.5U**	mg/l	25	2.5	1			6/12/2014 15:51	BW	

CERTIFICATE OF ANALYSIS

This report shall not be reproduced, except in full,
without the written consent of Microseeps/Pace Analytical Energy Services, LLC.

Microseeps/Pace Analytical Energy Services, LLC
220 William Pitt Way
Pittsburgh, PA 15238
Phone: (412) 826-5245
Fax: (412) 826-3433

ANALYTICAL RESULTS

Workorder: 12383 TOWN OF KERNERSVILLE /92204346

Lab ID: **123830003** Date Received: 6/9/2014 08:00 Matrix: Bubble Strip
Sample ID: **3404-MW3S** Date Collected: 6/5/2014 12:45

Parameters	Results	Units	PQL	MDL	DF	Prepared	By	Analyzed	By	Qual
RISK - MICR										
Analysis Desc: AM20GAX			Analytical Method: AM20GAX							
Hydrogen	**1.2**	nM	0.60	0.13	1			6/13/2014 12:53	SL	

CERTIFICATE OF ANALYSIS
This report shall not be reproduced, except in full,
without the written consent of Microseeps/Pace Analytical Energy Services, LLC.

Microseeps/Pace Analytical Energy Services, LLC
220 William Pitt Way
Pittsburgh, PA 15238
Phone: (412) 826-5245
Fax: (412) 826-3433

ANALYTICAL RESULTS

Workorder: 12383 TOWN OF KERNERSVILLE /92204346

Lab ID: **123830004** Date Received: 6/9/2014 08:00 Matrix: Water

Sample ID: **3404-MW3S** Date Collected: 6/5/2014 12:45

Parameters	Results	Units	PQL	MDL	DF	Prepared	By	Analyzed	By	Qual
EDonors - MICR										
Analysis Desc: AM21G			Analytical Method: AM21G							
Acetic Acid	**0.81U**	mg/l	5.0	0.81	1			6/12/2014 17:40	BW	
Propionic Acid	**0.66U**	mg/l	5.0	0.66	1			6/12/2014 17:40	BW	
Pyruvic Acid	**0.77U**	mg/l	10	0.77	1			6/12/2014 17:40	BW	
Butyric Acid	**0.70U**	mg/l	5.0	0.70	1			6/12/2014 17:40	BW	
Lactic Acid	**2.5U**	mg/l	25	2.5	1			6/12/2014 17:40	BW	

CERTIFICATE OF ANALYSIS

This report shall not be reproduced, except in full,
without the written consent of Microseeps/Pace Analytical Energy Services, LLC.

Microseeps/Pace Analytical Energy Services, LLC
220 William Pitt Way
Pittsburgh, PA 15238
Phone: (412) 826-5245
Fax: (412) 826-3433

ANALYTICAL RESULTS

Workorder: 12383 TOWN OF KERNERSVILLE /92204346

Lab ID: **123830005** Date Received: 6/9/2014 08:00 Matrix: Bubble Strip

Sample ID: **3404-MW3D** Date Collected: 6/5/2014 11:05

Parameters	Results	Units	PQL	MDL	DF	Prepared	By	Analyzed	By	Qual
RISK - MICR										
Analysis Desc: AM20GAX			Analytical Method: AM20GAX							
Hydrogen	**120**	nM	12	2.6	20			6/13/2014 14:01	SL	

CERTIFICATE OF ANALYSIS

This report shall not be reproduced, except in full,
without the written consent of Microseeps/Pace Analytical Energy Services, LLC.

Microseeps/Pace Analytical Energy Services, LLC
220 William Pitt Way
Pittsburgh, PA 15238
Phone: (412) 826-5245
Fax: (412) 826-3433

ANALYTICAL RESULTS

Workorder: 12383 TOWN OF KERNERSVILLE /92204346

Lab ID: **123830006** Date Received: 6/9/2014 08:00 Matrix: Water

Sample ID: **3404-MW3D** Date Collected: 6/5/2014 11:05

Parameters	Results	Units	PQL	MDL	DF	Prepared	By	Analyzed	By	Qual
EDonors - MICR										
Analysis Desc: AM21G			Analytical Method: AM21G							
Acetic Acid	**0.81U**	mg/l	5.0	0.81	1			6/12/2014 18:02	BW	
Propionic Acid	**0.66U**	mg/l	5.0	0.66	1			6/12/2014 18:02	BW	
Pyruvic Acid	**0.77U**	mg/l	10	0.77	1			6/12/2014 18:02	BW	
Butyric Acid	**0.70U**	mg/l	5.0	0.70	1			6/12/2014 18:02	BW	
Lactic Acid	**2.5U**	mg/l	25	2.5	1			6/12/2014 18:02	BW	

CERTIFICATE OF ANALYSIS

This report shall not be reproduced, except in full,
without the written consent of Microseeps/Pace Analytical Energy Services, LLC.

Microseeps/Pace Analytical Energy Services, LLC
220 William Pitt Way
Pittsburgh, PA 15238
Phone: (412) 826-5245
Fax: (412) 826-3433

ANALYTICAL RESULTS

Workorder: 12383 TOWN OF KERNERSVILLE /92204346

Lab ID: **123830007** Date Received: 6/9/2014 08:00 Matrix: Bubble Strip

Sample ID: **3404-MW4** Date Collected: 6/5/2014 14:10

Parameters	Results	Units	PQL	MDL	DF	Prepared	By	Analyzed	By	Qual
RISK - MICR										
Analysis Desc: AM20GAX			Analytical Method: AM20GAX							
Hydrogen	**3.5**	nM	0.60	0.13	1			6/13/2014 13:20	SL	

CERTIFICATE OF ANALYSIS

This report shall not be reproduced, except in full,
without the written consent of Microseeps/Pace Analytical Energy Services, LLC.

Microseeps/Pace Analytical Energy Services, LLC
220 William Pitt Way
Pittsburgh, PA 15238
Phone: (412) 826-5245
Fax: (412) 826-3433

ANALYTICAL RESULTS

Workorder: 12383 TOWN OF KERNERSVILLE /92204346

Lab ID: **123830008** Date Received: 6/9/2014 08:00 Matrix: Water

Sample ID: **3404-MW4** Date Collected: 6/5/2014 14:10

Parameters	Results	Units	PQL	MDL	DF	Prepared	By	Analyzed	By	Qual
EDonors - MICR										
Analysis Desc: AM21G			Analytical Method: AM21G							
Acetic Acid	**0.81U**	mg/l	5.0	0.81	1			6/12/2014 18:23	BW	
Propionic Acid	**0.66U**	mg/l	5.0	0.66	1			6/12/2014 18:23	BW	
Pyruvic Acid	**0.77U**	mg/l	10	0.77	1			6/12/2014 18:23	BW	
Butyric Acid	**0.70U**	mg/l	5.0	0.70	1			6/12/2014 18:23	BW	
Lactic Acid	**2.5U**	mg/l	25	2.5	1			6/12/2014 18:23	BW	

CERTIFICATE OF ANALYSIS

This report shall not be reproduced, except in full,
without the written consent of Microseeps/Pace Analytical Energy Services, LLC.

Microseeps/Pace Analytical Energy Services, LLC
220 William Pitt Way
Pittsburgh, PA 15238
Phone: (412) 826-5245
Fax: (412) 826-3433

ANALYTICAL RESULTS

Workorder: 12383 TOWN OF KERNERSVILLE /92204346

Lab ID: **123830009** Date Received: 6/9/2014 08:00 Matrix: Water

Sample ID: **3404-MW6** Date Collected: 6/5/2014 15:25

Parameters	Results	Units	PQL	MDL	DF	Prepared	By	Analyzed	By	Qual
EDonors - MICR										
Analysis Desc: AM21G			Analytical Method: AM21G							
Acetic Acid	**0.81U**	mg/l	5.0	0.81	1			6/12/2014 18:45	BW	
Propionic Acid	**0.66U**	mg/l	5.0	0.66	1			6/12/2014 18:45	BW	
Pyruvic Acid	**0.77U**	mg/l	10	0.77	1			6/12/2014 18:45	BW	
Butyric Acid	**0.70U**	mg/l	5.0	0.70	1			6/12/2014 18:45	BW	
Lactic Acid	**2.5U**	mg/l	25	2.5	1			6/12/2014 18:45	BW	

CERTIFICATE OF ANALYSIS
This report shall not be reproduced, except in full,
without the written consent of Microseeps/Pace Analytical Energy Services, LLC.

Microseeps/Pace Analytical Energy Services, LLC
220 William Pitt Way
Pittsburgh, PA 15238
Phone: (412) 826-5245
Fax: (412) 826-3433

ANALYTICAL RESULTS QUALIFIERS

Workorder: 12383 TOWN OF KERNERSVILLE /92204346

DEFINITIONS/QUALIFIERS

Disclaimer : The Pennsylvania Department of Environmental Protection (PADEP) has decided to no longer recognize analyses that do not produce data for primary compliance, for NELAP accreditation. The methods affected by this decision are AM20GAx, AM21G, SW846 7199 and AM4.02. The laboratory shall continue to administer the NELAP/TNI standard requirements in the performance of these methods.

MDL	Method Detection Limit. Can be used synonymously with LOD; Limit Of Detection.
PQL	Practical Quanitation Limit. Can be used synonymously with LOQ; Limit Of Quantitation.
ND	Not detected at or above reporting limit.
DF	Dilution Factor.
S	Surrogate.
RPD	Relative Percent Difference.
% Rec	Percent Recovery.
U	Indicates the compound was analyzed for, but not detected at or above the noted concentration.
J	Estimated concentration greater than the set method detection limit (MDL) and less than the set reporting limit (PQL).

CERTIFICATE OF ANALYSIS
This report shall not be reproduced, except in full,
without the written consent of Microseeps/Pace Analytical Energy Services, LLC.

Microseeps/Pace Analytical Energy Services, LLC
220 William Pitt Way
Pittsburgh, PA 15238
Phone: (412) 826-5245
Fax: (412) 826-3433

QUALITY CONTROL DATA

Workorder: 12383 TOWN OF KERNERSVILLE /92204346

QC Batch: EDON/2152 Analysis Method: AM21G

QC Batch Method: AM21G

Associated Lab Samples: 123830002, 123830004, 123830006, 123830008, 123830009

METHOD BLANK: 28336

Parameter	Units	Blank Result	Reporting Limit	Qualifiers
EDonors				
Acetic Acid	mg/l	0.81U	0.81	
Propionic Acid	mg/l	0.66U	0.66	
Pyruvic Acid	mg/l	0.77U	0.77	
Butyric Acid	mg/l	0.70U	0.70	
Lactic Acid	mg/l	2.5U	2.5	

LABORATORY CONTROL SAMPLE: 28337

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% Rec Limits	Qualifiers
EDonors						
Acetic Acid	mg/l	100	100	102	70-130	
Propionic Acid	mg/l	100	110	107	70-130	
Pyruvic Acid	mg/l	100	100	100	70-130	
Butyric Acid	mg/l	100	100	104	70-130	
Lactic Acid	mg/l	100	100	102	70-130	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 28338 28339 Original: 123830002

Parameter	Units	Original Result	Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limit	RPD	Max RPD	Qualifiers
EDonors											
Acetic Acid	mg/l	0	100	99	99	99	99	70-130	0	20	
Propionic Acid	mg/l	0	100	100	100	103	102	70-130	0.98	20	
Pyruvic Acid	mg/l	0	100	92	93	92	93	70-130	1.1	20	
Butyric Acid	mg/l	0	100	100	100	101	100	70-130	1	20	
Lactic Acid	mg/l	0	100	100	100	103	103	70-130	0	20	

CERTIFICATE OF ANALYSIS
This report shall not be reproduced, except in full,
without the written consent of Microseeps/Pace Analytical Energy Services, LLC.

Microseeps/Pace Analytical Energy Services, LLC
220 William Pitt Way
Pittsburgh, PA 15238
Phone: (412) 826-5245
Fax: (412) 826-3433

QUALITY CONTROL DATA

Workorder: 12383 TOWN OF KERNERSVILLE /92204346

QC Batch: DISG/3840 Analysis Method: AM20GAX

QC Batch Method: AM20GAX

Associated Lab Samples: 123830001, 123830003, 123830005, 123830007

METHOD BLANK: 28380

Parameter	Units	Blank Result	Reporting Limit	Qualifiers
RISK				
Hydrogen	nM	0.13U	0.13	

LABORATORY CONTROL SAMPLE & LCSD: 28381 28382

Parameter	Units	Spike Conc.	LCS Result	LCSD Result	LCS % Rec	LCSD % Rec	% Rec Limit	RPD	Max RPD	Qualifiers
RISK										
Hydrogen	nM	24	24	24	97	98	80-120	1	20	

CERTIFICATE OF ANALYSIS
This report shall not be reproduced, except in full,
without the written consent of Microseeps/Pace Analytical Energy Services, LLC.

Microseeps/Pace Analytical Energy Services, LLC
220 William Pitt Way
Pittsburgh, PA 15238
Phone: (412) 826-5245
Fax: (412) 826-3433

QUALITY CONTROL DATA CROSS REFERENCE TABLE

Workorder: 12383 TOWN OF KERNERSVILLE /92204346

Lab ID	Sample ID	Prep Method	Prep Batch	Analysis Method	Analysis Batch
123830002	3404-MW2			AM21G	EDON/2152
123830004	3404-MW3S			AM21G	EDON/2152
123830006	3404-MW3D			AM21G	EDON/2152
123830008	3404-MW4			AM21G	EDON/2152
123830009	3404-MW6			AM21G	EDON/2152
123830001	3404-MW2			AM20GAX	DISG/3840
123830003	3404-MW3S			AM20GAX	DISG/3840
123830005	3404-MW3D			AM20GAX	DISG/3840
123830007	3404-MW4			AM20GAX	DISG/3840

CERTIFICATE OF ANALYSIS
This report shall not be reproduced, except in full,
without the written consent of Microseeps/Pace Analytical Energy Services, LLC.

12383

Chain of Custody

Pace Analytical®
www.pacelabs.com

Workorder: 92204346 **Workorder Name:** TOWN OF KERNERSVILLE MNA **Results Requested** 6/20/2014

Report / Invoice To

Kevin Godwin
Pace Analytical Charlotte
9800 Kincey Ave. Suite 100
Huntersville, NC 28078
Phone (704)875-9092
Email: kevin.godwin@pacelabs.com

Subcontract To: Microseeps P.O. KRG14129

Requested Analysis

Item	Sample ID	Collect Date/Time	Lab ID	Matrix	Preserved Containers: Unpreserved	Diss Hydrogen	Vol Fatty Acids	LAB USE ONLY
1	3404-MW2 12	6/5/2014 09:45	92204346001	Water		✓	✓	
2	3404-MW3S 34	6/5/2014 12:45	92204346002	Water		✓	✓	
3	3404-MW3D 56	6/5/2014 11:05	92204346003	Water		✓	✓	
4	3404-MW4 78	6/5/2014 14:10	92204346004	Water		✓	✓	
5	3404-MW5 9	6/5/2014 15:25	92204346005	Water		✓	✓	

Transfers	Released By	Date/Time	Received By	Date/Time
1	[illegible]	6/6/14 17:00	FedEx	6/6/14 17:00
2			[illegible] PACE	6.9.14 08 00
3				

Comments

Cooler Temperature on Receipt 1 °C | Custody Seal Y or N | Received on Ice Y or N | Samples Intact Y or N

NON-CONFORMANCE FORM

Microseeps Project Number: 12383

Date: 6.9.14 Time of Receipt: 0800 Receiver: LY

Client: Pace - H

REASON FOR NON-CONFORMANCE:

Did not receive a Hydrogen vial for 3404-MWS.

ACTION TAKEN:

Client name: Kevin Godwin Date: 6/9/14 Time: email

Per attached email - hydrogen was not collected for sample 3404-MWS.

Customer Service Initials: RR Date: 6/10/14

Robbin Robl

From: Angela Baioni <Angela.Baioni@pacelabs.com>
Sent: Tuesday, June 10, 2014 11:53 AM
To: Robbin Robl
Cc: Kevin Godwin
Subject: 92204346

12383

Follow Up Flag: Follow up
Flag Status: Flagged

Hey Robbin,

I hope you're doing well today! I just left you a VM, but I am assisting Kevin Godwin with this project. He said you're missing a dissolved hydrogen vial for sample 92204346002. According to our records, 4 vials should have been received for samples 001-004, and 3 vials should have been received for sample 005. According to the client, no dissolved hydrogen vial should have been received for sample 005; however, I wonder if the vials were mislabeled before they were sent to you. Please let me know.

Thank you,
Angela

Angela M. Baioni
Pace Analytical - Project Manager
9800 Kincey Avenue Suite 100
Huntersville, NC 28078
Phone 704.875.9092 x 233
Fax 704.875.9091
www.pacelabs.com

The email and documents accompanying this transmission contain confidential information belonging to the sender who is legally privileged. The information is intended only for the use of the individual(s) or entity(ies) named herein. If you are not the intended recipient, you are hereby notified that any disclosure, copying distribution or the taking of any action in reliance on the contents of this information is strictly prohibited. If you have received this in error, please immediately notify us by telephone (1.888.990.PACE) to arrange for return of the original documents.

Mark Mikesell

From: Robbin Robl
Sent: Wednesday, June 25, 2014 2:52 PM
To: Mark Mikesell
Subject: FW: 92204346 and 92203957
Attachments: PACE-H 12383_20140618163441.pdf

Please see below – this is for our WO 12383.

From: Kevin Godwin [mailto:Kevin.Godwin@pacelabs.com]
Sent: Wednesday, June 25, 2014 2:49 PM
To: Robbin Robl
Subject: Fwd: 92204346 and 92203957

Hi Robbin,

Hope you are well. Could you update the sample ID for 3404-MW5? Its supposed to be 3404-MW6.

Thanks,

Kevin Godwin
Project Manager
Pace Analytical
9800 Kincey Ave, Suite 100
Huntersville, NC 28078
Phone: 704.875.9092 ext. 237
Fax: 704.875.9091
www.pacelabs.com

>>> "Robbin Robl" <rrobl@microseeps.com> 6/18/2014 4:51 PM >>>
Please see attached data and invoices.

Pace Analytical Energy Services (formerly Microseeps) will not be accepting samples on Friday, July 4 and Saturday, July 5. Please plan your sampling event accordingly.

Robbin Robl
Pace Analytical Energy Services, LLC
220 William Pitt Way
Pittsburgh, PA 15238
Direct: 412-826-4483
Fax: 412-826-3433
Main: 412-826-5245

Disclaimer: This message contains confidential information and is intended only for the individual(s) named. If you are not the named addressee, you should permanently delete this e-mail from your system and should not disseminate, distribute or copy this e-mail. E-mail transmission cannot be guaranteed to be secure or error-free as information delivered over the internet could be corrupted, lost, destroyed, delayed, or contain viruses.

Cooler Receipt Form

Client Name: Pace - H **Project:** Town of Kernersville 192204346 **Lab Work Order:** 12383

A. **Shipping/Container Information** (circle appropriate response)

Courier: (FedEx) UPS USPS Client Other:_____ **Air bill Present:** (Yes) No

Tracking Number: 7702 2341 8542

Custody Seal on Cooler/Box Present: (Yes) No **Seals Intact:** (Yes) No

Cooler/Box Packing Material: (Bubble Wrap) Absorbent Foam Other:_____

Type of Ice: (Wet) Blue None **Ice Intact:** (Yes) Melted

Cooler Temperature: 10°C **Radiation Screened:** Yes (No) **Chain of Custody Present:** (Yes) No

Comments:_____

B. **Laboratory Assignment/Log-in** (check appropriate response)

	YES	NO	N/A	Comment Reference non-Conformance
Chain of Custody properly filled out	✓			
Chain of Custody relinquished	✓			
Sampler Name & Signature on COC		✓		
Containers intact	✓			
Were samples in separate bags		✓		
Sample container labels match COC Sample name/date and time collected		✓		
Sufficient volume provided		✓		
Microseeps containers used		✓		
Are containers properly preserved for the requested testing? (as labeled)			✓	
If an unknown preservation state, were containers checked? Exception: VOA's coliform			✓	If yes, see pH form.
Was volume for dissolved testing field filtered, as noted on the COC? Was volume received in a preserved container?			✓	

Comments:_____

Cooler contents examined/received by: LY **Date:** 6.9.14

Project Manager Review: RR **Date:** 6/11/14

DATE: 6/5/14

JOYCE ENGINEERING

GROUND WATER SAMPLING LOG

Project Name: Town Of Kernersville **Project No./Task No.:** 838.1301.12.01

Well ID: MW-2 **Sampler(s):** A. Freeman/ D. Girdner

Well Location: Back side of landfill along Creek

Well Diameter: 2 inches

Initial Depth to Water (DTW): 3.74 feet

Depth to Bottom (DTB): 13.18 feet

Water Column Thickness (WCT): 9.44 feet [DTB-DTW]

Calculation for One Well Volume (WV):

For 2" Well: WCT X 0.163 = 1.5 gallons

For 4" Well: WCT X 0.653 = - gallons

For THREE Well Volumes: WV X 3 = 4.5 gallons

Actual Amount Purged/Bailed: 4.5 gallons

Purged with: **Disposable bailer**

Sampled with: **Disposable bailer**

Depth to Water before Sampling: - feet

Gallons	Time	Temp(°C)	DO	Cond. (µS)	pH	ORP	Turb.(ntu)	Initials
0	0936	16.4	1.83	254.8	5.69	1093	8.50	AF
1.5	0939	16.0	2.44	256.9	5.69	107.0	12.64	AF
3.0	0942	15.2	1.79	265.9	5.59	94.3	12.89	AF
4.5	0945	15.2	2.11	268.7	5.56	92.6	13.05	AF
Before Sampling	0945	15.2	2.11	268.7	5.56	92.6	13.05	AF

Comments (weather conditions, odor, color, silt, etc.): The weather was sunny with temperatures in the 80s on 6/5/14.

Signature: Amanda Freeman **Date:** 6/5/14

QA/QC Sign Off: [illegible] **Date:** 7/2/14

DATE: 6/5/14

JOYCE ENGINEERING

GROUND WATER SAMPLING LOG

Project Name: Town Of Kernersville **Project No./Task No.:** 838.1301.12.01

Well ID: MW-3S **Sampler(s):** A. Freeman/ D. Girdner

Well Location: Back side of landfill along Creek

Well Diameter: 2 inches

Initial Depth to Water (DTW): 13.90 feet

Depth to Bottom (DTB): 24.00 feet

Water Column Thickness (WCT): 10.10 feet [DTB-DTW]

Calculation for One Well Volume (WV):

For 2" Well: WCT X 0.163 = 1.6 gallons

For 4" Well: WCT X 0.653 = - gallons

For THREE Well Volumes: WV X 3 = 4.8 gallons

Actual Amount Purged/Bailed: 4.8 gallons

Purged with: **Disposable bailer**

Sampled with: **Disposable bailer**

Depth to Water before Sampling: - feet

Gallons	Time	Temp(°C)	DO	Cond. (µS)	pH	ORP	Turb.(ntu)	Initials
0	1136	16.1	1.66	323.1	6.31	37.1	4.86	AF
1.6	1140	15.0	2.21	312.1	6.21	49.4	>1000	DG
3.2	1143	15.1	2.09	313.1	6.11	57.8	584	DG
4.8	1145	15.1	1.84	314.2	6.25	54.6	371	DG
Before Sampling	1245	18.7	1.89	335.4	6.62	65.7	11.50	AF

Comments (weather conditions, odor, color, silt, etc.): The weather was cloudy with temperatures in the 80s on 6/5/14.

Fe2+: 0 mg/L, Dissolved CO2: 55 mg/L

Signature: Amanda Freeman **Date:** 6/5/14

QA/QC Sign Off: [illegible] **Date:** 7/2/14

DATE: 6/5/14

JOYCE ENGINEERING

GROUND WATER SAMPLING LOG

Project Name: Town Of Kernersville **Project No./Task No.:** 838.1301.12.01

Well ID: MW-3D **Sampler(s):** A. Freeman/ D. Girdner

Well Location: Back side of landfill along Creek

Well Diameter: 2 inches

Initial Depth to Water (DTW): 12.42 feet

Depth to Bottom (DTB): 56.96 feet

Water Column Thickness (WCT): 44.54 feet [DTB-DTW]

Calculation for One Well Volume (WV):

For 2" Well: WCT X 0.163 = 7.3 gallons

For 4" Well: WCT X 0.653 = - gallons

For THREE Well Volumes: WV X 3 = 21.9 gallons

Actual Amount Purged/Bailed: 21.9 gallons

Purged with: 12–Volt pump

Sampled with: 12–Volt pump

Depth to Water before Sampling: - feet

Gallons	Time	Temp(°C)	DO	Cond. (µS)	pH	ORP	Turb.(ntu)	Initials
0	1056	17.2	1.56	517	6.41	-44.5	8.07	AF
7.3	1059	15.6	1.25	317.5	6.38	-66.3	9.15	AF
14.6	1102	16.6	0.93	319.0	6.03	-3.1	8.48	AF
21.9	1105	16.5	1.31	315.4	6.05	15.4	8.01	AF
Before Sampling	1105	16.5	1.31	315.4	6.05	15.4	8.01	AF

Comments (weather conditions, odor, color, silt, etc.): The weather was partly cloudy with temperatures in the 80s on 6/5/14.

Fe2+: 0 mg/L, Dissolved CO2: 80 mg/L

Signature: [signature] **Date:** 6/5/14

QA/QC Sign Off: [signature] **Date:** 7/2/14

DATE: 6/5/14

JOYCE ENGINEERING

GROUND WATER SAMPLING LOG

Project Name: Town Of Kernersville **Project No./Task No.:** 838.1301.12.01

Well ID: MW-4 **Sampler(s):** A. Freeman/ D. Girdner

Well Location: Back side of landfill along Creek

Well Diameter: 2 inches

Initial Depth to Water (DTW): 6.90 feet

Depth to Bottom (DTB): 14.40 feet

Water Column Thickness (WCT): 7.50 feet [DTB-DTW]

Calculation for One Well Volume (WV):

For 2" Well: WCT X 0.163 = 1.2 gallons

For 4" Well: WCT X 0.653 = - gallons

For THREE Well Volumes: WV X 3 = 3.6 gallons

Actual Amount Purged/Bailed: 3.6 gallons

Purged with: Peristaltic pump

Sampled with: Peristaltic pump

Depth to Water before Sampling: - feet

Gallons	Time	Temp(°C)	DO	Cond. (µS)	pH	ORP	Turb.(ntu)	Initials
0	1345	20.0	3.96	373.7	6.70	80.6	3.28	AF
1.2	1352	16.6	2.74	349.0	6.31	81.7	4.02	AF
2.4	1402	16.8	1.97	348.2	6.16	43.5	4.29	AF
3.6	1410	17.4	1.84	347.5	6.41	38.3	4.35	AF
Before Sampling	1410	17.4	1.84	347.5	6.41	38.3	4.35	AF

Comments (weather conditions, odor, color, silt, etc.): The weather was partly cloudy with temperatures in the 80s on 6/5/14.

Fe2+: 0.9 mg/L, Dissolved CO2: 115 mg/L

Signature: Amanda Freeman **Date:** 6/5/14

QA/QC Sign Off: [illegible] **Date:** 7/2/14

DATE: 6/5/14

JOYCE ENGINEERING

GROUND WATER SAMPLING LOG

Project Name: Town Of Kernersville **Project No./Task No.:** 838.1301.12.01

Well ID: MW-6 **Sampler(s):** A. Freeman/ D. Girdner

Well Location: On Right side of road behind old scale house location.

Well Diameter: 2 inches

Initial Depth to Water (DTW): 19.03 feet

Depth to Bottom (DTB): 20.46 feet

Water Column Thickness (WCT): 1.43 feet [DTB-DTW]

Calculation for One Well Volume (WV):

For 2" Well: WCT X 0.163 = 0.2 gallons

For 4" Well: WCT X 0.653 = - gallons

For THREE Well Volumes: WV X 3 = 0.6 gallons

Actual Amount Purged/Bailed: 0.6 gallons

Purged with: **Disposable bailer**

Sampled with: **Peristaltic pump**

Depth to Water before Sampling: - feet

Gallons	Time	Temp(°C)	DO	Cond. (µS)	pH	ORP	Turb.(ntu)	Initials
0	0822	15.4	-	51.5	4.86	-	17.1	DG
0.2	0823	13.8	-	45.8	4.59	-	231	DG
0.4	0825	13.8	-	47.0	4.69	-	107	DG
0.6	0827	13.5	2.77	46.0	4.40	183.5	109	DG
Before Sampling	1525	18.1	3.04	43.9	6.46	99.1	103.8	DG

Comments (weather conditions, odor, color, silt, etc.): The weather was sunny with temperatures in the 80s, when the well was purged. The weather was raining with temperatures in the 80s when the well was sampled.

The field blank was taken at 1540 on 6/5/14.

Fe2+: 0 mg/L, Dissolved CO2: 60 mg/L

Signature: [signature] **Date:** 6/5/14

QA/QC Sign Off: [signature] **Date:** 7/2/14

APPENDIX D

BIOCHLOR Modeling
Input and Output

BIOCHLOR Natural Attenuation Decision Support System

Version 2.2
Excel 2000

Town of Kernersville
Landfill
Run Name

Data Input Instructions:

115 → 1. Enter value directly....or
↑ or
0.02 ↗ 2. Calculate by filling in gray cells. Press Enter, then (C)

(To restore formulas, hit "Restore Formulas" button)
Variable* → Data used directly in model.

Test if Biotransformation is Occurring → Natural Attenuation Screening Protocol

TYPE OF CHLORINATED SOLVENT: Ethenes ◉ Ethanes ○

1. ADVECTION

Seepage Velocity*	Vs	61.0	(ft/yr)
or		↑	
Hydraulic Conductivity	K	1.2E-06	(cm/sec)
Hydraulic Gradient	i	0.05	(ft/ft)
Effective Porosity	n	0.2	(-)

2. DISPERSION

Alpha x*	50	(ft)
(Alpha y) / (Alpha x)*	0.33	(-)
(Alpha z) / (Alpha x)*	1.E-99	(-)

Calc.

3. ADSORPTION

Retardation Factor* → R

or

Soil Bulk Density, rho	1.6	(kg/L)		
FractionOrganicCarbon, foc	1.8E-3	(-)		
Partition Coefficient	Koc			
PCE	426	(L/kg)	7.13	(-)
TCE	130	(L/kg)	2.87	(-)
DCE	125	(L/kg)	2.80	(-)
VC	30	(L/kg)		(-)
ETH	302	(L/kg)		(-)

Common R (used in model)* = 2.87

4. BIOTRANSFORMATION -1st Order Decay Coefficient*

Zone 1

	λ (1/yr)	half-life (yrs)	Yield
PCE → TCE	2.300		0.79
TCE → DCE	2.100		0.74
DCE → VC	1.200		0.64
VC → ETH	0.000		0.45

Zone 2

	λ (1/yr)	half-life (yrs)
PCE → TCE	2.300	
TCE → DCE	2.100	
DCE → VC	1.200	
VC → ETH	0.000	

λ HELP

5. GENERAL

Simulation Time*	10	(yr)
Modeled Area Width*	700	(ft)
Modeled Area Length*	200	(ft)
Zone 1 Length*	150	(ft)
Zone 2 Length*	50	(ft)

L, W

Zone 2= L - Zone 1

6. SOURCE DATA TYPE: Continuous, Single Planar

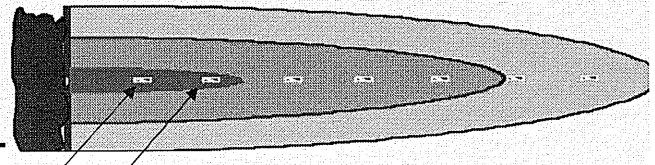
Source Options

Source Thickness in Sat. Zone* 30 (ft)

Width* (ft) Y1: 700

Conc. (mg/L)*	C1	K_s (1/yr)
PCE	0.0023	0
TCE	0.0089	0
DCE	0.0470	0
VC	0.0071	0
ETH	0.0000	0

Vertical Plane Source: Determine Source Well Location and Input Solvent Concentrations



View of Plume Looking Down

Observed Centerline Conc. at Monitoring Wells

7. FIELD DATA FOR COMPARISON

PCE Conc. (mg/L)	0.0023	0.0020	0.0017	0.0014	0.0010	0.0000					
TCE Conc. (mg/L)	0.0089	0.0085	0.0070	0.0050	0.0020	0.0000					
DCE Conc. (mg/L)	0.0470	0.0420	0.0350	0.0280	0.1800	0.0000					
VC Conc. (mg/L)	0.0071	0.0065	0.0060	0.0040	0.0020	0.0000					
ETH Conc. (mg/L)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000					
Distance from Source (ft)	20	40	60	80	100	120					
Date Data Collected	2014-06										

8. CHOOSE TYPE OF OUTPUT TO SEE:

RUN CENTERLINE | RUN ARRAY | Help | Restore | RESET | SEE OUTPUT | Paste

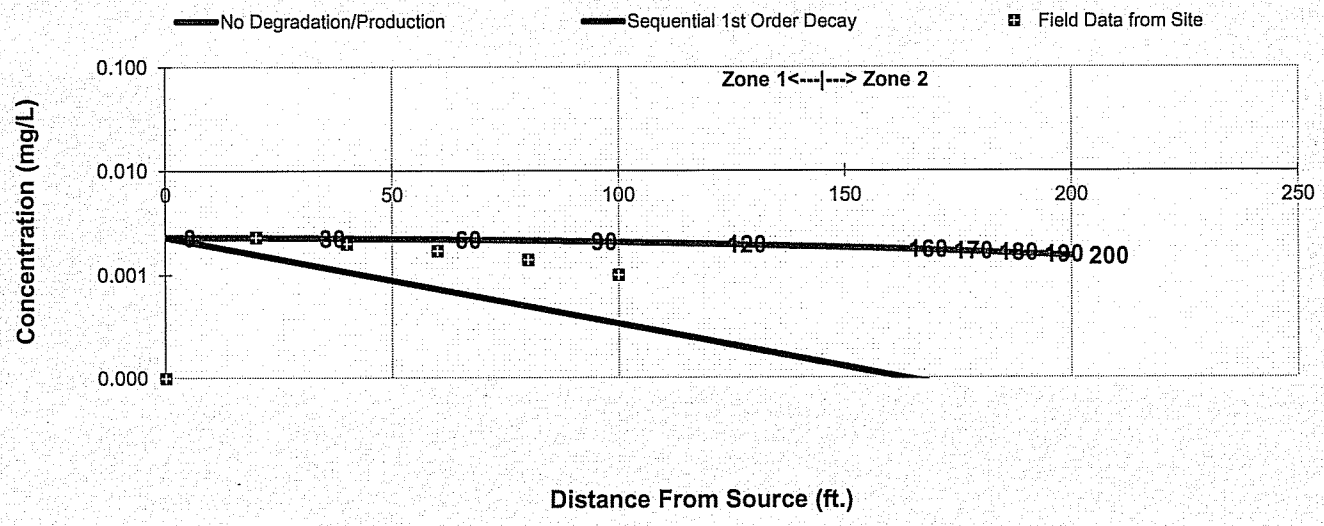
DISSOLVED CHLORINATED SOLVENT CONCENTRATIONS ALONG PLUME CENTERLINE (mg/L) at Z=0

Distance from Source (ft)

PCE	0	30	60	90	120	150	160	170	180	190	200
No Degradation	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
Biotransformation	0.0023	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Monitoring Well Locations (ft)

	20	40	60	80	100	120					
Field Data from Site	0.002	0.002	0.002	0.001	0.001	0.000					



See PCE

See TCE

See DCE

See VC

See ETH

Time:

10.0 Years

Log ⟺ Linear

Return to Input

To All

To Array

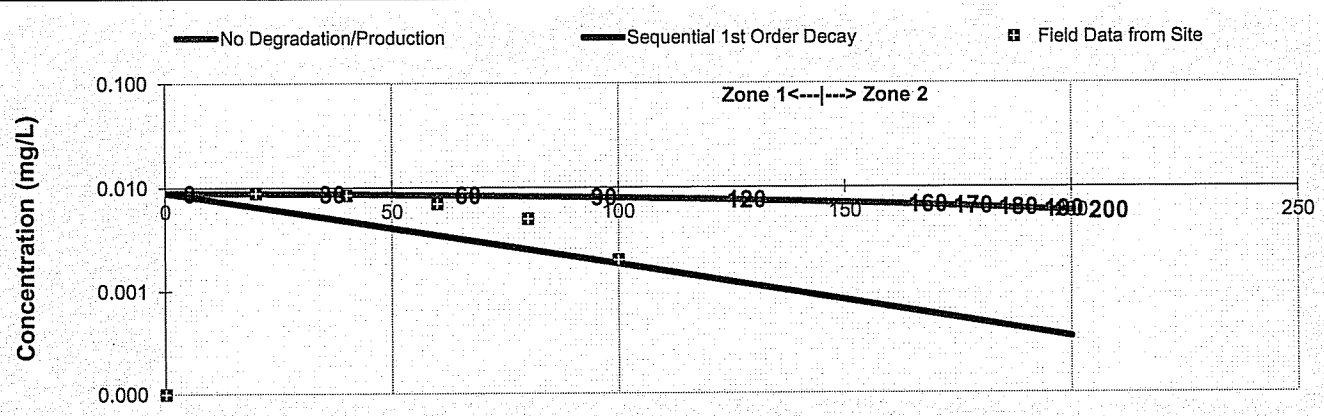
DISSOLVED CHLORINATED SOLVENT CONCENTRATIONS ALONG PLUME CENTERLINE (mg/L) at Z=0

Distance from Source (ft)

TCE	0	30	60	90	120	150	160	170	180	190	200
No Degradation	0.009	0.009	0.008	0.008	0.008	0.007	0.007	0.007	0.006	0.006	0.006
Biotransformation	0.0089	0.006	0.003	0.002	0.001	0.001	0.001	0.001	0.000	0.000	0.000

Monitoring Well Locations (ft)

	20	40	60	80	100	120					
Field Data from Site	0.009	0.009	0.007	0.005	0.002	0.000					



Distance From Source (ft.)

See PCE

See TCE

See DCE

See VC

See ETH

Time:

10.0 Years

Log ⟺ Linear

Return to Input

To All

To Array

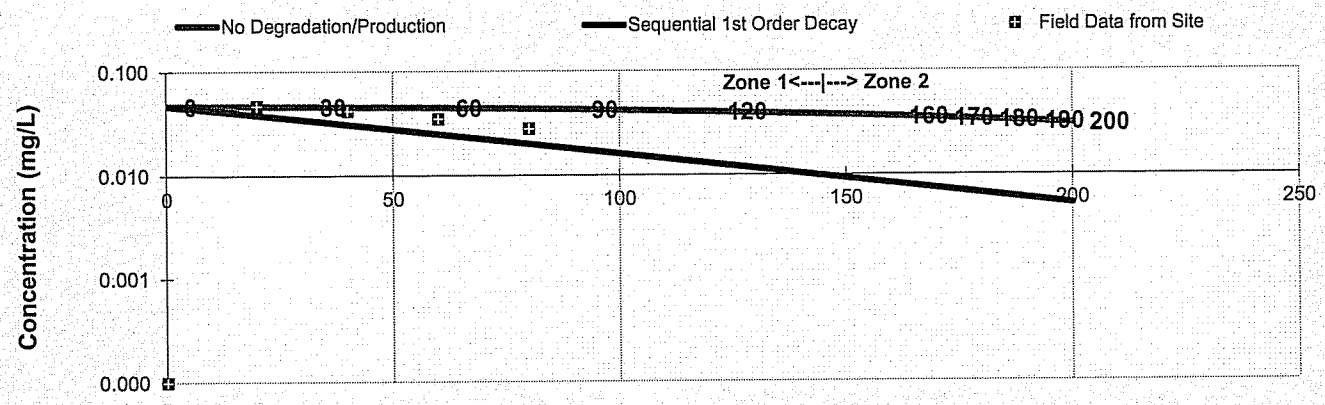
DISSOLVED CHLORINATED SOLVENT CONCENTRATIONS ALONG PLUME CENTERLINE (mg/L) at Z=0

Distance from Source (ft)

DCE	0	30	60	90	120	150	160	170	180	190	200
No Degradation	0.047	0.046	0.045	0.043	0.040	0.037	0.036	0.035	0.034	0.032	0.031
Biotransformation	0.0470	0.034	0.025	0.018	0.013	0.009	0.008	0.007	0.007	0.006	0.005

Monitoring Well Locations (ft)

	20	40	60	80	100	120					
Field Data from Site	0.047	0.042	0.035	0.028	0.180	0.000					



Distance From Source (ft.)

See PCE

See TCE

See DCE

See VC

See ETH

Time:

10.0 Years

Log ⟺ Linear

Return to Input

To All

To Array

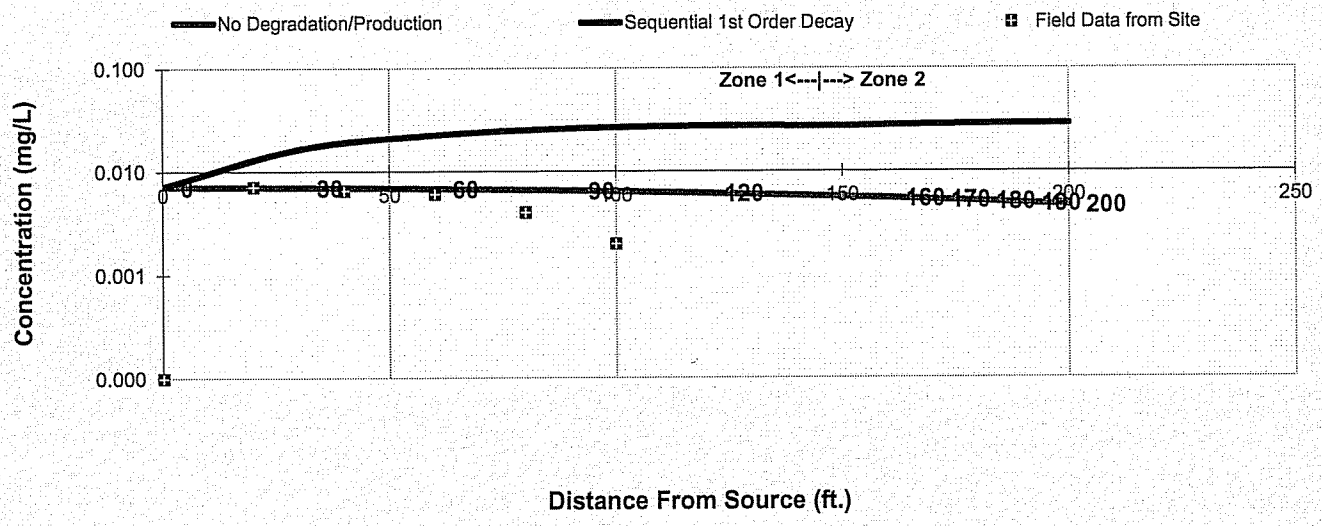
DISSOLVED CHLORINATED SOLVENT CONCENTRATIONS ALONG PLUME CENTERLINE (mg/L) at Z=0

Distance from Source (ft)

VC	0	30	60	90	120	150	160	170	180	190	200
No Degradation	0.007	0.007	0.007	0.006	0.006	0.006	0.005	0.005	0.005	0.005	0.005
Biotransformation	0.0071	0.016	0.023	0.026	0.028	0.027	0.028	0.028	0.029	0.029	0.029

Monitoring Well Locations (ft)

	20	40	60	80	100	120					
Field Data from Site	0.007	0.007	0.006	0.004	0.002	0.000					



See PCE

See TCE

See DCE

See VC

See ETH

Time:

10.0 Years

Log ⟺ Linear

Return to Input

To All

To Array

Start Here → ◉ PCE
○ TCE
○ DCE
○ VC
○ ETH

DISSOLVED SOLVENT CONCENTRATIONS IN PLUME

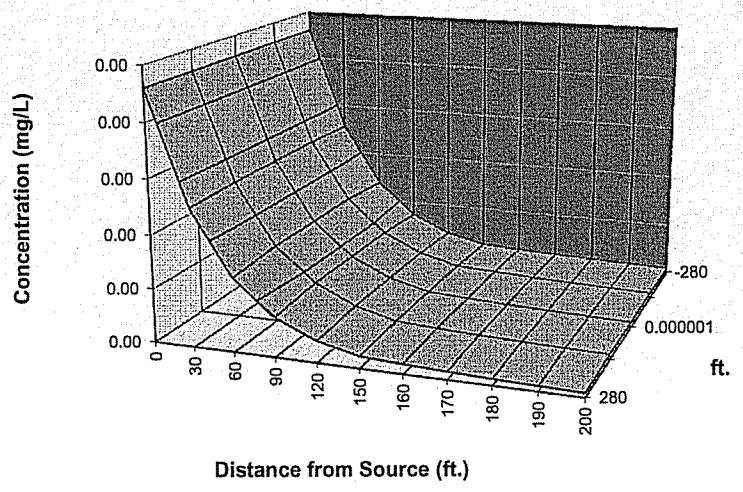
Transverse Distance (ft) ↓	Distance from Source (ft): 0	30	60	90	120	150	160	170	180	190	200
280	0.002	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
140	0.002	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0	0.002	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-140	0.002	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-280	0.002	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MASS RATE (mg/day)	4.6E+1	2.6E+1	1.4E+1	7.8E+0	4.3E+0	2.4E+0	2.0E+0	1.6E+0	1.3E+0	1.1E+0	9.0E-1

Show No

Show

Displayed Compound

Time: 10 yr Target Level: 0.005 mg/L Displayed Model: Biotransformation PCE



Plume Mass (Order-of-Magnitude Accuracy)

See Gallons

Plume Mass If No Degradation	0.1	(Kg)
- Plume Mass If Biotransformation/Production	0.0	(Kg)
Mass Removed	0.1	(Kg)

If "Can't Calc.", make model area longer

% Biotransformed = +70.9%

% Change in Mass Rate = 98.0 % (source to edge)

See acre-ft

Current Volume of Ground Water in Plume	0.00	MGal
Flow Rate of Water Through Source Area	0.005	MGD

Compare to Pump and Treat

Pumping Rate		(gpm)
# Pore Volumes Removed Per Yr.	#DIV/0!	
# Pore Volumes to Clean-Up		
Clean-Up Time		(yr)

Plot All Data Plot Data > Target Mass HELP To Centerline Return to Input

Start Here → ○ PCE ◉ TCE ○ DCE ○ VC ○ ETH

DISSOLVED SOLVENT CONCENTRATIONS IN PLUME

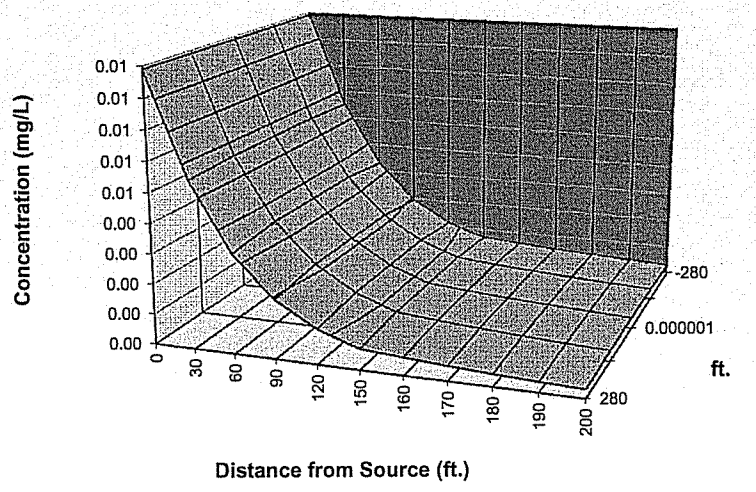
Transverse Distance (ft) ↓ / Distance from Source (ft)	0	30	60	90	120	150	160	170	180	190	200
280	0.009	0.006	0.003	0.002	0.001	0.001	0.001	0.000	0.000	0.000	0.000
140	0.009	0.006	0.003	0.002	0.001	0.001	0.001	0.001	0.000	0.000	0.000
0	0.009	0.006	0.003	0.002	0.001	0.001	0.001	0.001	0.000	0.000	0.000
-140	0.009	0.006	0.003	0.002	0.001	0.001	0.001	0.001	0.000	0.000	0.000
-280	0.009	0.006	0.003	0.002	0.001	0.001	0.001	0.000	0.000	0.000	0.000
MASS RATE (mg/day)	1.8E+2	1.1E+2	6.8E+1	4.1E+1	2.5E+1	1.5E+1	1.3E+1	1.1E+1	9.1E+0	7.7E+0	6.5E+0

Show No

Show

Displayed Compound

Time: 10 yr Target Level: 0.005 mg/L Displayed Model: Biotransformation TCE



Plume Mass (Order-of-Magnitude Accuracy)

See Gallons

Plume Mass If No Degradation	0.5	(Kg)
- Plume Mass If Biotransformation/Production	0.2	(Kg)
Mass Removed	0.4	(Kg)

If "Can't Calc.", make model area longer

% Biotransformed = +65.5%

% Change in Mass Rate = 96.3 % (source to edge)

See acre-ft

Current Volume of Ground Water in Plume	1.88	MGal
Flow Rate of Water Through Source Area	0.005	MGD

Compare to Pump and Treat

Pumping Rate		(gpm)
# Pore Volumes Removed Per Yr.	0.00	
# Pore Volumes to Clean-Up		
Clean-Up Time		(yr)

Plot All Data Plot Data > Target Mass HELP To Centerline Return to Input

Start Here → ○ PCE ○ TCE ◉ DCE ○ VC ○ ETH

DISSOLVED SOLVENT CONCENTRATIONS IN PLUME

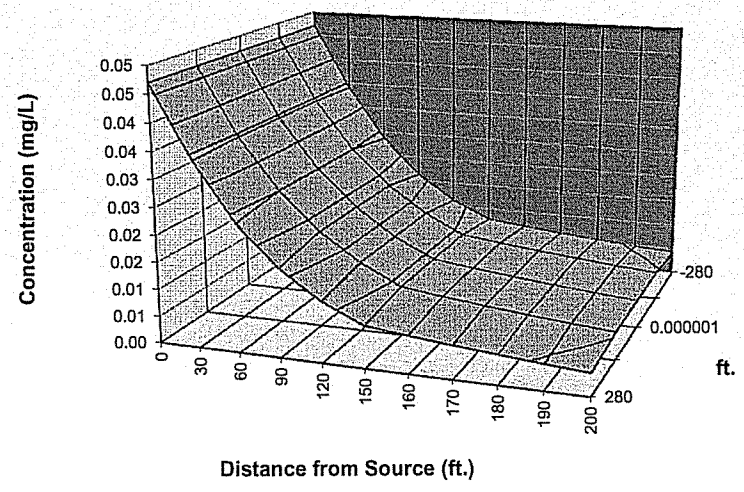
Transverse Distance (ft) ↓ / Distance from Source (ft)	0	30	60	90	120	150	160	170	180	190	200
280	0.047	0.034	0.024	0.016	0.011	0.008	0.007	0.006	0.005	0.005	0.004
140	0.047	0.034	0.025	0.018	0.013	0.009	0.008	0.007	0.007	0.006	0.005
0	0.047	0.034	0.025	0.018	0.013	0.009	0.008	0.007	0.007	0.006	0.005
-140	0.047	0.034	0.025	0.018	0.013	0.009	0.008	0.007	0.007	0.006	0.005
-280	0.047	0.034	0.024	0.016	0.011	0.008	0.007	0.006	0.005	0.005	0.004
MASS RATE (mg/day)	9.3E+2	6.8E+2	4.9E+2	3.4E+2	2.4E+2	1.7E+2	1.5E+2	1.4E+2	1.2E+2	1.1E+2	9.5E+1

Show No

Show

Displayed Compound

Time: 10 yr Target Level: 0.070 mg/L Displayed Model: Biotransformation DCE



Plume Mass (Order-of-Magnitude Accuracy)

See Gallons

Plume Mass If No Degradation	2.9	(Kg)
- Plume Mass If Biotransformation/Production	1.3	(Kg)
Mass Removed	1.5	(Kg)
% Biotransformed =	+53.3%	
% Change in Mass Rate =	89.8 %	(source to edge)

If "Can't Calc.", make model area longer

See acre-ft

Current Volume of Ground Water in Plume	Can't Calc.	MGal
Flow Rate of Water Through Source Area	0.005	MGD

Compare to Pump and Treat

Pumping Rate		(gpm)
# Pore Volumes Removed Per Yr.		
# Pore Volumes to Clean-Up		
Clean-Up Time		(yr)

Plot All Data Plot Data > Target Mass HELP To Centerline Return to Input

Start Here → ○ PCE ○ TCE ○ DCE ◉ VC ○ ETH

DISSOLVED SOLVENT CONCENTRATIONS IN PLUME

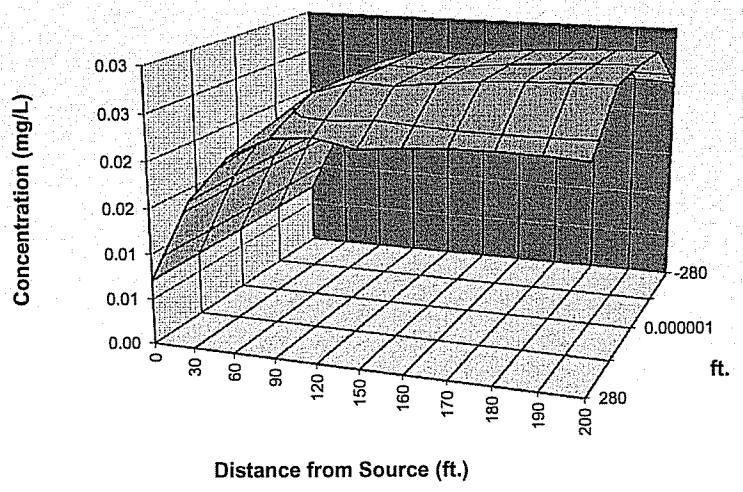
Transverse Distance (ft) ↓	Distance from Source (ft): 0	30	60	90	120	150	160	170	180	190	200
280	0.007	0.016	0.021	0.023	0.024	0.023	0.024	0.024	0.024	0.024	0.024
140	0.007	0.016	0.023	0.026	0.028	0.027	0.028	0.028	0.029	0.029	0.029
0	0.007	0.016	0.023	0.026	0.028	0.027	0.028	0.028	0.029	0.029	0.029
-140	0.007	0.016	0.023	0.026	0.028	0.027	0.028	0.028	0.029	0.029	0.029
-280	0.007	0.016	0.021	0.023	0.024	0.023	0.024	0.024	0.024	0.024	0.024
MASS RATE (mg/day)	1.4E+2	3.2E+2	4.4E+2	5.0E+2	5.2E+2	5.1E+2	5.2E+2	5.3E+2	5.3E+2	5.3E+2	5.3E+2

Show No

Show

Displayed Compound

Time: 10 yr Target Level: 0.002 mg/L Displayed Model: Biotransformation VC



Plume Mass (Order-of-Magnitude Accuracy)

See Gallons

Plume Mass If No Degradation	0.4	(Kg)
- Plume Mass If Biotransformation/Production	1.7	(Kg)
Mass Removed	-1.2	(Kg)

If "Can't Calc.", make model area longer

% Biotransformed = -285.7 %

% Change in Mass Rate = -277.6 % (source to edge)

See acre-ft

Current Volume of Ground Water in Plume	Can't Calc.	MGal
Flow Rate of Water Through Source Area	0.005	MGD

Compare to Pump and Treat

Pumping Rate		(gpm)
# Pore Volumes Removed Per Yr.		
# Pore Volumes to Clean-Up		
Clean-Up Time		(yr)

Plot All Data Plot Data > Target Mass HELP To Centerline Return to Input

APPENDIX E

Sample Field Logs and Chain of Custody

DATE: _____

GROUND WATER SAMPLING LOG

Project Name: Kernersville Landfill (34-04) **Project No./Task No.:** _____

Well ID: _____ **Sampler(s):** _____

Well Location: _____

Well Diameter: _____inches

Initial Depth to Water (DTW): _____feet

Depth to Bottom (DTB): _____feet

Water Column Thickness (WCT): _____feet [DTB-DTW]

Calculation for One Well Volume (WV):

For 2" Well: WCT X 0.163 = _____gallons

For 4" Well: WCT X 0.653 = _____gallons

For THREE Well Volumes: WV X 3 = _____gallons

Actual Amount Purged/Bailed: _____gallons

Purged with: _____

Sampled with: _____

Depth to Water before Sampling: _____feet

Gallons	Time	Temp. °C	pH	Cond. mS	Turb. ntu	DO mg/L	ORP mV	Initials
Before Sampling								

Dis. CO_2 _____ Fe^{+2} _____

Comments (weather conditions, odor, color, silt, etc.): _____

_____

_____

Signature: _____ **Date:** _____

QA/QC Sign Off: _____ **Date:** _____

DATE:_____

SURFACE WATER MONITORING LOG

Project Name: Kernersville Landfill (34-04) **Project/Task No.:**_____

Surface Point ID:_____ **Sampler(s):**_____

Location:_____

Field Parameters:

Time of Sampling: _____

pH: _____

Temperature: _____**(°C)**

Conductivity: _____**(µS)**

Turbidity: _____**(ntu)**

Comments/Sample Description (weather conditions, odor, color, silt, etc.):_____

_____

_____

Signature:_____ **Date:**_____

QA/QC Sign Off:_____ **Date:**_____

JOYCE ENGINEERING

GREENSBORO, NC
2211 West Meadowview Rd. Suite 101
Greensboro, NC 27407
Phone: (336) 323-0092
Fax: (336) 323-0093

CHARLESTON, SC
3251 Landmark Drive #240
North Charleston, SC 29418
Phone: (843) 207-1373
Fax: (843) 207-9029

RICHMOND, VA
1604 Ownby Lane
Richmond, VA 23220
Phone: (804) 355-4520
Fax: (804) 355-4282

CHAIN OF CUSTODY RECORD

PROJECT NAME:

PROJECT NUMBER:

PROJECT MANAGER:

SAMPLERS:

PAGE _____ OF _____

☐ STANDARD REPORT DELIVERY

☐ EXPEDITED REPORT DELIVERY

DATE DUE: _____

SAMPLE					MATRIX TYPE							REQUIRED ANALYSIS													REMARKS
SAMPLE ID	DATE	TIME	GRAB	COMP	SURFACE WATER	GROUND WATER	DRINKING WATER	SOIL/SOLID/SEDIMENT	AIR	LEACHATE	OTHER														
1																									
2																									
3																									
4																									
5																									
6																									
7																									
8																									
9																									
10																									
11																									
12																									
13																									

RELINQUISHED BY (SIGNATURE):	DATE:	TIME:	CUSTODY INTACT	DATA REPORT LEVEL	ADDITIONAL COMMENTS:
RECEIVED BY (SIGNATURE):	DATE:	TIME:	☐ YES ☐ NO	☐ LEVEL I ☐ LEVEL III ☐ LEVEL II ☐ LEVEL IV	

RELINQUISHED BY (SIGNATURE):	DATE:	TIME:	RELINQUISHED BY (SIGNATURE):	DATE:	TIME:	LABORATORY:
RECEIVED BY (SIGNATURE):	DATE:	TIME:	RECEIVED BY (SIGNATURE):	DATE:	TIME:	

APPENDIX F

Tree Inspection Form

Phytoremediation Tree and Flora Inspection Log

SITE: Town of Kernersville Landfill, Kernersville, NC **DATE:** _____

Personnel: _____

Weather Conditions: _____

Description of Area: _____

Has the ground surface been disturbed by rutting, erosion, tire tracks, settlement, etc.?

Are there any indications of vandalism or trespassing:

Is there any ponded water in the area?

Has there been any change in the number of live/dead trees in the area since the last inspection?

Do any trees exhibit signs of disease, damage, or distress (discolored leaves, damaged bark, broken limbs, etc.)?

Are there any signs of unusual animal/insect damage to the trees?

Has there been any change in the type, amount, or health of undergrowth or ground cover flora?

Has there been any change in the observed wetlands (size, maturity, health) in the area?

Please describe the prevalent tree species and give approximate percentages in the area:

SPECIES or COMMON NAME	%	AVERAGE MATURITY	AVERAGE HEALTH

COMMENTS:

Signature of Inspector: _____

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

NC DENR
Division of Waste Management - Solid Waste

Environmental Monitoring Reporting Form

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

Instructions:

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

Solid Waste Monitoring Data Submittal Information

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

Joyce Engineering

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

Name: Van Burbach. Ph.D., P.G. Phone: (336)-323-0092

E-mail: vburbach@joyceengineering.com

Facility name:	Facility Address:	Facility Permit #	NC Landfill Rule: (.0500 or .1600)	Actual sampling dates (e.g., October 20-24, 2006)
Town of Kernersville Landfill	Freeman Road Kernersville, NC 27284	34-04	.0500	June 5, 2014

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 Parameters
☐ 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.

G. Van Ness Burbach, Ph.D., P.G. Technical Consultant (336)-323-0092

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

Signature 10/9/14 Date

Affix NC Licensed Professional Geologist Seal

NORTH CAROLINA LICENSED SEAL 1349 GEOLOGIST G. VAN NESS BURBACH

2211 W. Meadowview Rd. Ste. 101, Greensboro, NC 27407

Facility Representative Address

C-0782

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

Revised 6/2009