

*Caemen Johnson*  
Fac/Perm/Co ID # 95-02  
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**Groundwater and Surface Water  
Assessment Monitoring Results Report  
January 14-15, 1998 Event**

**Watauga County Landfill  
Watauga County, North Carolina  
NCDENR Permit No. 95-02**

Prepared for:

Watauga County Board of Commissioners

and

North Carolina Department of Environment and Natural Resources  
Division of Solid Waste Management  
Solid Waste Section

Prepared by:

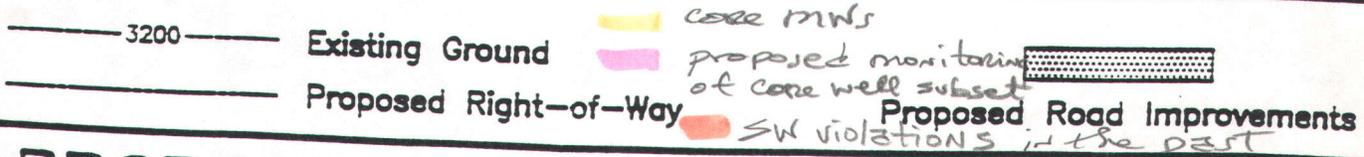
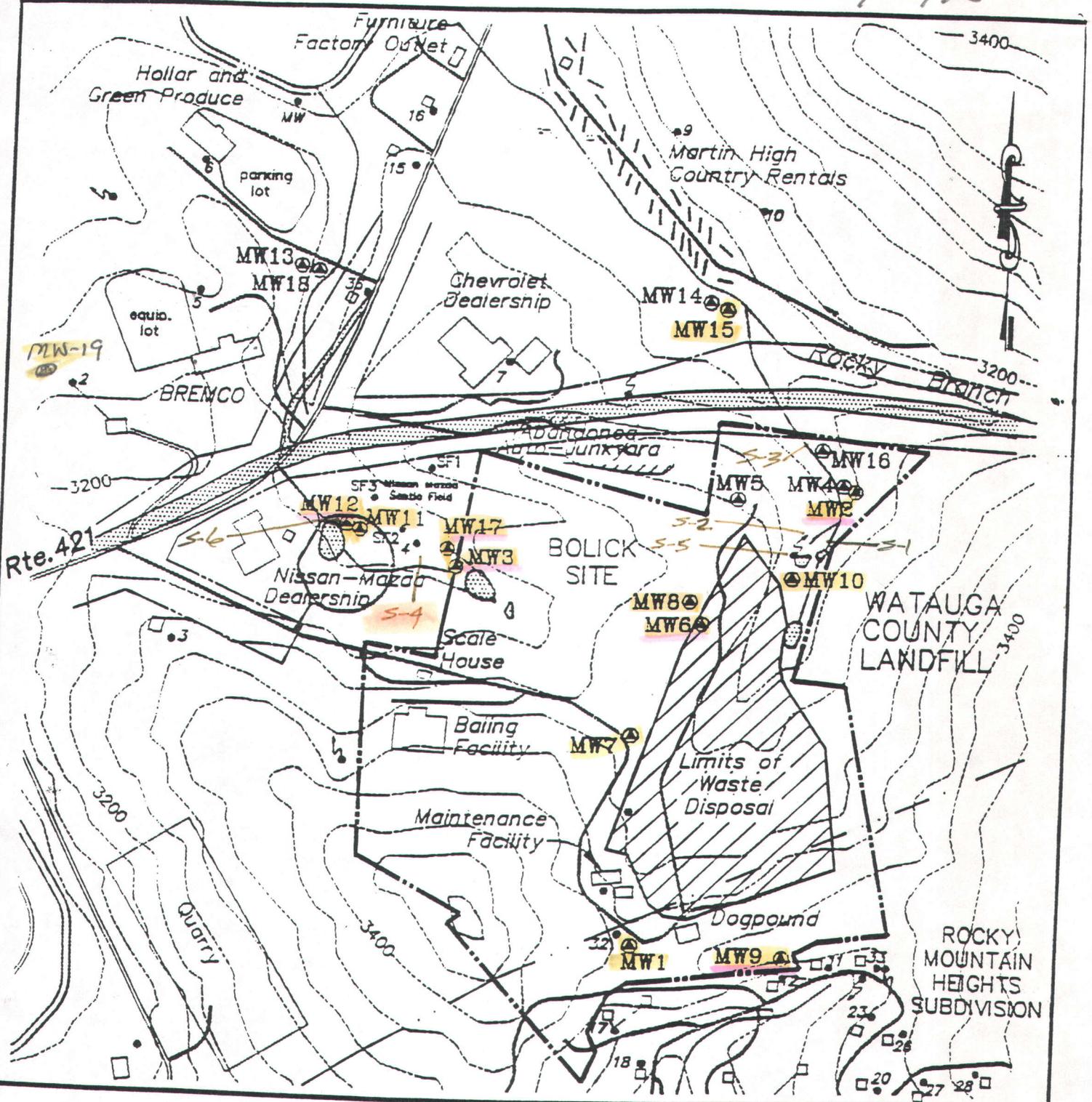
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DAA Job No. 6520-21

May 6, 1998



6/22/98



# PROPOSED ROUTE 421 BYPASS MAP

 <p><b>Draper Aden Associates</b> CONSULTING ENGINEERS Blacksburg, Va. - Richmond, Va. - Nashville, Tenn.</p>	<p>JOB No. 6520-14</p>	<p>DATE: 10 JUN 94</p>	<p>SCALE: 1"=600'±</p>	<p>FIGURE 2</p>
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## Draper Aden Associates

CONSULTING ENGINEERS

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May 6, 1998



Mr. Mark Poindexter  
Hydrogeologist  
Groundwater Compliance Unit  
Solid Waste Section  
Division of Waste Management  
North Carolina Department of Environment and Natural Resources  
401 Oberlin Road, Suite 150  
Raleigh, N.C. 27605

RE: Watauga County Landfill, Assessment Monitoring Program,  
DAA Job No. 6520-21

Dear Mr. Poindexter:

Please find enclosed the Fourth Semiannual Assessment Monitoring Event Report for the Watauga County Landfill for your review and comments. The enclosed report presents the validated results of the fourth semi-annual Assessment Monitoring event, conducted on January 13-15, 1998 by Draper Aden Associates. Preliminary summary analytical data tables for this event were sent to you on January 29, 1998.

The report discusses sampling procedures, analytical results, and overall conclusions of the monitoring event. Appendix E, in the CD-ROM format, contains copies of all associated laboratory data and data validation reports.

Note that the report recommends for NCDENR approval of the initiation of monitoring a smaller set of the core monitoring well network for semiannual monitoring and a larger set for annual monitoring, annual rather than semiannual analysis for target metals, and withdrawal of select non-impacted assessment monitoring wells from routine groundwater monitoring during 1998-1999.

Mr. Mark Poindexter  
May 6, 1998  
Page 2

Upon NCDENR approval, the next assessment monitoring event will be performed in June 1998 as defined above. If you should have any questions or comments concerning the enclosed report, please do not hesitate to contact me.

Sincerely,  
DRAPER ADEN ASSOCIATES



Jeffrey E. Smith  
Project Geologist

JES  
enclosure

cc: Mr. James S. Ratchford, Watauga County Manager  
Mr. Bob Frye, Assistant Watauga County Manager, with enclosure  
Mr. Bill Ross, Brooks, Pierce, McLendon, Humphrey and Leonard, L.L.P., w/ enclosure  
Mr. Richard M. DiSalvo, Jr., P.E., Vice-President, DAA  
Mr. Scott Kroll, P.E., Environmental Program Manager, DAA  
Mr. Michael D. Lawless, P.G., Groundwater Project Manager, DAA

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#### CLP VOLATILES

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#### SECTION 2.0

#### CLP METALS

Section 2.1	-	Data Validation Forms
Section 2.2	-	Revisions to Original Data Set (no revisions)
Section 2.3	-	CLP Metals Original Analytical Data Package

## EXECUTIVE SUMMARY

This report presents the results of the fourth semiannual sampling event for Assessment Groundwater and Surface Water Monitoring at the Watauga County Landfill, NCDENR Permit No. 95-02, Watauga County, North Carolina, conducted on January 14-15, 1998 by Draper Aden Associates. Assessment monitoring was conducted in accordance with the Watauga County Landfill Assessment Plan (DAA, September 3, 1993), approved by the NCDENR on September 30, 1993, and monitoring program revisions detailed in the Remedial Investigation and Alternatives Report (DAA, January 12, 1996), conditionally approved by the NCDENR on March 27, 1996.

The analytical results obtained from the monitoring event are similar to the results obtained from the previous seven assessment events. Parameter concentration and distribution trends indicate steady state conditions, where sourcing of contaminants is balanced by removal, are predominant across the site. The analytical results indicate the northern edge of the occurrence of assessment target parameters in the groundwater primarily exists within the construction right-of-way for the pending Route 421 bypass. South of the proposed bypass, the detection of assessment target parameters was concentrated between the saddle, located between the landfill and the Rocky Mountain Heights Subdivision, and the west and north drainages below the landfill.

The report also presents the results of the fourth semiannual potable well sampling event performed in February, 1998. The potable well sampling program is jointly conducted by the Appalachian District Health Department and the North Carolina State Laboratory of Public Health. In summary, review of the analytical results from the potable well sampling, performed by the NC Department of Epidemiology, indicate that the sampled well waters are acceptable for all uses due to either nondetection or very low level detection of the organic analytes.

Subsequent to the previous Assessment monitoring event performed on April 8-9, 1997, the County requested the following for changes:

- 1) the initiation of annual rather than semiannual monitoring,
- 2) withdrawal of the metal target assessment parameters, and
- 3) continued withdrawal of select non-impacted assessment monitoring wells from routine groundwater monitoring.

The NCDENR Solid Waste Section responded to the proposals with the following comments:

*"While the Watauga County landfill is a unique site with a unique assessment history, approval of the changes cannot be granted as proposed. However, concerning the County's first proposal, the Section will consider a proposal that includes a smaller set of core monitoring wells to be monitored semi-annually and annual sampling of a larger set of monitoring wells. Concerning the County's second proposal, based on the historical data base of water sample results from the site, the Section will consider monitoring for metals on an annual basis. The third proposal is granted for the monitoring year 1997-1998."*

## EXECUTIVE SUMMARY (cont.)

In consideration of the Section's comments, Draper Aden Associates recommends the following, on behalf of Watauga County, for NCDENR approval:

- 1) the initiation of monitoring a smaller set of the core monitoring well network for semiannual monitoring and a larger set for annual monitoring,
- 2) annual rather than semiannual analysis for target metals, and
- 3) withdrawal of select non-impacted assessment monitoring wells from routine groundwater monitoring during 1998-1999, rather than monitoring year 1997-1998.

The subset of the existing twelve core well network proposed for semiannual monitoring includes the following six wells: MW-2, MW-3, MW-6, MW-9, MW-12 and MW-17. The groundwater at these six monitoring points exceeds the EPA MCL for one or more organic target parameters. Note that except for the estimated concentration of one target organic compound detected below the method quantitation limit in one well, the boundary well results obtained from the January 13-15, 1998 monitoring event continue to show non-impact. *B per J. Smith*

A remedial cap was installed at the facility in the fall of 1996. The remedial cap focuses on source containment as an immediate remedial action, as established by the EPA's presumptive remedy directive (EPA 540-F-93-035, September 1993). Additional risk assessment activities address exposure pathways outside the source area. These activities include the provision of potable water via the extension of public water along the existing Route 421 alignment. Response actions for exposure pathways outside the source area are being combined with the presumptive remedy to develop a comprehensive site response. Source containment, implemented through a remedial cap, supplemented by risk assessment, institutional controls, natural attenuation, and continuing assessment investigation comprise the broad package of remedial actions currently being conducted at the site.

## 1.0. INTRODUCTION

This report presents the results of the fourth semiannual sampling event for Assessment Groundwater and Surface Water Monitoring at the Watauga County Landfill, NCDENR Permit No. 95-02, Watauga County, North Carolina, conducted on January 14-15, 1998 by Draper Aden Associates. This report discusses sampling procedures, analytical results, and overall conclusions of the January 14-15, 1998 event. Tables and figures are provided in Appendix A. A summary of target parameter analytical results is presented in Tables 2A-C. Non-target parameter analytical results are provided in Table 3. Groundwater elevation measurements are provided in Table 4. Background Assessment analytical results are provided in Tables 5A-E and Tables 6A-B. Copies of all associated laboratory data are contained in Appendix E (on CD-ROM). Appendix E also contains Data Validation Forms summarizing the guidelines and results of the data validation procedures utilized for evaluating the data discussed in this report.

Assessment monitoring was conducted in accordance with the Watauga County Landfill Assessment Plan (DAA, September 3, 1993), approved by the NCDENR on September 30, 1993, and monitoring program revisions detailed in the Remedial Investigation and Alternatives Report (DAA, January 12, 1996), conditionally approved by the NCDENR on March 27, 1996. Appendix I of the Assessment Plan, The Groundwater and Surface Water Monitoring Program, details the schedule and procedures to be implemented for collecting groundwater and surface water samples, analyzing the samples for specified parameters, and evaluating and reporting data.

### 1.1. Groundwater Monitoring Well Network

Nineteen groundwater monitoring wells (MW-1 through MW-19) comprise the assessment groundwater monitoring well network at the Watauga County Landfill. As described below, two wells (MW-8 and MW-16) have been abandoned. Monitoring well locations are shown on the Groundwater and Surface Water Monitoring Program site map (Figure 1).

*6 per J. Smith*  
In order to maximize the effectiveness and efficiency of the groundwater monitoring program, the assessment well network is stratified into two groups of "core" and "boundary" wells. Core assessment wells are selected based on the well's ability to monitor and characterize migration of potential slugs of contaminants. Boundary assessment wells are selected based on the well's ability to monitor and characterize the limits of the horizontal and vertical extent of the contaminants. The decision criteria utilized for the classification of boundary wells in the assessment monitoring well network is the exceedance of the analytical method limit of detection as determined by the laboratory for parameters identified as target parameters in the core assessment monitoring wells. The presence of target parameters above the analytical method limit of detection are evaluated with respect to repeated sampling events prior to confirmation.

Seven monitoring wells (MW-1 through MW-7) were installed at the landfill prior to initiation of the Assessment monitoring program. Eleven additional monitoring wells (MW-8 through MW-18) were installed in January and February of 1994. For the first quarter background event, four of the previous seven wells, MW-2, MW-3, MW-4, and MW-6, were denoted as core wells based available data. The upgradient well MW-1 was also evaluated similarly for purposes of

comparison. All other wells were initially denoted as boundary wells for the first assessment background sampling event.

Based on the analytical data obtained from the first quarter background event, the well network was restratified for the following background monitoring events. Revisions to the network of core and boundary wells resulted in the upgrading of six of the eleven additional wells to "core" status (MW-8, MW-9, MW-10, MW-11, MW-12, and MW-17).

Upon review of the analytical data obtained from all four background events, two additional wells, MW-4 and MW-7, were also restratified for the following semiannual monitoring events. MW-7 was upgraded to "core" status and MW-4 was downgraded to "boundary" status. Due to the repeated detection of low levels of 1,1,1-TCA, MW-15 was also upgraded to core status for the second semiannual assessment monitoring event.

The NCDENR conditional approval of monitoring program revisions detailed in the Remedial Investigation and Alternatives Report (DAA, January 12, 1996), requested that the boundary wells be rotated in and out of routine monitoring on a regular basis. After the first semiannual assessment monitoring event (the fifth assessment event), the non-impacted boundary wells (i.e.: MW-4, MW-5, MW-13, MW-14, MW-16, and MW-18) were withdrawn from the routine compliance monitoring program. The six non-impacted boundary wells remained operational to allow for future monitoring based on temporal contaminant distribution trends observed after each semiannual event.

Subsequent to the previous April 8-9, 1997 Assessment monitoring event (third semiannual), Draper Aden Associates, on behalf of Watauga County, recommended the continued withdrawal of the boundary wells from routine groundwater monitoring. The NCDENR granted the continued withdrawal of the boundary wells for the monitoring year 1997-1998. Note that the boundary wells were included in the January 13-15, 1998 monitoring event and continue to show non-impact. As presented at the conclusion of the report, Draper Aden Associates recommends herein, the withdrawal the boundary wells from routine groundwater monitoring during 1998-1999. If temporal contaminant distribution trends observed after future semiannual events indicate significant changes in contaminant concentrations have occurred, sampling of non-impacted boundary wells will be reevaluated.

As approved by NCDENR, MW-6 and MW-16 were abandoned subsequent to the second semiannual assessment monitoring event. The abandonment of MW-6 was necessary to permit construction of the landfill cap (Figure 1) and the abandonment of MW-16 was necessary to permit construction of the 421 bypass (Figure 2). As requested by NCDENR, MW-19 was drilled and installed on March 11 and 12, 1997 in the west drainage adjacent to the Blue Ridge Electric Company's (BREMCO) potable well (well reference no. 5, see Figure 1).

The current stratification of the assessment monitoring well network is as follows:

<u>CORE WELLS</u>	<u>BOUNDARY WELLS</u>
MW-1	MW-4
MW-2 ✓	MW-5
MW-3 ✓	MW-13
MW-6 (abandoned) ✓	MW-14
MW-7	MW-16 (abandoned)
MW-8	MW-18
MW-9	
MW-10	
MW-11	
MW-12 ✓	
MW-15	
MW-17 ✓	
MW-19	

### 1.2 Surface Water Sampling

The goal of the surface water monitoring system at Watauga County Landfill is to provide representative surface water samples for assessing the potential impact of landfill runoff and leachate on the streams located downgradient of the waste disposal area. Six surface water monitoring points, combined with the sampling of any observed leachate production, serve to meet this objective.

- (S-1) The last of the series of sediment ponds is sampled to provide a representative sample for assessing the quality of the surface water originating from the landfill before the water discharges into the stream.
- (S-2) The spring capture outfall located adjacent to the last of the series of sediment ponds is sampled to provide a representative sample for assessing the quality of the water originating from the spring capture system located beneath the fill area.
- (S-3) The stream is sampled at the landfill property boundary (approximately 600 feet below the last sediment pond) to provide a representative sample for assessing the water quality of the stream below the waste disposal area. No sampling location is available upstream of the waste disposal area since the stream originates immediately below and adjacent to the disposal area.
- (S-4) The stream located below the Bolick site is sampled approximately 30 feet below the landfill property boundary to provide a representative sample for assessing the water quality of the surface water below the Bolick site. This sampling location is chosen instead of the

off site

sediment pond located on the Bolick site to provide a sample that is more representative of the potential influence of groundwater from the soil aquifer.

- (S-5) A seep, located below the waste disposal area and directly above the sediment pond, was observed flowing during the first quarter background event. This seep is sampled in addition to the four originally proposed surface water sampling locations when observed flowing during routine surface water sampling events.
- (S-6) An additional surface water monitoring point, located below the existing surface water monitoring point S-4, was proposed subsequent to the first semiannual sampling event. This monitoring point will provide information to assess the persistence of surface water impacts observed at S-4 further downgradient along this west drainage.

In addition to these six surface water sampling locations, any leachate production observed during surface water sampling events is also sampled. A grid field screening inspection of the landfill was conducted concurrent with the fourth semiannual event to verify the presence or absence of leachate production. No leachate production was observed. Observations resulting from the inspection is documented in the field notes (Appendix B).

### **1.3 Sampling and Analysis Schedule**

#### **1.3.1 Groundwater**

During the first year of Assessment groundwater monitoring, four quarterly background sampling events were conducted on each groundwater monitoring well. Semiannual sampling is currently conducted. The fourth semiannual Assessment monitoring event was conducted on January 14-15, 1998. The groundwater Assessment monitoring schedule is outlined in Table 1.

#### Monitoring Parameters

The analytical scans performed on each monitoring well during the first year of assessment background monitoring were designed to analyze for all the target parameters detected and tentatively confirmed as a result of the initial comprehensive sampling event performed on the previously existing well network MW-1 through MW-7 on March 5, 1993. The initial March 5, 1993 sampling event was comprised of the complete EPA Appendix II List of Hazardous Inorganic and Organic Parameters (40 CFR, Part 258) required for Assessment Monitoring under the NCDENR requirements for Municipal Solid Waste Landfills (15A NAACO 13B Section .1600). A summary results table of the initial March 5, 1993 sampling event are contained in Appendix C of this report and detailed in Sections II and III of the Assessment Plan (DAA, September 3, 1993).

The complete EPA Appendix II analysis was repeated on the revised network of core wells

during the first semiannual event, performed on July 10-13, 1995. Additional parameters detected, and verified through Quality Assurance / Quality Control (QA/QC) validation procedures as being present, that were not identified in prior Assessment monitoring events, were added to the assessment target parameter list. Target parameters not detected during all five previous assessment monitoring program events, and verified through QA/QC validation procedures as not being present, were deleted from the assessment target parameter list. As required, amendments to the existing target parameter list were evaluated and approved by the NCDENR, prior to implementation. For amended target parameters, it was proposed that four independent samples be collected and analyzed for those additional parameters during the following four semiannual sampling events at all core wells to establish background.

Revisions to the target inorganic parameter list involved adding four metal parameters (chromium, cobalt, nickel, and vanadium) and deleting two other metal parameters (cadmium and mercury). The presence of cadmium and mercury in the groundwater at the site was not supported by the analytical results of all four assessment background or the first semiannual monitoring events. Chromium, cobalt, nickel, and vanadium were observed in three or more wells, although also at levels far below EPA MCL and NC groundwater standards (NCSs), as a result of the comprehensive EPA Appendix II analytical scan performed during the first semiannual event.

As a result of four successive assessment sampling events, all the assessment target metal parameters (including chromium, cobalt, nickel, and vanadium) were observed at levels far below EPA MCL and NCSs. In the previous third semiannual monitoring event report, Draper Aden Associates recommended the withdrawal of the metal target assessment parameters from routine groundwater monitoring. The NCDENR responded that the agency would consider completing target metal analysis annually rather than semiannually. As presented at the conclusion of the report, Draper Aden Associates recommends herein, on behalf of Watauga County, the initiation of annual rather than semiannual analysis for target metals.

Revisions to the target organic parameter list involved deleting trans-1,3-dichloropropene. The analytical results of the four background monitoring events and the first semiannual assessment sampling event confirmed the absence of trans-1,3-dichloropropene in the groundwater and surface waters at the site. Thus, per the decision criteria outlined in the Assessment Plan, trans-1,3-dichloropropene was removed from the target parameter list. No additions to the organic target parameter list were warranted, nor are any additions to the list proposed at this time.

### Analytical Methods

During the first year of background Assessment Monitoring, analyses of the core wells utilized EPA CLP-SOW for all four quarterly events. Organic analyses of the boundary wells alternated between CLP and Low Level Risk Assessment (LLRA) analytical methods for each quarterly event. Metal analyses of all monitoring wells utilized CLP methods on all events.

Since completing the first year of quarterly background sampling, the core wells have been monitored on a semiannual basis. The first semiannual assessment monitoring event analyzed for all the assessment monitoring parameters included in the EPA Appendix II List of Hazardous Inorganic and Organic Parameters (40 CFR Part 258), utilizing LLRA analytical methods for organic parameters and CLP analytical methods for metal parameters. As approved by the NCDENR, monitoring of additional EPA Appendix II parameters that have not been confirmed in any of monitoring wells to date is no longer required.

The assessment monitoring schedule alternates between CLP and LLRA analytical methods for groundwater organic analyses each annual event. The second and fourth (detailed herein) semiannual assessment monitoring events analyzed for all target assessment monitoring parameters (both organic and metal) using CLP-SOW. The third semiannual assessment monitoring event analyzed for all target assessment monitoring parameters in the core wells utilizing LLRA analytical methods for organic parameters and CLP analytical methods for metal parameters.

Groundwater monitoring continues to be conducted on all core wells on a annual basis for the organic target parameters detected as a result of the complete EPA Appendix II analysis. Reevaluation of the site network and monitoring scheme will be conducted after review of the results of each sampling event. The groundwater monitoring program will continue to follow a two-tiered analytical approach utilizing both EPA CLP-SOW analytical methods and LLRA screening by EPA-SW846 analytical methods. The CLP SOW are utilized to generate high-level quality data with documented QA/QC protocols. The LLRA methods (EPA-SW-846) are utilized for risk assessment screening to preliminary identify low levels of parameters that may be present. The groundwater analysis schedule provides an outline of analytical methodology designated for each event (Table 1).

### **1.3.2 Surface Water**

Surface water and leachate monitoring has been conducted on a semiannual basis since the initiation of the Assessment Plan monitoring program. The analytical scans that are performed on the surface water and leachate samples utilize CLP SOW and are designed to analyze for all the target parameters detected as a result of the comprehensive Appendix II analysis. The surface water assessment monitoring schedule is outlined in Table 1.

## **2.0 GROUNDWATER AND SURFACE WATER SAMPLING FIELD PROCEDURES**

Groundwater and surface water samples were collected according to the Watauga County Landfill Groundwater and Surface Water Monitoring Plan (DAA, September 3, 1993). Field notes, contained in Appendix B, document sample collection procedures.

## **2.1 Well Purging and Sample Collection**

Dedicated stainless steel and TEFLON electrical submersible pumps were permanently installed in the monitoring well network subsequent to the first Assessment event. Draper Aden Associates' environmental technicians used the dedicated pumps to purge and collect groundwater samples from the well network during the January 14-15, 1998 sampling event. Note that monitoring well MW-5 is purged and sampled utilizing a disposable bailer, since this well does not recharge sufficiently to permit use of a dedicated pump. All non-dedicated equipment was decontaminated between sampling of each monitoring well.

A minimum of three well casing volumes of groundwater were removed from each monitoring well prior to sample collection. Well casing volumes were calculated from measurements of depth to water, and total well depth taken prior to purging. Stabilization of field analyses for pH and specific conductivity were used to verify that stagnant water within the well as removed during purging, and that groundwater representative of the near-aquifer was being sampled. Field notes recorded during each sampling event, contained in Appendix B, summarize and document well purging calculations and results.

The potentiometric surface, inferred from static water level elevations obtained during the recent January sampling event (Table 4), is presented on the enclosed Groundwater and Surface Water Monitoring Program Site Map (Figure 1).

## **2.2 Field Meter Calibration**

Measurements of pH and specific conductivity were analyzed at each well by completing multiple measurements in the field, at the time of groundwater purging. Although pH and specific conductivity are not assessment monitoring parameters, the measurements were used to ensure groundwater quality and stabilization.

A Corning Checkmate 90 pH/Conductivity/Temperature meter was used for the field measurement of pH, and conductivity. The meter was calibrated in the field using laboratory-grade buffers for pH, and KCl solution for specific conductivity. Field notes in Appendix B document field meter calibration methods for each sampling event.

## **2.3 Quality Control Blank Samples**

Trip blanks were utilized as part of the assessment monitoring program. Trip blanks were prepared by the analyzing laboratory to accompany the sample kits at all times. The trip blanks employed sample containers and volumes identical in physical and chemical integrity to the samples used for actual sample collection. The trip blank was analyzed for all parameters included

in the sampling event. The trip blank served as a control on sample kit preparation, analysis in the laboratory, and sample kit transportation.

Field blanks were not collected, due to the use of dedicated purging/sampling equipment.

## **2.4 Sample Containers and Shipment**

Groundwater samples were collected in U.S. EPA approved containers prepared and supplied by the analyzing laboratory. Where applicable, the analyzing laboratory prepared organic sample containers with hydrochloric acid (HCl) prior to sample collection. Total metal samples were preserved in the field using nitric acid supplied by the analyzing laboratory. All samples were placed on ice in a cooler at approximately 4°C immediately after collection. A chain of custody seal was placed on each sample and each cooler to verify samples were not disturbed during transport. The coolers were shipped to the analyzing laboratory by overnight courier service.

## **2.5 Chain of Custody Documentation**

Chain of Custody (COC) documentation and analysis requests are contained with the laboratory report. Laboratory analytical data sheets are found in Appendix E.

COC forms provided by the analyzing laboratory or developed by Draper Aden Associates were used to document the custody of the samples from the time they were collected in the field to the time the custody of the samples was relinquished by Draper Aden personnel. Relinquishing custody of the samples was accomplished by shipping through an overnight carrier service. The information recorded in the COC included sampling location, sampling points, number of samples, type of sampling containers, sample preservation procedures, matrix spike samples, if any, blanks accompanying the samples, date and time of sample collection, and the date and time custody was relinquished. These COC forms were sent with the samples to the analyzing laboratory. Analysis request forms which included lists of parameters required to be analyzed for the different analytical methods to be used were also attached along with the COC forms.

## **3.0. LABORATORY ANALYSIS**

### **3.1 List of Laboratories**

Volatile organic analyses and total metal analyses by EPA CLP-SOW were performed by CompuChem Environmental Corporation, a division of Liberty Analytical Corporation of Research Triangle Park, NC (CompuChem).

### **3.2 Analytical Methods**

All CLP analytical techniques used were in accordance with the procedures listed in the CLP-SOW Organics OLMO3.2, Inorganics ILMO3.0.

### **3.3 Data Quality Objectives**

#### **Quality Assurance Objectives for Measurements**

Data quality objectives (DQO) are established to ensure that the data collected throughout is sufficient and of adequate quality for the intended use. Overall DQO included the following:

- Precision - A measurement of the reproducibility of measurements compared to their average value. Precision is measured by the use of splits, replicate samples, or co-located samples and field audit samples.
- Accuracy - This measures the bias in a measurement system by comparing a measured value to a true or standard value. Accuracy is measured by the use of standards, spiked samples, and field audit samples.
- Representativeness - This is the degree to which a sample represents the characteristic of the population being measured. Representativeness is controlled by defining sample collection protocols and adhering to them throughout the evaluation.
- Completeness - This is the ratio of validated data points to the total samples collected. Completeness is achieved through duplicate sampling and resampling, when necessary.
- Comparability - This is the confidence that one data set can be compared to another. Comparability is achieved through the use of standard methods to control the precision and accuracy of the data sets to be compared by use of field audit samples.

The CLP-SOWs are utilized to generate a high level quality data with documented QA/QC protocols. Estimated CLP-SOW results are similarly provided for preliminary assessment purposes only. Estimated data is not intended for use in determining regulatory compliance issues.

#### **Internal Quality Control**

- i. **Field Quality Control** - Field QC procedures are summarized in Section 2.0.

ii. **Analytical Quality Control** - Analytical QC procedures for CLP analytical techniques are guided by adherence to CLP deliverables. All QC data and records generated by the laboratory were examined by Draper Aden Associates for adherence to method requirements. A laboratory QC report generally consists of the following components:

- spikes
- surrogate parameters
- chromatograms
- blanks
- instrument adjustment
- additional QC requirements (organic and inorganic)
- duplicates
- raw data
- calibration
- quantification

For this project, QC reports are provided with the target parameter analytical results for all sampling events.

#### 4.0. DATA VALIDATION

The CLP analyses for organic as well as inorganic parameters were performed in adherence to the relevant CLP-SOW. Results of the CLP-SOW analyses were summarized and reported by the analyzing laboratory in standard CLP reporting format. Draper Aden Associates conducted data validation of each data set. The results from each sampling event were evaluated in association with corresponding QA/QC information provided by the analyzing laboratory.

##### 4.1 Laboratory Reporting Qualifiers

Two different types of qualifiers were associated with laboratory analyses and data validation: they were **laboratory reporting qualifiers** and **data validation qualifiers**.

The laboratory used **laboratory reporting qualifiers** to flag sample results with reference to relevant QA/QC criteria. Laboratory reporting qualifiers were unique to the analyzing laboratory and are defined in the laboratory data package presented in Appendix E. The defined **organic** laboratory reporting qualifiers are not equivalent to the defined **inorganic** laboratory reporting qualifiers and review of the definitions is recommended. In addition to the laboratory reporting qualifiers defined in Appendix E, project specifications required the laboratory performing the analytical services to utilize the following additional data qualifiers and definitions:

##### Qualifiers

- D - Denotes the sample was diluted to obtain the result.
- S - Method of Standard Additions was utilized to obtain the result.
- E - Laboratory recoveries fell outside EPA control limits. Results are approximate concentrations.
- TI - The laboratory tentatively identified the parameter.

## Definitions

- CRDL.** Contract Required Detection Limit (associated with CLP-inorganics only).
- IDL.** Instrument Detection Limit (Associated with CLP-inorganics only). Inorganic Data qualified with a "U" refers to IDL.
- CRQL.** Contract Required Quantitation Limit (associated with CLP organics only). Organic Data qualified with a "U", refer to CRQL.

### 4.2 Data Validation Qualifiers

Data validation was completed using guidance from the "USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review", (Document 1) USEPA, February, 1993; and "USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review - February 1994" (Document 2).

Data Validation was performed on the results presented in the laboratory analysis report, and the validated results were flagged, where required, using the appropriate national **data validation qualifiers** defined from the aforementioned CLP guidance documents. The data validation qualifiers were divided into two categories; **organic** data validation qualifiers and **inorganic** data validation qualifiers. The **data validation qualifiers** (as defined in Documents 1 and 2 above) are different from the **laboratory reporting qualifiers**. Definitions of the nationally recognized data validation qualifiers used by Draper Aden Associates in the validation process and for the reported results are presented below.

#### Organic Data Validation Qualifiers

- U - The parameter was analyzed for, but was not detected (the numerical value associated with the data validation qualifier is the reported sample LOQ for organics and the reported sample IDL for onorganics).
- J - The parameter was positively identified; the associated numerical value is the approximate concentration of the parameter in the sample.
- N - The analysis indicates the presence of an parameter for which there is presumptive evidence to make a "tentative identification".
- NJ - The analysis indicates the presence of an parameter that has been "tentatively identified" and the associated numerical value represents its approximate concentration.

- UJ - The parameter was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the parameter in the sample.
- R - The sample results are rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the parameter cannot be verified.

#### Inorganic Data Validation Qualifiers

- U - The parameter was analyzed for, but was not detected above the IDL.
- J - The result is estimated.
- R - The sample result is rejected due to serious deficiencies in the ability to analyze the sample or meet quality control criteria. The presence or absence of the parameter in the sample cannot be verified.

### **4.3 Inorganic Data Review**

Draper Aden Associates performed a limited review of the analytical results for six inorganic target parameters *viz.* barium, iron, chromium, cobalt, nickel and vanadium analyzed per USEPA CLP Method 200.7, for this semiannual Assessment monitoring event. Sampling for this Assessment monitoring event was performed on January 14-15, 1997. The samples were split into two sample delivery groups (SDG). The surface water samples, S-1, S-2, S-3, S-4, S-5, and S-6, are included in SDG-001. The groundwater samples, MW-1, MW-2, MW-3, MW-4, MW-5, MW-7, MW-8, MW-9, MW-10, MW-11, MW-12, MW-13, MW-14, MW-15, MW-17, MW-18, MW-19 and Trip Blank1 are included in SDG-002. Inductively Coupled Plasma Atomic Emission Spectroscopy (ICP) technique was used to analyze for barium, chromium, cobalt, iron, nickel, and vanadium.

CompuChem performed all the inorganic analyses. CompuChem submitted results to Draper Aden Associates in a final certificate of analysis which included sample analytical results as well as relevant documentation to verify and validate the results. The results of this data validation presented here are based upon a limited review of QA/QC information including holding times, preservation procedures and standards, spike analysis on sample matrix, blank samples analyses (method, trip, and calibration blanks), duplicate sample analyses, interference check sample results, laboratory control samples, serial dilution criteria, and IDL/CRDL information. Review was limited mainly to summary sheets provided by the laboratory, unless a notable discrepancy in the data package required review of the raw data. The completeness of

this data package was verified including the presence of raw analytical data, chain of custody and preparation logs.

**CLP-ICP Method 200.7 Review.** All analyses were performed in accordance with USEPA CLP-SOW ILM04.0. All the above target metals were analyzed for their total concentrations. Designated QC samples for duplicate analyses and matrix spike analyses in SDG-001 were S-6S and S-6D. Designated QC samples for duplicate analyses and matrix spike analyses in SDG-002 were MW3S and MW3D.

The revised certificate of analysis appeared complete in its presentation and the data were of acceptable quality. The certificate of analysis demonstrated the ability of the laboratory to achieve the reported CRDL for each target parameter. All CRDLs were equal to or less than the respective MCLs and NCSs, where applicable.

All relevant instrument calibration and calibration verification criteria were met. All CRDL standards recovered well within control limits. Interference check sample (ICS-AB), spike sample and lab control samples recovered within control limits. Representative duplicate sample analysis results were also within control limits. All applicable serial dilution criteria were verified to be met.

Reported blank sample results included barium in trip blank (0.17  $\mu\text{g/l}$ ), and several calibration blanks, and iron in preparation blank (17.9  $\mu\text{g/l}$ ). None of the sample results for barium were deemed to be affected by the observed blank results. However, results for iron in samples MW-5, MW-12, and MW-15 were less than 5 times preparation blank result, and were deemed attributable to the observed blank contamination source and were hence validated as "U\*" per validation criteria. The pre-digestion matrix spike recovery for iron performed on representative sample S-6 recovered outside control limits (70% recovery). However, the original sample concentration was noted to be more than 10 times the true value of spike added and hence per validation criteria no qualification was deemed to be required. All other iron results were deemed to be acceptable as reported.

All sample results unaffected by the above data validation process were recorded as reported by the laboratory or, if the reported value was less than the IDL, validated and reported as "U".

#### 4.4 Organic Data Review

CompuChem also performed the GC/MS analysis. CompuChem submitted results to Draper Aden Associates in a final certificate of analysis which included sample analytical results as well as relevant documentation to validate and verify the results. Draper Aden Associates performed a limited review of the analytical results for volatile organic parameters analyzed by

EPA CLP-SOW Document Number OLM03.2. The parameter list included dichlorodifluoromethane in addition to the standard OLM03.2 SOW parameter list.

The evaluation of Compuchem's compliance with the method was based on a limited review of the following items: QC deliverables package, case narrative, technical holding time and preservation requirements, laboratory control samples, instrument performance check, instrument calibrations, blank analysis, surrogate spike recoveries, internal standard requirements and confirmation of detected parameters. Review of transcriptions from raw data to summary sheets was performed. Specific representative calculations were not performed except where noted.

The samples for CLP organic analysis were split into the same two sample delivery groups as the CLP inorganic analysis. The surface water samples, S-1, S-2, S-3, S-4, S-5, and S-6, are included in SDG-001. The groundwater samples, MW-1, MW-2, MW-3, MW-4, MW-5, MW-7, MW-8, MW-9, MW-10, MW-11, MW-12, MW-13, MW-14, MW-15, MW-17, MW-18, MW-19 and Trip Blank1 are included in SDG-002.

The original certificates of analysis were complete in presentation and the data was of acceptable quality. Technical holding time, and preservation requirements were met for all samples. Laboratory control samples were analyzed and met quality control requirements. All initial and continuing calibration requirements were met. The trip blank included with the SDG-002 batch analysis was free from contamination. A trip blank was not included with the SDG-001 batch analysis. The laboratory method blanks were free from contamination. All surrogate recoveries, internal standard area and retention time requirements were fulfilled. Overall instrument performance appeared stable and dependable.

During validation, 2-butanone results in MW-2, MW-10, MW-11, MW-12, and MW-19 were qualified as estimated due to a high relative percent difference. Additionally, 2-hexanone results in MW-2 and toluene results in MW-10, MW-11, MW-12, and MW-19 were qualified as estimated due to elevated percent deviation results in the associated continuing calibrations. Matrix spike/matrix spike duplicate analyses were performed on MS-3. All QC requirements were met except for the RPD value for benzene, which was slightly high. Qualification of the data was not analyzed and all results met QC requirements.

Numerous target parameters were detected both above and below the CRQL. The sample from MW-2 was analyzed at a 1/2 dilution. CRQLs were raised to 20 µg/l for all MW-2 parameter results. The sample from MW-10 was analyzed at a 1/1.4 dilution. CRQLs were raised to 14 µg/l for all MW-10 parameter results. A review of tentatively identified compound (TIC) results revealed the presence of dichlorofluoromethane in several samples and ether in sample S-2..

## 5.0 DISCUSSION OF ANALYTICAL RESULTS

Tables 2A-C (Appendix A) provide a summary of the target analytical results obtained from the January 14-15, 1998 sampling event. Note that the analytical results are remarkably similar to the results obtained from the previous seven assessment events (Tables 5A-D).

These results were validated in-house by Draper Aden Associates according to the discussion provided in Sections 3.0 and 4.0 of this report. Tables 2A-C list for each parameter, as applicable, an MCL established by the USEPA and groundwater quality standard established by the state of NC, the IDL for CLP-Inorganic results, the CRQL for CLP-Organic results, and the analytical method.

Estimated analytical results for the target parameters are provided for preliminary assessment purpose only. Estimated analytical data is not intended for use in determining regulatory compliance issues.

A summary of additional non-target parameter analytical results obtained from the second semiannual assessment sampling event is provided in Table 3. Non-target parameter data is provided for preliminary assessment purpose only and is not intended for use in determining regulatory compliance issues.

### 5.1 Inorganic Analytical Results

#### Previous Inorganic Analyses

The evaluation of existing inorganic data on metal parameters, collected prior to development of the Assessment Plan, indicated the tentative presence of four metals at elevated concentrations in the groundwater. Previous metal concentrations detected in the groundwater are generally low or are below analytical method quantitation limits. However, two metals, cadmium and iron, were historically observed at levels above those established by the EPA MCL and Secondary MCL, respectively. Barium, a common naturally occurring parameter, was also observed at relatively elevated levels, but below water quality standards. Mercury was also detected, although only once for each well in the six or more sampling and analysis events previously conducted.

Since cadmium and mercury were not detected as a result of the initial four background and the first semiannual assessment monitoring analyses, cadmium and mercury were removed from the existing target parameter list.

As a result of the comprehensive EPA Appendix II analyses performed during the first semiannual monitoring event, four additional metals were observed in three or more core



monitoring wells, although also at levels far below EPA MCL and NC groundwater standards.

- chromium
- cobalt
- nickel
- vanadium

These four metals were added to the existing metal target parameter list. Three independent samples were collected and analyzed for these four metals during the three previous semiannual sampling events at all core assessment wells to establish background.

### **Recent Inorganic Analyses**

The analytical results for the current six target metal parameters, barium, chromium, cobalt, iron, nickel, and vanadium, obtained from the January 14-15, 1998 sampling event, are summarized in Tables 2A-C and discussed below. Note that the inorganic analytical results and associated parameter distribution trends are similar to the results and trends obtained from the previous assessment events.

#### Barium (total) and Iron (total)

Barium and iron concentrations obtained from the January 14-15, 1998 monitoring event are similar to those observed as a result of previous assessment monitoring events. Barium and iron, both common naturally occurring parameters, have been detected in all monitoring wells and surface water sampling locations, as a result of the previous background Assessment monitoring events. Although observed in all of the monitoring wells and surface water sampling locations, barium was detected at levels below the Federal Primary Drinking Water Standard (EPA MCL) and NC groundwater quality standard (NCS) of 2,000  $\mu\text{g/l}$  as a result of all previous Assessment background monitoring events. Concentrations of iron were often at levels significantly above associated water quality criteria (i.e., secondary EPA MCL of 300  $\mu\text{g/l}$ ). No primary EPA MCL or NCS exists for iron.

Although barium was detected at every point sampled, over half of the barium levels detected in the groundwater at the site were reported at concentrations less than 150  $\mu\text{g/l}$ . The distribution of barium detected above 150  $\mu\text{g/l}$  indicates a slight association between distribution and proximity to the waste disposal area. Barium was observed above 150  $\mu\text{g/l}$  in seven monitoring wells.

Barium was observed at concentrations above 500  $\mu\text{g/l}$  in one well:

- MW-9 (628  $\mu\text{g/l}$ ), located ~50 ft south of the waste disposal area.

Barium was also observed at levels above 150 µg/l in:

- MW-7 (450 µg/l) and MW-8 (401 µg/l), both located ~30 ft west of the waste disposal area; and
- MW-2 (195 µg/l), located within the bedrock aquifer in the north drainage >50 ft below the waste disposal area.

The remaining two wells for which concentrations of barium were detected at levels above 150 µg/l include the nested well pair, shallow well MW-11 (163 µg/l) and deep well MW-12 (163 µg/l). This nested well pair is not located adjacent of the waste disposal area but rather >1000 ft away, downgradient of the Bolick site and the Boone-Nissan septic field. Concentrations of barium above 500 µg/l were detected in one surface water sample, S-2 (887 µg/l), again located downgradient of the Bolick site within the west drainage. Barium was observed at concentrations above 150 µg/l in all surface water monitoring locations.

The distribution of iron detected above 5000 µg/l also suggests a slight relationship between distribution and proximity to the waste disposal area. Iron was observed at levels above 5000 µg/l in MW-7 (5660 µg/l) and MW-8 (18,400 µg/l), both located ~30 ft west of the waste disposal area.

#### Chromium (total) and Nickel (total)

Chromium and nickel were either not detected above the IDL or detected at trace levels in all well and surface water samples, except the sample obtained from well MW-8. Chromium was detected in MW-8 at 90.0 µg/l (between the NCS of 50 µg/l and the EPA MCL of 100 µg/l). Nickel was detected in MW-8 at 103 µg/l (above the NCS and EPA MCL). Chromium and nickel were either not detected above the IDL or detected at trace levels in all surface water samples. The anomalous chromium and nickel detects in MW-8, located ~30 ft west of the waste disposal area, suggest a relationship between chromium and nickel distribution and proximity to the waste disposal area.

#### Cobalt (total) and Vanadium (total)

Low level concentrations of cobalt were detected at nine monitoring wells and all surface water sampling locations. Elevated concentrations of cobalt were detected at three wells (MW-8, MW-9, and MW-17) and one surface water sampling location (S-4). Low level concentrations of vanadium were detected in twelve monitoring wells and five surface water sampling locations. Elevated concentrations of vanadium were detected at one well (MW-8) and one surface water sampling location (S-4). No EPA MCL, NCS, or NC surface water standard exists for cobalt or vanadium.

Cobalt and vanadium distribution trends indicate a slight relationship between distribution and proximity to the waste disposal area. Two of the three monitoring wells for which concentrations of cobalt were estimated at elevated concentrations, MW-8 (22.2 µg/L) and MW-9 (23.9 µg/L), are located adjacent of the waste disposal area. Vanadium was also estimated at an elevated concentration at MW-8 (44.6 µg/l). The remaining well and surface water sampling location for which concentrations of cobalt and vanadium were detected at similar elevated concentrations, MW-17 and S-4, are not located adjacent of the waste disposal area but rather downgradient of the Bolick site within the west drainage.

As a result of previous assessment sampling events, all the assessment target metal parameters (including chromium, cobalt, nickel, and vanadium) were observed at levels far below EPA MCL and NCSs. In the previous third semiannual monitoring event report, Draper Aden Associates recommended the withdrawal of the metal target assessment parameters from routine groundwater monitoring. The NCDENR responded that the agency would consider completing target metal analysis annually rather than semiannually. **Draper Aden Associates recommends herein, on behalf of Watauga County, the initiation of annual rather than semiannual analysis for target metals.**

## 5.2 Organic Analytical Results

### Target Organic Parameters

The analytical results for the eleven current target organic parameters obtained from the January 14-15, 1998 assessment sampling event are summarized in Tables 2A-C. The analytical results obtained from each parameter is individually discussed below. A discussion of distribution trends for each parameter is also presented.

#### 1,1-Dichloroethane (1,1-DCA)

1,1-DCA was observed at elevated concentrations in more monitoring wells and occurs more pervasively throughout the site than any other target parameter. 1,1-DCA was detected in nine downgradient groundwater monitoring wells (MW-2, MW-3, MW-7, MW-8, MW-9, MW-10, MW-11, MW-12 and MW-17). All 1,1-DCA concentrations were considerably below the NC groundwater quality standard of 700 µg/l. No EPA MCL exists for 1,1-DCA. Concentrations of 1,1-DCA were also observed at one surface water sampling location (S-2). 1,1-DCA was not detected in the upgradient well MW-1 or MW-15 and MW-19. No NC surface water quality standard exists for 1,1-DCA.

1,1-DCA was observed at concentrations above 50 µg/l at various locations:

- the nested well pair, shallow well MW-3 (97 µg/l) and deep well MW-17 (88 µg/l),

located at the downgradient property boundary of the Bolick site;

- MW-8 (55 µg/l), located between the landfill and the Bolick site, and
- MW-12 (82 µg/l), located downgradient of the Bolick site.

Lower concentrations of 1,1-DCA were observed at:

- MW-2 (29 µg/l) and MW-10 (11 J), both located in the north drainage below the waste disposal area;
- MW-9 (27 µg/l), located along the southern saddle above the landfill;
- MW-11(30 µg/l), located downgradient of the Bolick site; and
- surface water monitoring location S-2 (15 µg/l), located at the spring capture outfall below the waste disposal area in the north drainage.

#### Tetrachloroethene (PCE)

PCE was detected at concentrations above the EPA MCL of 5 µg/l in five groundwater monitoring wells (MW-3, MW-8, MW-11, MW-12 and MW-17) and estimated above the NCS of 0.7 µg/l in three additional wells (MW-2, MW-9 and MW-10). PCE was not detected at any surface water sampling location.

PCE was detected primarily along the west drainage basin adjacent to the landfill, located within and below the Bolick site. PCE was detected at concentrations above the EPA MCL (5 µg/l) at the following locations:

- the nested well pair shallow well MW-3 (21 µg/l) and deep well MW-17 (28 µg/l), located at the downgradient property boundary of the Bolick site;
- the nested well pair, shallow well MW-11 (10 µg/l) and deep well MW-12 (25 µg/l), located downgradient of the Bolick site, below the Boone-Nissan septic field; and
- MW-8 (11 µg/l), located within the Bolick site.

PCE was also estimated at concentrations below the EPA MCL (5 µg/l) in:

- MW-2 (4 J µg/l) and MW-10 (3 J µg/l), located within the bedrock aquifer in the north drainage below the waste disposal area; and
- MW-9 (3 J µg/l), located along the southern saddle above the landfill.

#### Trichloroethene (TCE)

TCE was detected at concentrations above the EPA MCL of 5 µg/l in three groundwater monitoring wells (MW-3, MW-12 and MW-17) and estimated (detected below the method CRQL)

above the EPA MCL in one well (MW-8). TCE was detected at concentrations above the NCS of 2.8 µg/l in two additional wells (MW-9 and MW-11). TCE was also estimated (detected below the method CRQL) at concentrations below the EPA MCL and NCS in one well (MW-7). TCE was not detected at any surface water sampling location.

TCE distribution trends are similar to PCE distribution trends. With few exceptions, TCE was detected primarily along the west drainage basin adjacent to the landfill, located within and below the Bolick site. TCE was detected at the highest concentrations at the following locations:

- the nested well pair, shallow well MW-3 (11 µg/l) and deep well MW-17 (16 µg/l), located at the downgradient property boundary of the Bolick site; and
- MW-12 (12 µg/l), located downgradient of the Bolick site below the Boone-Nissan septic field.

Estimated TCE concentrations above the EPA MCL of 5 µg/l were also observed in:

- MW-8 (8 J µg/l), located adjacent to the landfill, within the Bolick site.

Estimated concentrations at and below the EPA MCL for TCE were also observed in:

- MW-11 (5 J µg/l), located downgradient of the Bolick site, below the Boone-Nissan septic field;
- MW-9 (4 J µg/l), located between the landfill and the Rocky Mountain Heights Subdivision;
- MW-7 (1 J µg/l), located south of the Bolick site, adjacent to the disposal area.

#### cis-1,1-Dichloroethene (cis-1,2-DCE)

As previously discussed in Section 4.4, CLP-SOW analytical results for cis-1,2- DCE are reported as part of a total concentration of cis- and trans- isomers of the parameter (total 1,2-DCE). Total 1,2-DCE was detected at concentrations above the EPA MCL and NCS of 70 µg/l in one groundwater monitoring well (MW-17). 1,2-DCE was also detected below the EPA MCL and NCS in six additional wells (MW-3, MW-7, MW-8, MW-9, MW-11, and MW-12). 1,2-DCE was estimated at two surface water sampling locations (S-2 and S-4). No NC surface water quality standard exists for 1,2-DCE.

1,2-DCE distribution trends are similar to PCE, TCE, and dichlorodifluoromethane distribution trends. With two exceptions (MW-9 and spring capture outfall S-2), 1,2-DCE was only detected along the west drainage basin adjacent to the landfill, located within and below the Bolick site.

1,2-DCE was observed at the highest concentration (above the EPA MCL and NCS) at:

- MW-17 (87 µg/l), located at the downgradient property boundary of the Bolick site;

Concentrations of 1,2-DCE (below the EPA MCL and NCS) were also observed at:

- MW-3 (62 µg/l), located at the downgradient property boundary of the Bolick site,
- the nested well pair, shallow well MW-11 (17 µg/l) and deep well MW-12 (56 µg/l), located downgradient of the Bolick site,
- MW-8 (29 µg/l), located adjacent to the landfill and the Bolick site;
- MW-7 (11 µg/l), located south of the Bolick site; and
- MW-9 (14 µg/l), located along the southern saddle above the landfill.

Estimated concentrations of 1,2-DCE were observed at surface water sampling locations:

- S-2 (5 J µg/l), located at the spring capture outfall below the waste disposal area in the north drainage; and
- S-4 (1 J µg/l), stream below landfill property boundary of the Bolick site.

#### Dichlorodifluoromethane

Dichlorodifluoromethane was detected at concentrations above the NCS of 0.19 µg/l in five groundwater monitoring wells (MW-3, MW-8, MW-9, MW-11, and MW-12). No EPA MCL exists for dichlorodifluoromethane. Dichlorodifluoromethane was not detected at any surface water sampling locations.

Dichlorodifluoromethane distribution trends are similar to PCE, TCE, and 1,2-DCE distribution trends. Dichlorodifluoromethane was detected primarily along the west drainage basin adjacent to the landfill, located within and below the Bolick site. Concentrations of dichlorodifluoromethane were observed in the west drainage in MW-3 (6.4 µg/l), MW-8 (17 µg/l), MW-11 (3.0 µg/l) and MW-12 (10 µg/l), and between the landfill and the Rocky Mountain Heights Subdivision in MW-9 (11 µg/l).

#### 1,1,1-Trichloroethane (1,1,1-TCA)

1,1,1-TCA was detected at concentrations above the EPA MCL and NCS of 200 µg/l in one groundwater monitoring wells (MW-2). 1,1,1-TCA was also detected below the EPA MCL and NCS in eight additional wells (MW-3, MW-8, MW-9, MW-10, MW-11, MW-12, MW-15 and MW-17). An estimated concentration of 1,1,1-TCA (below the method CRQL) was also observed below the EPA MCL and NCS at one surface water sampling location (S-5) and one boundary well

(MW-14). No NC surface water quality standard exists for 1,1,1-TCA.

1,1,1-TCA, although occurring throughout the core of the site, was observed at the highest concentrations, above the EPA MCL and NCS of 200  $\mu\text{g/l}$ , deep in the bedrock of the northern drainage basin below the landfill, in:

- MW-2 (320  $\mu\text{g/l}$ ) located in the northern drainage below the landfill.

1,1,1-TCA was also observed at lower concentrations, below the EPA MCL and NCS, in:

- MW-10 (150  $\mu\text{g/l}$ ), also located in the northern drainage, directly below the fill areas.

Lower concentrations of 1,1,1-TCA were estimated in:

- the two nested pairs located in the west drainage basin; shallow MW-3 (7 J  $\mu\text{g/l}$ ) and deep MW-17 (3 J  $\mu\text{g/l}$ ), and shallow MW-11 (7 J  $\mu\text{g/l}$ ) and deep MW-12 (9 J  $\mu\text{g/l}$ ), located along and downgradient of the Bolick Site property boundary, respectively,
- MW-8 (4 J  $\mu\text{g/l}$ ), located in the west drainage basin upgradient of these nested pairs,
- MW-15 (5 J  $\mu\text{g/l}$ ), located adjacent to Rocky Branch in the northern drainage; and
- surface water sampling location S-5 (1 J  $\mu\text{g/l}$ ), a seep located directly above the landfill sediment ponds in the northern drainage.

#### 1,1-Dichloroethene (1,1-DCE)

1,1-DCE was detected at concentrations above the EPA MCL and NCS of 7  $\mu\text{g/l}$  in two monitoring wells (MW-2 and MW-10). 1,1-DCE was also detected and/or estimated (observed both above and below the method LOQ) at concentrations below the EPA MCL and NCS in four additional wells (MW-3, MW-8, MW-12 and MW-17). 1,1-DCE was not detected in any of the surface water samples.

Similar to the distribution of 1,1,1-TCA, 1,1-DCE was also observed at the highest concentrations deep in the bedrock of the northern drainage basin below the landfill. Concentrations for 1,1-DCE above the EPA MCL and NCS were observed in:

- the deep well MW-2 (50  $\mu\text{g/l}$ ), located in northern drainage below the landfill; and
- MW-10 (20  $\mu\text{g/l}$ ), located in the northern drainage directly below the fill areas.

Monitoring wells located in the west drainage basin reveal either low level, estimated concentrations below the EPA MCL and NCS, or the non-detection of 1,1-DCE; MW-3 (2 J  $\mu\text{g/l}$ ), MW-8 (3 J  $\mu\text{g/l}$ ), MW-11 (non-detect), MW-12 (2 J  $\mu\text{g/l}$ ), and MW-17 (1 J  $\mu\text{g/l}$ ).

### Benzene

Concentrations of benzene were estimated (below the method CRQL) below the EPA MCL of 5 µg/l and above the NCS of 1 µg/l in six monitoring wells (MW-3, MW-7, MW-8, MW-9, MW-12 and MW-17). Benzene was also estimated at concentrations above the NC surface water quality standard of 1.19 µg/l in one surface water sampling location (S-2).

Benzene distribution trends suggest a relationship between benzene distribution and proximity to the waste disposal area. Estimated benzene concentrations were preferentially distributed in wells proximate to the waste disposal area; MW-3 (3 J µg/L), MW-7 (2 J µg/L), MW-8 (2 J µg/L), MW-9 (3 J µg/L), MW-12 (2 J µg/L) and MW-17 (2 J µg/L). An estimated Benzene concentration was also detected at the landfill spring capture outfall, S-2 (3 J µg/L).

### Vinyl Chloride

Vinyl chloride was not detected in any of the groundwater or surface water samples. Vinyl chloride distribution trends on previous Assessment monitoring events have been similar to PCE, TCE, and cis-1,2-DCE distribution trends.

### Methylene Chloride

Similar to previous assessment monitoring events, methylene chloride was detected at concentrations above the EPA MCL and NCS of 5 µg/l in only one groundwater monitoring well (MW-9). MW-9 is located adjacent to the Carroll Residence, between the landfill and the Rocky Mountain Heights Subdivision. Low levels of methylene chloride were observed below the method LOQ in all the other 22 groundwater and surface water samples. The anomalous methylene chloride concentration detected at MW-9 (90 µg/l) is similar concentrations observed on previous monitoring events. This methylene chloride concentration is 18 times the EPA MCL and NCS of 5 µg/l. The distribution trends inferred from the methylene chloride analytical results below the method LOQ observed in the other 22 groundwater and surface water samples are inconclusive. As discussed in Section 4.4, these low level methylene chloride detects are attributed to laboratory contamination. Methylene chloride is a common laboratory contaminant. Although the trip and method blanks did not detect methylene chloride, the ubiquitous distribution of methylene chloride in all the groundwater and surface water samples strongly indicates laboratory contamination.

### Chloroethane

Chloroethane was detected and/or estimated (detected below the method CRQL) in six groundwater monitoring wells (MW-3, MW-7, MW-8, MW-9, MW-12 and MW-17) and one surface water sampling locations (S-2). No EPA MCL, NCS, or NC surface water quality

standard exists for chloroethane.

Chloroethane was observed at the highest concentrations in wells adjacent to the disposal area:

- MW-7 (19 µg/l), located south of the Bolick site, west of the disposal area;
- MW-9 (12 µg/l), located adjacent to the Carroll property and south of the disposal area;
- MW-8 (12 µg/l), located within the Bolick site, west to the disposal area

Lower concentrations of chloroethane were also observed in three monitoring wells located further downgradient in the west drainage:

- the nested well pair, shallow well MW-3 (10 µg/l) and deep well MW-17 (9 J µg/l), located at the downgradient property boundary of the Bolick site; and
- MW-12 (5 J µg/l), located downgradient of the Bolick site below the Boone-Nissan septic field.

Chloroethane was also detected in the landfill spring capture outfall, S-2 (56 µg/L).

#### **Non-Target Organic Parameters**

The analytical results of additional detected non-target organic parameters are summarized in Table 3. The analytical results obtained for non-target parameters, are provided to preliminary identify those parameters which may need to be continually monitored. If upon continued semiannual data collection, the presence of any non-target parameters are confirmed by repeated analysis, the parameter will be added to the target parameter list.

Additional non-target parameters were estimated (detected below the method CRQL) or tentatively identified in six monitoring wells (MW-3, MW-7, MW-8, MW-9, MW-12, and MW-17) and one surface water sampling location (S-2). Although a combined total of three non-target parameters were estimated or tentatively identified in the six monitoring wells, two of the three non-target parameters were individually observed in only one of these six wells. These six monitoring wells are preferentially located along the N55°W lineament, both adjacent to the waste disposal area and within the west drainage. A combined total of four non-target compounds were estimated or tentatively identified in the surface water monitoring location.

The non-target parameters and associated sampling points are presented below.

<u>NON-TARGET PARAMETER</u>	<u>MONITORING POINT(S)</u>
1,2-dichloropropene	MW-7
ethylbenzene	S-2

toluene	S-2
xylene	S-2
<u>tentatively identified</u>	
ether	S-2
trimethylsilanol	MW-3
dichlorofluoromethane	MW-3, 8, 9 , 12, and 17

All of the estimated or tentatively identified non-target parameter concentrations were observed at levels below corresponding EPA MCLs and NC groundwater quality standards. The BTEX compounds, ethylbenzene, toluene, and xylene, detected in surface water sampling location S-2, have also been detected at this location in three previous events. This surface water sampling location receives runoff from the scale-house and the transfer station/bailing facility's access roads and it is suspected the BTEX compounds originate from this runoff.

As indicated in Table 6A and 6B (Cumulative Detected Non-target Organic Parameter Analytical Results), the presence of all the other non-target compounds detected in the January 14-15, 1998 sampling event are not confirmed by the non-target analytical results obtained from previous assessment sampling events. Confirmation of the presence or absence of these non-target parameters will continue to be evaluated on the following semiannual monitoring events.

Non-target parameter distribution trends will continue to be evaluated. These non-target compounds have not been repeatedly detected in the wells as a result of previous background analyses (Table 6A, Appendix A). The isolated detection of these non-target compounds in the wells is not indicative of a pervasive, persistent occurrence.

## 6.0. POTABLE WELL SAMPLING AND ANALYSIS PROGRAM

The initial domestic and commercial use potable well sampling event was developed and conducted by Draper Aden Associates on March 5, 1993 at the direction of Watauga County and approval of State officials to protect public health and welfare. The ongoing potable water well sampling and analysis program is currently being jointly conducted by the Appalachian District Health Department (ADHD) and the NC State Laboratory of Public Health.

The objective of the potable well sampling and analysis program is to investigate and evaluate the potential influence and associated risks of the landfill on neighboring groundwater resources. Potable well water samples collected by the ADHD are analyzed for volatile organic compounds by the State Laboratory utilizing EPA Method 502.2. Potable water well locations with accompanying sampled well reference number can be found on the Site Map (Figure 1). A summary of the analytical results of the potable well testing program collected to date are presented in Appendix D.

The analytical results of the domestic and commercial use potable water well sampling and analysis program previously indicated that two of the forty-one sampled potable wells neighboring the landfill are significantly impacted by volatile organic compounds. These two significant impacted wells are the Carroll residence (well reference no. 12) and the Nissan-Mazda Dealership well (well reference no. 4). These two potable water wells have been replaced by connections to the Town of Boone's public water system and have not been resampled during the past several years. Discussions of individual potable well analytical results obtained previously can be found in earlier Assessment reports.

At this time the cause or source of all the organics detected in the potable well sampling program cannot be determined. It should be noted that eight (8) of twenty-one (21) compounds detected in the Carroll residence well have not been detected in the landfill monitoring well network. The differences in parameter "fingerprints" in groundwater beneath these sites compared to "fingerprints" for landfill wells tends to indicate potential impacts resulting from activities specifically undertaken on these sites and/or immediately around the private well heads and/or components of the well systems.

Review of the analytical results from all the potable well sampling conducted recently, performed by the NC Department of Epidemiology, indicate that the sampled well waters are acceptable for all uses due to either non-detection or low level detection of organic analytes. Individual well analytical results obtained recently are discussed below.

#### **6.1 February 1998 Sampling Event**

Eight wells were resampled in February 1998:

- Blue Ridge Electric Membership Company (well reference no. 5),
- Bolick rental house (well reference no. 2),
- Chevrolet Dealership (well reference no. 7),
- Edwards residence; shared well #2 (well reference no. 14),
- Ward Residence (well reference no. 24),
- Johnson residence (well reference no. 32),
- Meadowridge condominiums; Holloway (well reference no. 42), and
- Meadowridge condominiums; Stanley (well reference no. 43).

#### Blue Ridge Electric Membership Company, BREMCO (well reference no. 5)

Six chlorinated volatile organic solvent compounds (1,1-DCA, 1,1-DCE, cis-1,2-DCE, 1,1,1,-TCA, TCE, and PCE) and trace levels of benzene were detected in the February, 1998 sampling of the BREMCO well. Estimated concentrations below the quantitation limit of 5 ppb were reported for cis-1,2-DCE, 1,1-DCA and 1,1-DCE (e.g. 0.5 ppb, 3.2 ppb, and 3.9 ppb,

respectively). The EPA MCL for cis-1,2-DCE is 70 ppb and for 1,1-DCE is 7 ppb, No EPA MCL exists for 1,1-DCA. The other detected organic compounds were observed at trace and unquantifiable levels below 1 ppb.

The same six chlorinated volatile organic solvent compounds detected as a result of the February, 1998 sampling event have also been detected in previous sampling events conducted on the BREMCO well. All six compounds have been detected in the past eight sampling events. Three of these compounds (1,1-DCA, 1,1,1-TCA, and TCE) have been detected in all nine previous sampling events.

#### Bolick rental residence (well reference no. 2)

The Bolick rental residence well, located directly to the southwest of the BREMCO business, was also resampled and analyzed during this sampling event. The Bolick rental residence potable well has been sampled six previous times. The February, 1998 resampling and analysis of the Bolick rental residence well resulted in **no detected volatile organic compounds**.

Trace levels (less than 1.0 ppb) of two common chlorinated volatile organic compounds (1,1-DCA and 1,1-DCE) and significant levels of methyl ethyl ketone (MEK) and tetrahydrofuran had been detected as a result of previous sampling events. MEK and tetrahydrofuran have not been detected in the landfill monitoring well network to date. Coincidentally, three of the four compounds detected in the initial Bolick rental residence well sampling event conducted on March 5, 1993 (benzene derivative compounds) were also not detected in the landfill monitoring wells.

#### Chevrolet Dealership (well reference no. 7)

The February, 1998 resampling of the Chevrolet Dealership well resulted in the detection of chloroform and bromodichloromethane at 39.7 ppb and 5.0 ppb, respectively. Neither of these compounds have been detected in any of the landfill assessment monitoring wells to date. The presence of these compounds in the Chevrolet Dealership well is likely due to activities and sources immediately surrounding the well head.

The initial sampling of the Chevrolet Dealership well, performed on March 5, 1993, resulted in no detected volatile organic compounds. The well was resampled in April, 1995 in response to NCDENR Solid Waste Section recommendations. The second sampling of the Chevrolet Dealership well detected tert-butyl methyl ether at a concentration of 24.4 ppb. A residence located behind the Chevrolet Dealership's lot and connected to the dealership's well was sampled in April, 1996. This third sampling of the dealership's well also detected tert-butyl methyl ether at a concentration of 2.5 ppb. Tert-butyl methyl ether has not been detected in any of the assessment monitoring wells to date. Similar to the two non-landfill related compounds detected during the February, 1998 resampling, the presence of tert-butyl methyl ether in the dealership's

well is likely due to activities and sources immediately surrounding the well head.

Shared Well #2 (well reference no. 14)

Shared well #2, which serves four residences, was sampled for the eighth time in January, 1998. Shared well #2 was originally sampled from the Cone residence on March 18, 1993. Subsequent resampling of shared well #2 (2nd, 3rd, 4th, and 5th sampling events) was performed on the adjacent Edwards residence and more recently (6th and 7th sampling events) on the Milsap's residence. The recent 8th resampling of shared well #2 was performed on the Edwards residence.

The February, 1998 and June, 1997 sampling events resulted in **no detected volatile organic compounds.**

The initial March, 1993 sampling detected only low levels of 1,4-dichlorobenzene, which is a compound that has not been detected in the landfill monitoring well network.

The second March, 1994 sampling detected trace levels of chloroform, which is a common transformation product resulting from the chlorination of well systems, and also detected two common chlorinated organic compounds (1,1-DCE and 1,1,1-TCA) at unquantifiable levels below 1 ppb.

The third January, 1995 sampling only detected 1,1-DCE at unquantifiable levels below 1 ppb.

Shared well #2 was drilled deeper in the fall of 1995 in order to provide needed water production. Resampling was performed to investigate the effect of drilling the well deeper on the concentrations of organic compounds found in this potable well. The fourth resampling, performed in October, 1995, detected 1,1-DCA (not 1,1-DCE) at unquantifiable levels below 1 ppb, trace levels of PCE and 1,1,1-TCA, and chloroform at 9 ppb. Chloroform is likely a transformation product resulting from the recent chlorination of the well system. A variety of additional compounds that do not appear related to the organic constituents found in the landfill's monitoring well network were also detected. These compounds include the following: bromodichloromethane, dibromochloromethane, 2-chlorotoluene, 4-chlorotoluene, methyl ethyl ketone, and tetrahydrofuran. The presence of these compounds was likely a byproduct resulting from the overdrilling of the well bore.

The fifth April, 1996 resampling only detected 1,1-DCE at unquantifiable levels below 1 ppb, and the sixth October, 1996 resampling again detected 1,1-DCE at unquantifiable levels below 1 ppb and trace levels of PCE.

Ward Residence (well reference no. 24)

The recent tenth resampling and analysis of the Ward residence potable well performed in February, 1998 resulted in **no detected volatile organic compounds**.

Only one of nine previous Ward residence sampling events, the fourth sampling event, also resulted in no detected volatile organic compounds. The combined analyses from nine previous sampling events conducted on the Ward residence well had detected trace and/or unquantifiable levels below 1 ppb of five chlorinated organic compounds (carbon tetrachloride, 1,1-DCA, 1,1,1-TCA, TCE, and PCE).

Three previous Ward residence sampling events also detected trace levels of chloroform. Chloroform is a common transformation product result from the chlorination of well systems. The initial Ward residence sampling event also detected methylene chloride at 3.2 ppb. The next nine consecutive sampling events at the Ward residence have resulted in the non-detection of methylene chloride. Methylene chloride is also a known laboratory contaminant.

Johnson residence (well reference no. 32)

The potable well water from the Johnson residence was resampled in February, 1998 to confirm the non-detect results obtained from three previous sampling events conducted in 1993, 1996 and 1997. The previous three sampling events detected chloroform, a common transformation product resulting from the chlorination of well systems, at unquantifiable levels below 1 ppb. The recent resampling and analysis of the Johnson residence well resulted in **no detected volatile organic compounds**.

Meadowridge condominiums; Holloway (42) and Stanley (43)

Two wells, separately providing potable water to the "uppermost" and "lowermost" levels of the Meadowridge condominiums (well reference no. 42 and. 43), were sampled in February, 1998. The analysis of water from both of these wells resulted in **no detected volatile organic compounds**.

Previously, the Meadowridge condominiums was sampled from the Welch residence (well reference no. 38), located in the "midlevel" of the condominium complex. The first sampling event performed in October, 1993, detected chloroform and trans-1,2-DCE at unquantifiable levels below 1 ppb and trace levels of 1,1,1-TCA and TCE. Chloroform is a common transformation product from the chlorination of well systems and trans-1,2-DCE has not been confirmed present in the landfill monitoring well network to date. 1,1,1-TCA and TCE, detected at trace levels, are found in many common solvents. Resampling of the "midlevel" of the Meadowridge condominium complex in February, 1995 from Unit #2 resulted in the detection of no volatile organic compounds.

It is the understanding of the ADHD that a total four wells provide potable well water in the Meadowridge condominiums. As detailed above, three of these wells have been sampled to date. Upon confirming the total number of Meadowridge wells, the remaining well(s) will be sampled during the next semiannual sampling event. The "midlevel" well (well reference no. 38), providing water to the Welch residence, will also be resampled during this event.

## **6.2 Pending Potable Well Sampling**

The next semiannual potable well sampling event is scheduled to coincide with the next groundwater monitoring event, tentatively scheduled for June, 1998. The sampling program will continue to involve the semiannual sampling of six to eight residences.

The sampling program will continue to concentrate on sampling those wells that have previously shown trace level detections of organics similar to those detected in the landfill groundwater monitoring well network. This is accomplished by routine, semiannual sampling of the three wells that have previously shown trace level detections of organics similar to those detected in the landfill groundwater monitoring well network [i.e. BREMCO (well reference no. 5), Ward Residence (well reference no. 24), and Shared Well #2 (well reference no. 14)].

Upon confirming the total number of Meadowridge condominium wells, the remaining Meadowridge well(s) not sampled to date, and the "midlevel" well (well reference no. 38), providing water to the Welch residence, will be sampled during the next semiannual sampling event in June, 1998. The Health Department will also continue attempts to sample the seasonally occupied McClintock residence (well reference no. 33) during the next summer sampling event. It is anticipated that the residents may be available during the summer. The two previous sampling events performed on this well were performed during August and October.

The semiannual schedule also continues to incorporate periodic confirmational sampling on other potable wells that have previously shown nondetection of target organic analytes, or have shown detections of organics dissimilar to those detected in the landfill groundwater monitoring well network. This can be accomplished by including the sampling of three (or more as appropriate) additional potable wells during each semiannual sampling event. The decision criteria for inclusion of additional wells in the potable well sampling program will continue to be based both on previous sampling results as well as public input or requests.

In summary, review of the analytical results from all the potable well sampling conducted recently, performed by the NC Department of Epidemiology, indicate that the recently sampled well waters are acceptable for all uses due to either nondetection or very low level detection of the organic analytes. At this time the cause or source of all the low level detected organics can not be determined.

## 7.0. CONCLUSIONS

### 7.1 Parameter Distribution

The analytical results obtained from the fourth semiannual assessment monitoring event are similar to the results obtained from the previous assessment events. The analytical results indicate the northern edge of the occurrence of assessment target parameters in the groundwater primarily exists within the construction right-of-way for the proposed Route 421 bypass. South of the proposed bypass, the detection of assessment target parameters was concentrated between the saddle, located between the landfill and the Rocky Mountain Heights Subdivision, and the west and north drainages below the landfill.

#### West Drainage

In the west drainage, the detection of target parameters above groundwater standards was observed in both the soil and bedrock groundwater, extending from the landfill to the proposed bypass. All eleven target organic parameters were detected above the method LOQ in MW-12, located south of the proposed bypass. Previous organic analyses performed on the piezometer network on November 16-18, 1992, indicates the target parameters are confined to the trough of the west drainage.

One target organic parameter was estimated at a concentration below the method CRQL in the surface water sampling location, S-4, located in the west drainage. Sampling and analysis performed on surface water sampling location, S-6, located approximately 150 feet downstream from S-4, did not detect any target organic parameters. The non-target BTEX compounds, ethylbenzene, toluene, and xylene, detected in the west drainage at surface water sampling location S-2 appear to be due to pavement surface runoff, rather than groundwater discharge. This surface water sampling location receives runoff from the scale-house and the transfer station/baling facility's access roads and it is suspected the BTEX compounds originate from this runoff.

#### North Drainage

In the north drainage, the detection of target parameters is confined to the bedrock aquifer. The elevated levels of the target parameters detected in the two monitoring wells accessing the bedrock groundwater in the north drainage indicate the parameters have preferentially migrated to deeper fracture zones within the bedrock. Downgradient of the northern drainage, the bedrock aquifer system enters the central watershed of Rocky Branch and is likely significantly diluted. The low level detection of 1,1,1-TCA in the nested well pair, MW-14 and MW-15, suggests groundwater flow continues to follow the northern drainage orientation before reaching the apex of the watershed at Rocky Branch. Note, the absence of similar volatile organic parameters detected at

the Chevrolet Dealership's potable well suggests non-impact at the dealership's well location (Appendix D).

### Southern Saddle

Several organic compounds detected in the monitoring well located along the southern saddle between the landfill and the Rocky Mountain Heights subdivision, particularly methylene chloride, were observed at markedly different concentrations than the levels of the organic compounds detected in the remainder of the monitoring well network. The analytical results obtained from the monitoring well installed along the saddle between the landfill and the Rocky Mountain Heights Subdivision (MW-9) indicates the organic parameters observed in the Carroll residence potable well are not confined to the Carroll property.

## **7.2 Target Parameter Summary**

As discussed previously throughout this report, the analytical results obtained from the fourth semiannual assessment monitoring event are similar to the results obtained from the previous seven assessment events.

The detection of five target parameters, benzene, cis-1,2-DCE, TCE, chloroethane and dichlorodifluoromethane, were only reported within the west drainage and southern saddle.

The detection of 1,1,1-TCA and 1,1-DCE was observed in both the west and the north drainages, although these parameters were observed at higher levels in the north drainage, particularly at the deep bedrock well MW-2. Concentrations of 1,1,1-TCA were also estimated in both wells of the well pair, MW-14 and MW-15, located downgradient of MW-2 in the north drainage, adjacent to Rocky Branch.

The detection of PCE was observed in both the west and the north drainages, although at higher levels in the west drainage.

The detection of 1,1-DCA was observed at elevated concentrations in more monitoring wells throughout the site than any other target parameter.

Methylene chloride was observed in MW-9, located along the southern saddle between the landfill and the Rocky Mountain Heights subdivision, at concentrations 18 times the EPA MCL. Due to low level laboratory contamination of methylene chloride, the presence or absence of methylene chloride in the other 22 groundwater and surface water samples could not be determined. The low levels of methylene chloride attributed to laboratory contamination were at concentrations below the EPA MCL and less than 1/20<sup>th</sup> the concentration observed in MW-9.

Vinyl chloride was not detected in any of the groundwater or surface water samples.

As a result of four successive assessment sampling events, all the amended assessment target metal parameters were observed at levels far below EPA MCL and NC groundwater standards. In the previous third semiannual monitoring event report, Draper Aden Associates recommended the withdrawal of the metal target assessment parameters from routine groundwater monitoring. The NCDENR responded that the agency would consider completing target metal analysis annually rather than semiannually. Draper Aden Associates recommends herein, on behalf of Watauga County, the initiation of annual rather than semiannual analysis for target metals.

### 7.3 Closing

#### Next Assessment Monitoring Event

The next assessment monitoring event is tentatively scheduled to be performed in June, 1998. **Based on an evaluation of risk, combined with the steady state conditions observed in the fourth semiannual assessment monitoring event and seven previous assessment events, Draper Aden recommends the following, on behalf of Watauga County:**

- 1) the initiation of monitoring a smaller set of the core monitoring well network for semiannual monitoring and a larger set for annual monitoring, for 1998-1999
- 2) annual rather than semiannual analysis for target metals, and
- 3) withdrawal of select non-impacted assessment monitoring wells from routine groundwater monitoring during 1998-1999 for NCDENR approval.

The proposed subset of the existing twelve core monitoring well network for semiannual monitoring includes the following six core wells: MW-2, MW-3, MW-6, MW-9, MW-12 and MW-17. The groundwater at these six monitoring points exceeds the EPA MCL for one or more organic target parameters. *13?* *abandoned MW-8 installed*

Upon NCDENR approval, the next assessment monitoring event will be performed as defined above, in June, 1998. *omitting MW-7, 8, 10, 11 (contaminated) & MW-1, 15, 19 (new MW-contaminated)*

#### Additional Assessment Investigations

An additional assessment monitoring well, MW-19, was installed in the west drainage in response to trace level detections observed in the Blue Ridge Electric Company's (BREMCO) potable well (Potable Well Analysis Summary Table, Appendix D). These trace level detections suggest groundwater flow within the west drainage may follow a N55°W lineament set within the west drainage. The well was installed approximately fifty feet north-northwest of BREMCO's

potable well (well reference no. 5, see Figure 1), along the N55°W lineament set trace. Two subsequent samplings of MW-19 have resulted in no detected volatile organic compounds.

The depth of the screened interval of the proposed monitoring well was chosen to coincide with the first portion of the aquifer encountered most likely to be impacted, based on present contaminant distributions identified in the west drainage. At 55 feet in depth, the drilling encountered the geologic contact between a porous schist/gneiss unit and a dense, discretely fractured amphibolite/gneiss unit. This contact coincides with the N55°W lineament set trace at this location. The geologic contact along the N55°W lineament set trace represents a core fracture zone within the bedrock fracture system. Abundant groundwater was observed at this depth and the monitoring well was completed at 70 feet in depth and screened over the geologic contact.

Watauga County is currently exploring the options available for assessing impacts observed in the BREMCO potable well in the west drainage of landfill. Impacts observed in the BREMCO well suggest that contaminants are migrating in a deeper zone than that screened by monitoring well MW-19. The BREMCO well is reported to be drilled to a total depth of 425 feet. We have been unsuccessful at locating a detailed well record specifying groundwater production zones.

Rather than installing an additional monitoring well, the County is exploring the feasibility of utilizing the existing BREMCO well bore to identify the depth of impact. The BREMCO well is currently used only for washing vehicles; potable water is supplied via a connection to the Town of Boone's water system. The BREMCO well is an open bore and likely intersects numerous discrete fractures. The County is interested in first geophysically logging the well bore to identify water-producing fracture zones. An inflatable straddle packer assembly can then be used to hydraulically isolate and sample each discrete fracture zone. Once the impacted fracture zone(s) is identified, the packer assembly can continue to be utilized on subsequent events to discretely monitor that zone. This strategy is considered the most efficient method of evaluating the vertical distribution of impacted groundwater at this location.

## LIST OF ACRONYMS

### Acronyms and Terms

ADHD	Appalachian District Health Department
BREMCO	Blue Ridge Electric Membership Company
CFR	Code of Federal Regulations
CLP	Contract Laboratory Program
COC	Chain of Custody
CRQL	Contract Required Quantitation Limit
CVAA	Cold Vapor Atomic Absorption
DAA	Draper Aden Associates
DQO	Data Quality Objectives
EPA	Environmental Protection Agency
EQL	Estimated Quantitation Limit
GC	Gas Chromatography
GC/MS	Gas Chromatography with Mass Spectrometry
GFAA	Graphite Furnace Atomic Absorption
GMP	Groundwater Monitoring Program
IDL	Instrument Detection Level (IDL)
ICP	Inductively Coupled Plasma
LLRA	Low Level Risk Assessment
LOD	Limit of Detection
LOQ	Limit of Quantitation
MCL	Maximum Contaminant Level
MDL	Method Detection Limit
MW	Monitoring Well
NCDENR	North Carolina Department of Environment and Natural Resources
NCS	North Carolina groundwater standard
PQL	Practical Quantitation Limit
QA/QC	Quality Assurance / Quality Control
SOW	Statements of Work
SW-846	USEPA Solid Waste document 846
USEPA	United States Environmental Protection Agency
VOC	Volatile Organic Compound

### Units of Measure

μ	micron (10 <sup>-6</sup> meters)
ml	milliliter (0.001 liter)
l	liter
μg/l	microgram per liter (equivalent to parts per billion - ppb)
μS/cm	microsiemens per centimeter
°C	degrees Celsius

**APPENDIX A**  
**TABLES AND FIGURES**

Table 1

**Watauga County Landfill  
Groundwater and Surface Water  
Assessment Monitoring Schedule**

GROUNDWATER MONITORING	1st Year (94/95) Quarterly Sampling Events					Subsequent Semiannual Sampling Events*
<b>"CORE" ASSESSMENT WELLS</b>						
Target Parameter Monitoring Parameters	CLP Methods	CLP Methods	CLP Methods	CLP Methods	CLP Methods	Low Level Risk Assessment Screening Methods  CLP Methods
<b>"BOUNDARY" ASSESSMENT WELLS**</b>						
Target Parameter Monitoring Parameters	LLRA Methods	CLP Methods	CLP Methods	LLRA Methods	CLP Methods	LLRA Methods  -
<b>SURFACE WATER MONITORING</b>						
Target Parameter Monitoring Parameters	CLP Methods	-	-	CLP Methods	-	CLP Methods

CLP - EPA Contract Laboratory Program Methods  
LLRA - Low Level Risk Assessment Screening Methods (EPA SW-846)

\* - proposed initiation annual rather than semiannual analysis for target metals and initiation of a smaller set of the core monitoring well network for semiannual monitoring and a larger set for annual monitoring. (The proposed subset of the existing twelve core monitoring well network for semiannual monitoring includes the following six core wells:

MW-2, MW-3, MW-6, MW-9, MW-12 and MW-17. The groundwater at these six monitoring points exceeds the EPA MCL for one or more organic target parameters.)

\*\* - proposed withdrawal of non-impacted wells for monitoring year 1998-1999.

Watauga County Landfill  
 Watauga County, North Carolina  
 Upgradient Well: MW-1  
 1/27/1998

Table 2A  
 Fourth Semi-Annual Monitoring Event  
 Assessment Target Parameter Analytical Results  
 Core Groundwater Monitoring Wells

Parameters	Event	Results ug/L(ppb)													MCL (ug/L)
		MW-1	MW-2	MW-3	MW-7	MW-8	MW-9	MW-10	MW-11	MW-12	MW-15	MW-17	MW-19	NCS (ug/L)	
METALS, TOTAL															
Barium, Total	1/15/98	133	195	109	450	401	628	61.5	163	163	79.4	111	28.6	2000	
Chromium, Total	1/15/98	5.2	0.90	3.3	2.2	90.9	0.90	5.7	0.90	U	3.8	0.90	U	50	
Cobalt, Total	1/15/98	1.3	0.80	1.7	3.6	22.2	23.9	0.97	2.5	0.80	0.80	23.2	1.2	-	
Iron, Total	1/15/98	1970	15.7	2310	5660	18400	795	813	15.7	U	89.5	191	96.1	300*	
Nickel, Total	1/15/98	3.9	1.2	4.6	4.5	103	4.4	7.3	1.6	1.8	6.0	6.0	1.2	100	
Vanadium, Total	1/15/98	3.6	1.7	4.9	5.3	44.6	0.60	4.1	0.60	U	3.5	0.60	U	0.74	
ORGANICS															
Benzene	1/15/98	10	U	3	2	J	2	J	10	U	2	J	10	U	1
Chloroethane	1/15/98	10	U	10	19	12	12	14	U	U	5	J	10	U	-
Dichlorodifluoromethane	1/15/98	10	U	11	10	U	10	U	U	U	10	U	10	U	0.19
1,1-Dichloroethane	1/15/98	10	U	97	13	55	27	11	J	30	10	U	10	U	700
1,1,1-Trichloroethane	1/15/98	10	U	50	2	J	10	U	3	J	10	U	1	J	7
1,2-Dichloroethane (total)	1/15/98	10	U	62	11	29	14	14	U	18	10	U	10	U	70
Methylene Chloride	1/15/98	1	J	2	J	3	J	4	J	1	J	2	J	J	5
Tetrachloroethene	1/15/98	10	U	21	10	U	11	3	J	10	U	28	10	U	0.7
Trichloroethene	1/15/98	10	U	4	J	8	J	4	J	4	J	16	10	U	5
1,1,1-Trichloroethane	1/15/98	10	U	7	J	10	U	150	7	J	J	3	J	U	200
Vinyl Chloride	1/15/98	10	U	10	U	10	U	14	U	10	U	10	U	U	0.015

Notes:

U Denotes not detected. (the associated numerical value is the Instrument Detection Level (IDL) for Inorganics, and the Limit of Quantitation (LOQ) for Organics.)

J Denotes an estimated value.

Shading denotes parameter results that exceed U.S. EPA MCLs.

(1) Metal parameters were analyzed in accordance with EPA Contract Laboratory Program (CLP) Statement of Work ILMO 3.0.

CLP analytical methods utilize relevant Atomic Adsorption technique and Inductively Coupled Plasma (ICP) method for metal analysis.

(2) Organic parameters were analyzed in accordance with EPA CLP Statement of Work OLM03.2.

NCS Denotes North Carolina Groundwater Quality Standard (T15A: 02L .0200)

MCL Denotes EPA Maximum Contaminant Level (EPA 822-R-94-001)

\* Denotes a Secondary MCL for Total Iron.

. Denotes Not Established.

Watauga County Landfill  
Watauga County, North Carolina  
Upgradient Well: MW-1

Table 2B  
Fourth Semi-Annual Monitoring Event  
Assessment Target Parameter Analytical Results  
Boundary Groundwater Monitoring Wells

02/27/98

Parameters	Sampling Date											NCS (ug/L)	MCL (ug/L)
		MW-4		MW-5		MW-13		MW-14		MW-18			
Barium, Total	1/15/98	25.2		487		62.2		18.7		109		2000	2000
Chromium, Total	1/15/98	1.6		1.2		1.6		1.5		0.96		50	100
Cobalt, Total	1/15/98	0.80	U	0.80	U	0.80	U	0.80	U	0.80	U	-	-
Iron, Total	1/15/98	95.9		89.5	U	195		15.7	U	15.7	U	300*	300*
Nickel, Total	1/15/98	1.2	U	3.3		1.6		1.5		1.2	U	100	100
Vanadium, Total	1/15/98	1.2		0.95		0.60	U	2.0		1.0		-	-
Benzene	1/15/98	10	U	10	U	10	U	10	U	10	U	1	5
Chloroethane	1/15/98	10	U	10	U	10	U	10	U	10	U	-	-
Dichlorodifluoromethane	1/15/98	10	U	10	U	10	U	10	U	10	U	0.19	-
1,1-Dichloroethane	1/15/98	10	U	10	U	10	U	10	U	10	U	700	-
1,1-Dichloroethene	1/15/98	10	U	10	U	10	U	10	U	10	U	7	7
1,2-Dichloroethene (total)	1/15/98	10	U	10	U	10	U	10	U	10	U	70	70
Methylene Chloride	1/15/98	2	J	2	J	1	J	1	J	1	J	5	5
Tetrachloroethene	1/15/98	10	U	10	U	10	U	10	U	10	U	0.7	5
Trichloroethene	1/15/98	10	U	10	U	10	U	10	U	10	U	2.8	5
1,1,1-Trichloroethane	1/15/98	10	U	10	U	10	U	1	J	10	U	200	200
Vinyl Chloride	1/15/98	10	U	10	U	10	U	10	U	10	U	0.015	2

Notes:

NCS Denotes North Carolina Groundwater Quality Standard (T15A: 02L .0200)

MCL Denotes EPA Maximum Contaminant Level (EPA 822-R-94-001)

\* Denotes a Secondary MCL for Total Iron.

U Denotes not detected. (the associated numerical value is the IDL for Inorganics, and the LOQ for Organics.)

- Denotes Not Established.

J Denotes an estimated value.

(1) Metal parameters were analyzed in accordance with EPA Contract Laboratory Program (CLP) Statement of Work ILMO 3.0.

CLP analytical methods utilize relevant Atomic Adsorption technique and Inductively Coupled Plasma (ICP) method for metal analysis.

(2) Organic parameters were analyzed in accordance with EPA CLP Statement of Work OLMO3.2.

Watauga County Landfill  
 Watauga County, North Carolina  
 Upgradient Well: MW-1

Table 2C  
 Fourth Semi-Annual Monitoring Event  
 Assessment Target Parameter Analytical Results  
 Surface Water Monitoring Locations

02/27/98

*SN standard*

Parameters	Sampling Date	Results ug/L(ppb)						WQS (ug/L)	MCL (ug/L)	
		S-1	S-2	S-3	S-4	S-5	S-6			
METALS, TOTAL										
Barium, Total	1/15/98	331	887	320	337	298	194	1000	2000	
Chromium, Total	1/15/98	1.5	1.3	0.90	U	4.1	10.6	-	100	
Cobalt, Total	1/15/98	8.5	15.9	7.2	23.5	3.7	8.0	-	-	
Iron, Total	1/15/98	6720	39200	4640	18800	49200	10500	-	300*	
Nickel, Total	1/15/98	2.6	3.3	2.0	10.7	4.4	10.3	25	100	
Vanadium, Total	1/15/98	0.69	1.4	0.60	U	12.4	17.4	-	-	
ORGANICS										
Benzene	1/15/98	10	U	J	10	U	10	U	1.19	5
Chloroethane	1/15/98	10	U	U	10	U	10	U	-	-
Dichlorodifluoromethane	1/15/98	10	U	U	10	U	10	U	-	-
1,1-Dichloroethane	1/15/98	10	U	U	10	U	10	U	-	-
1,1-Dichloroethene	1/15/98	10	U	U	10	U	10	U	-	7
1,2-Dichloroethene (total)	1/15/98	10	U	J	10	J	10	U	-	70
Methylene Chloride	1/15/98	1	J	J	4	J	2	J	-	5
Tetrachloroethene	1/15/98	10	U	U	10	U	10	U	0.8	5
Trichloroethene	1/15/98	10	U	U	10	U	10	U	3.08	5
1,1,1-Trichloroethane	1/15/98	10	U	U	10	U	2	J	-	200
Vinyl Chloride	1/15/98	10	U	U	10	U	10	U	2	2

*77.4*  
*860*  
*92*  
*1000*  
*555*

Notes:

- WQS Denotes North Carolina Class WS-1 Surface Water Quality Standard (T15A: 02B .0200)
- MCL Denotes EPA Maximum Contaminant Level (EPA 822-R-94-001)
- U Denotes not detected. (the associated numerical value is the IDL for Inorganics, and the LOQ for Organics.)
- J Denotes an estimated value.
- \* Denotes a Secondary MCL for Total Iron.
- Denotes Not Established.

- (1) Metal parameters were analyzed in accordance with EPA Contract Laboratory Program (CLP) Statement of Work ILMO 3.0. CLP analytical methods utilize relevant Atomic Adsorption technique and Inductively Coupled Plasma (ICP) method for metal analysis.
- (2) Organic parameters were analyzed in accordance with EPA CLP Statement of Work OLMO3.2.

Watauga County Landfill  
 Watauga County, North Carolina  
 Upgradient Well: MW-1  
 02/16/98

Table 3  
 Fourth Semi-Annual Assessment Monitoring Event

**PRELIMINARY, UNVALIDATED** Detected Non-Target Organic Parameters

Parameter	Event	S-2	MW-7		NCS (ug/L)	MCL (ug/L)
			2	J		
1,2-Dichloropropene	1/15/98	~			-	-
Ethylbenzene	1/15/98	2	J		29	700
Toluene	1/15/98	2	J		1000	1000
Xylene (total)	1/15-98	6	J		530	10000

Tentatively Identified Compounds

Parameter	Event	S-2	MW-3	MW-8	MW-9	MW-12	MW-17	NCS (ug/L)	MCL (ug/L)
Ether	1/15/98	7	~	~	~	~	~	-	-
Trimethylsilanol	1/15/98	~	7	NJ	6	NJ	~	-	-
Dichlorofluoromethane	1/15-98	~	14	NJ	22	NJ	9	1400	-

Notes:

- NCS Denotes North Carolina Groundwater Quality Standard (T15A: 02L .0200)
- MCL Denotes EPA Maximum Contaminant Level (EPA 822-R-94-001)
- ~ Denotes Not Detected
- Denotes Not Available
- J Denotes an estimated value
- N Denotes tentatively identified
- Organic parameters were analyzed in accordance with USEPA CLP SOW OLMO 3.2.

Watauga County Landfill  
 Watauga County, North Carolina  
 Upgradient Well: MW-1  
 02/16/98

Table 3  
 Fourth Semi-Annual Assessment Monitoring Event

**PRELIMINARY, UNVALIDATED** Detected Non-Target Organic Parameters

Parameter	Event	S-2	MW-7		NCS (ug/L)	MCL (ug/L)
			~	J		
1,2-Dichloropropene	1/15/98	~	~	J	-	-
Ethylbenzene	1/15/98	2	~	~	29	700
Toluene	1/15/98	2	~	~	1000	1000
Xylene (total)	1/15-98	6	~	~	530	10000

Tentatively Identified Compounds

Parameter	Event	S-2	MW-3	MW-8	MW-9	MW-12	MW-17	NCS (ug/L)	MCL (ug/L)
Ether	1/15/98	7	~	~	~	~	~	-	-
Trimethylsilanol	1/15/98	~	7	NJ	6	NJ	~	-	-
Dichlorofluoromethane	1/15-98	~	14	NJ	22	NJ	10	1400	-

Notes:

NCS Denotes North Carolina Groundwater Quality Standard (T15A: 02L .0200)

MCL Denotes EPA Maximum Contaminant Level (EPA 822-R-94-001)

~ Denotes Not Detected

- Denotes Not Available

J Denotes an estimated value

N Denotes tentatively identified

Organic parameters were analyzed in accordance with USEPA CLP SOW OLMO 3.2.

TABLE 4  
GROUNDWATER LEVEL DATA  
MONITORING WELLS

DATE	REFERENCE ELEVATION								
	MW-1	MW-2	MW-3	MW-4	MW-5	MW-6	MW-7	MW-8	MW-9
GROUND	3339.03	3151.24	3182.25	3150.06	3263.81	3263.55	3270.56	3235.39	3356.65
MEASURING POINT	3341.80	3152.94	3183.12	3152.52	3267.69	3266.04	3273.53	3239.77	3359.23

DATE	STATIC WATER LEVEL								
6/20/94	38.00	7.88	18.43	13.48	NM	44.12	23.03	17.68	59.35
9/27/94	39.69	7.51	17.42	10.45	NM	43.99	30.73	17.38	57.79
2/6/95	37.57	5.98	16.20	8.18	50.39	42.85	45.88	15.41	59.50
4/11/95	37.94	6.46	16.85	9.22	48.95	42.81	49.11	16.05	59.30
7/10/95	41.20	6.60	17.43	8.94	50.29	43.73	48.98	17.42	80.17
4/9/96	38.71	5.85	7.01	8.40	49.87	42.87	44.32	16.80	61.28
4/8/97	38.30	5.59	16.35	NM	NM	ABANDONED	40.50	17.43	62.47
1/13/98	43.71	7.00	17.51	8.54	55.46	ABANDONED	44.18	20.32	63.56

DATE	GROUNDWATER ELEVATION								
6/20/94	3303.80	3145.05	3164.69	3132.04	NM	3221.92	3250.50	3222.09	3299.88
9/27/94	3302.11	3145.43	3165.70	3142.07	NM	3222.05	3242.80	3222.39	3301.44
2/6/95	3304.23	3147.36	3166.92	3144.34	3217.30	3223.19	3227.65	3224.36	3299.69
4/11/95	3303.86	3146.48	3166.27	3143.30	3218.74	3223.23	3224.42	3223.72	3299.93
7/10/95	3300.60	3146.34	3165.69	3143.58	3217.40	3223.31	3224.55	3222.35	3279.06
4/9/96	3303.09	3147.09	3176.11	3144.12	3217.82	3223.17	3229.21	3222.97	3297.95
4/8/97	3303.50	3147.35	3166.77	NM	NM	ABANDONED	3233.03	3222.34	3296.76
1/13/98	3298.09	3145.94	3165.61	3143.98	3212.23	ABANDONED	3229.35	3219.45	3295.67

DATE	REFERENCE ELEVATION								
	MW-10	MW-11	MW-12	MW-13	MW-14	MW-15	MW-16	MW-17	MW-18
GROUND	3202.18	3156.44	3156.82	3117.39	3117	3117.15	3441.42	3181.14	3117.12
MEASURING POINT	3203.87	3159.6	3159.15	3119.72	3120	3120.65	3442.72	3183.62	3119.63

DATE	STATIC WATER LEVEL								
6/20/94	8.18	13.35	11.04	19.66	7.94	11.92	5.32	17.93	17.93
9/27/94	8.09	13.22	10.78	19.57	7.89	11.82	5.68	17.83	17.86
2/6/95	7.73	13.22	10.61	19.39	7.52	11.55	4.61	17.05	17.58
4/11/95	7.90	13.00	10.58	19.53	7.75	11.87	5.11	17.48	17.65
7/10/95	7.91	12.53	10.48	19.62	7.74	11.96	4.54	18.11	17.94
4/9/96	7.67	12.73	10.38	19.56	7.59	11.85	4.67	17.78	17.81
4/8/97	7.67	12.28	9.48	NM	NM	11.91	ABANDONED	17.17	NM
1/13/98	8.25	12.48	9.65	19.75	7.44	11.74	ABANDONED	18.60	18.32

DATE	GROUNDWATER ELEVATION								
6/20/94	3195.69	3146.25	3148.11	3100.06	3112.06	3108.73	3137.40	3165.69	3101.70
9/27/94	3195.78	3146.38	3148.37	3100.15	3112.11	3108.83	3137.04	3165.79	3101.77
2/6/95	3196.14	3146.38	3148.54	3100.33	3112.48	3109.10	3138.11	3166.57	3102.05
4/11/95	3195.97	3146.60	3148.57	3100.19	3112.25	3108.78	3137.61	3166.14	3101.98
7/10/95	3195.96	3147.07	3148.67	3100.10	3112.26	3108.69	3138.18	3165.51	3101.69
4/9/96	3196.20	3146.87	3148.77	3100.16	3112.41	3108.80	3138.05	3165.84	3101.82
4/8/97	3196.20	3147.32	3149.67	NM	NM	3108.74	ABANDONED	3165.45	NM
1/13/98	3195.62	3147.12	3149.50	3099.97	3112.56	3108.91	ABANDONED	3165.02	3101.31

1) ALL MEASUREMENTS IN FEET.  
2) ALL ELEVATIONS REFERENCE MEAN SEA LEVEL.  
3) MEASURING POINT (M.P.) IS FROM THE TOP OF WELL CASING.  
4) NM - NOT MEASURED

5) ESTIMATED ELEVATION OF MW-19 IS 3125.0.  
STATIC WATER LEVEL FOR MW-19 ON 4/8/97 WAS 4.85 FT, AND ON 1/15/97 WAS 10.21 FT.  
CORRESPONDING GROUNDWATER ELEVATION FOR MW-19 ON 4/8/97 WAS 3120.15 FT,  
AND ON 1/13/97 WAS 3114.79 FT.





saddle/Carroll property.

- 3) It is necessary, once the final locations have been decided, to obtain Section approval on the installation of additional monitoring wells.
- 4) Can further details be provided on the future activities anticipated on the "continuing assessment investigation" for the three areas of concern - the north and west drainage features and the area around the southern saddle/Carroll property?
- 5) Please summarize the results and outline future plans of the on-going investigation referenced on page 7, second paragraph, to determine the source of contamination in the potable supply wells.
- 6) **Mention that the Landfill is not under the Subtitle 'D' requirements (Appendix I and II lists).** Approval is given to amend the sample parameter list as proposed (adding Chromium, Cobalt, Nickel, and Vanadium; deleting Cadmium, Mercury and trans-1,3-Dichloropropene). Please submit an updated list in the next report of the new sample analyte list. Is it the County's intention to continue to collect and analyze samples per the CLP validation guidelines?

 7) **See table 5A and 5B in the *Initial Background Data Set, Fourth Quarter Event, dated October 9, 1995, for water quality data questions.***

- 8) The Section requests a copy of the potable well sampling program and recommends that an evaluation of possible "breakdown" products of the primary contaminants detected in the Landfill monitoring system be performed. The possible "breakdown" products should be included in the potable well analytical list.
- 9) Tables 3A and 3B were not included in the *Initial Background Data Set, Second Quarter Event, dated February 17, 1995* (page 17, second paragraph). *Please send copies of these tables with next submittal.*
- 10) In the *First Semi-Annual Event* report dated January 12, 1996, page 6, fourth paragraph; clarification is needed on what wells were used to obtain water level elevations.
- 11) Conditional approval is given on the proposed *routine* compliance monitoring program. The condition requires that the wells that will be withdrawn from the *routine* compliance monitoring program (MW's- 4, 5, 13, 14, 16 and 18) be rotated in and out of routine monitoring on a regular basis. A proposal should be included in the next report for Section evaluation.

If I can be of further assistance or if you have any further questions or comments, please call me at (919) 733-0692.

*of Bremen well.  
Approval is implemented  
before next sampling event.*

Sincerely,

Watauga County, North Carolina  
 Upgradient Well: MW-1  
 02/27/98

Table 5B  
 Background Assessment Organic Target Parameter Analytical Results  
 Boundary Groundwater Monitoring Wells  
 Results ug/(ppb)

*Steenerson*

Parameter	Event	MW-4	MW-5	MW-13	MW-14	MW-16	MW-18	Analysis Type	NCS (ug/L)	MCL (ug/L)	
Benzene	6/20/94	10	U	5.30	U	5.30	U	5.30	U	8021	1
	9/27/94	2	J	10	U	2	J	1	J	CLP	1
	2/06/95	10	U	1.0	U	1.0	U	1.0	U	8021	1
	4/11/95	10	U	10	U	10	U	10	U	CLP	1
	7/10/95	10	U	10	U	10	U	10	U	8021	1
	4/10/96	-	-	-	-	-	-	-	-	CLP	1
	4/8/97	-	-	-	-	-	-	-	-	8021	1
	1/15/98	10	U	10	U	9.29	U	9.29	U	CLP	1
	6/20/94	10	U	9.29	U	9.29	U	9.29	U	8021	1
	9/27/94	18	U	10	U	10	U	10	U	CLP	-
Chloroethane	2/06/95	10	U	1.0	U	1.0	U	1.0	U	8021	-
	4/11/95	10	U	10	U	10	U	10	U	CLP	-
	7/10/95	10	U	10	U	10	U	10	U	8021	-
	4/10/96	-	-	-	-	-	-	-	-	CLP	-
	4/8/97	-	-	-	-	-	-	-	-	8021	-
	1/15/98	10	U	10	U	10	U	10	U	CLP	-
	6/20/94	10	U	46.64	U	46.64	U	46.64	U	8021	0.19
	9/27/94	10	U	10	U	10	U	10	U	CLP	0.19
	2/06/95	10	U	1.0	U	1.0	U	1.0	U	8021	0.19
	4/11/95	10	U	10	U	10	U	10	U	CLP	0.19
1,1-Dichloroethane	7/10/95	10	U	10	U	10	U	10	U	8021	0.19
	4/10/96	-	-	-	-	-	-	-	-	CLP	0.19
	4/8/97	-	-	-	-	-	-	-	-	8021	0.19
	1/15/98	10	U	10	U	10	U	10	U	CLP	0.19
	6/20/94	10	U	0.99	J	43.10	U	43.10	U	8021	700
	9/27/94	10	U	10	U	10	U	10	U	CLP	700
	2/06/95	10	U	1.0	U	1.0	U	1.0	U	8021	700
	4/11/95	10	U	10	U	10	U	10	U	CLP	700
	7/10/95	10	U	10	U	10	U	10	U	8021	700
	4/10/96	-	-	-	-	-	-	-	-	CLP	700
1,1-Dichloroethene	1/15/98	10	U	10	U	10	U	10	U	8021	700
	6/20/94	10	U	9.75	U	9.75	U	9.75	U	CLP	700
	9/27/94	10	U	10	U	10	U	10	U	8021	7
	2/06/95	10	U	1.0	U	1.0	U	1.0	U	CLP	7
	4/11/95	10	U	10	U	10	U	10	U	8021	7
	7/10/95	10	U	10	U	10	U	10	U	CLP	7
	4/10/96	-	-	-	-	-	-	-	-	8021	7
	4/8/97	-	-	-	-	-	-	-	-	CLP	7
	1/15/98	10	U	10	U	10	U	10	U	8021	7
	6/20/94	10	U	9.49	U	9.49	U	9.49	U	CLP	7
cis-1,2-Dichloroethene (3)	9/27/94	10	U	10	U	10	U	10	U	8021	70
	2/06/95	10	U	1.0	U	1.0	U	1.0	U	CLP	70
	4/11/95	10	U	10	U	10	U	10	U	8021	70
	7/10/95	10	U	10	U	10	U	10	U	CLP	70
	4/10/96	-	-	-	-	-	-	-	-	8021	70
	4/8/97	-	-	-	-	-	-	-	-	CLP	70
	1/15/98	10	U	10	U	10	U	10	U	8021	70
	6/20/94	10	U	24.49	U	24.49	U	24.49	U	CLP	70
	9/27/94	10	U	10	U	10	U	10	U	8021	-
	trans-1,3-Dichloropropene	6/20/94	10	U	10	U	10	U	10	U	CLP
9/27/94		10	U	1.0	U	1.0	U	1.0	U	8021	-
2/06/95		10	U	1.0	U	1.0	U	1.0	U	CLP	-
4/11/95		10	U	10	U	10	U	10	U	8021	-
7/10/95		10	U	10	U	10	U	10	U	CLP	-

mw- mw-  
16 18

Methylene Chloride	6/20/94	10	U	U	36.20	UJ	36.20	UJ	36.20	U	8021	5	5	
		9/27/94	13	U	-	10	U	10	U	10	U	CLP	5	5
Tetrachloroethene	2/06/95	10	U	1.0	U	1.0	U	1.0	U	1.0	U	8021	5	
	4/11/95	10	U	10	U	10	U	10	U	10	U	CLP	5	
	7/10/95	10	U	10	U	10	U	10	U	10	U	8021	5	
	4/10/96	-	-	-	-	-	-	-	-	-	-	CLP	5	
	4/8/97	-	-	-	-	-	-	-	-	-	-	8021	5	
	1/15/98	-	-	-	-	-	-	-	-	-	-	CLP	5	
	6/20/94	10	U	-	7.84	U	0.24	J	7.84	U	7.84	U	8021	0.7
	9/27/94	10	U	-	10	U	10	U	10	U	10	U	CLP	0.7
	2/06/95	10	U	1.0	U	1.0	U	1.0	U	1.0	U	8021	0.7	
	4/11/95	10	U	10	U	10	U	10	U	10	U	CLP	0.7	
Trichloroethene	7/10/95	10	U	10	U	10	U	10	U	10	U	8021	0.7	
	4/10/96	-	-	-	-	-	-	-	-	-	-	CLP	0.7	
	4/8/97	-	-	-	-	-	-	-	-	-	-	8021	0.7	
	1/15/98	10	U	10	U	10	U	10	U	10	U	CLP	0.7	
	6/20/94	10	U	-	21.20	U	21.20	U	21.20	U	21.20	U	8021	2.8
	9/27/94	10	U	-	10	U	10	U	10	U	10	U	CLP	2.8
	2/06/95	10	U	2.5	U	2.5	U	2.5	U	2.5	U	8021	2.8	
	4/11/95	10	U	10	U	10	U	10	U	10	U	CLP	2.8	
	7/10/95	10	U	10	U	10	U	10	U	10	U	8021	2.8	
	4/10/96	-	-	-	-	-	-	-	-	-	-	CLP	2.8	
1,1,1-Trichloroethane	4/8/97	-	-	-	-	-	-	-	-	-	-	8021	2.8	
	1/15/98	10	U	10	U	10	U	10	U	10	U	CLP	2.8	
	6/20/94	10	U	-	30.11	U	30.11	U	30.11	U	30.11	U	8021	200
	9/27/94	10	U	-	10	U	10	U	10	U	10	U	CLP	200
	2/06/95	10	U	1.0	U	1.0	U	1.0	U	1.0	U	8021	200	
	4/11/95	10	U	10	U	10	U	10	U	10	U	CLP	200	
	7/10/95	10	U	10	U	10	U	10	U	10	U	8021	200	
	4/10/96	-	-	-	-	-	-	-	-	-	-	CLP	200	
	4/8/97	-	-	-	-	-	-	-	-	-	-	8021	200	
	1/15/98	10	U	10	U	10	U	10	U	10	U	CLP	200	
Vinyl Chloride	6/20/94	10	U	-	6.60	UJ	6.60	UJ	6.60	UJ	6.60	U	8021	0.02
	9/27/94	10	U	-	10	U	10	U	10	U	10	U	CLP	0.02
	2/06/95	10	U	1.0	U	1.0	U	1.0	U	1.0	U	8021	0.02	
	4/11/95	10	UJ	10	U	10	UJ	10	UJ	10	UJ	CLP	0.02	
	7/10/95	10	U	10	U	10	U	10	U	10	U	8021	0.02	
	4/10/96	-	-	-	-	-	-	-	-	-	-	CLP	0.02	
	4/8/97	-	-	-	-	-	-	-	-	-	-	8021	0.02	
	1/15/98	10	U	10	U	10	U	10	U	10	U	CLP	0.02	

*Subsided*

TABLE 5B NOTES:  
 U Denotes not detected (the associated numerical value is the CRQL/LOQ).  
 J Denotes an estimated value.  
 CRQL Contract Required Quantification Limit (CLP Methods)  
 LOQ Limit of Quantitation (SW-846 Methods)  
 - Denotes Not Available or Not Sampled.  
 Shading - denotes parameter results that exceed U.S. EPA Maximum Contaminant Levels.  
 NCS Denotes North Carolina Groundwater Quality Standard (T15A: 02L .0200).  
 MCL Denotes EPA Maximum Contaminant Level (EPA 822-R-94-001).

ANALYSIS TYPE:

- 1) For the 9/27/94, 4/11/95, 4/10/96 and 1/15/98 events, boundary monitoring well analyses were performed utilizing CLP Statement of Work OLMO3.2, SW-846 Method #8260 and/or #8021, as noted.
- 2) For CLP, 1,2-Dichloroethene was reported as total concentration; for 8021/8260 concentration was reported for cis-isomer.
- 3) For the 6/20/94, 2/6/95, 7/10/95 and 4/8/97 events, boundary monitoring well analyses were performed utilizing SW-846 Method #8021.

P:\0615\20\06520-21\CORRESP\REPORTS\TABLE5B4.XLS\BOUNDARY

Watauga County, North Carolina  
 Upgradient Well: MW-1  
 02/27/98

Table 5C  
 Background Assessment Organic Target Parameter Analytical Results  
 Surface Water Sampling Locations  
 Results ug/(ppb)

SW standard.

71.4

B60

570,000

42

3.2

17,000

Parameter	Event	S1	S2	S3	S4	S5	L1	Mt. Spring	MOS (ug/L)	MCL (ug/L)	
ORGANICS											
Benzene	6/20/94	10	3	10	U	1	J	10	U	1.19	5
	9/27/94	-	-	U	U	10	U	10	U	1.19	5
	2/06/95	10	10	U	U	10	U	10	U	1.19	5
	4/11/95	-	-	-	-	-	-	-	-	1.19	5
	7/10/95	10	10	U	U	10	U	10	U	1.19	5
	4/10/96	10	2	J	U	10	U	10	U	1.19	5
	4/8/97	10	2	J	U	10	U	10	U	1.19	5
	1/15/98	10	3	J	U	10	U	10	U	1.19	5
	6/20/94	10	56	10	U	10	U	11	-	1.19	5
	9/27/94	-	-	-	-	-	-	13	10	U	-
Chloroethane	2/06/95	10	26	10	U	2	J	7	U	-	-
	4/11/95	-	-	-	-	-	6	J	-	-	-
	7/10/95	15	10	U	U	4	J	10	U	-	-
	4/10/96	8	46	10	U	3	J	5	J	-	-
	4/8/97	10	50	10	U	1	J	23	-	-	-
	1/15/98	10	56	10	U	10	U	10	U	-	-
	6/20/94	10	4	J	U	10	U	10	U	-	-
	9/27/94	-	-	-	-	-	-	10	U	10	U
	2/06/95	10	10	U	U	10	U	10	U	-	-
	4/11/95	-	-	-	-	-	-	10	U	-	-
Dichlorodifluoromethane	7/10/95	10	10	U	U	10	U	10	U	-	-
	4/10/96	10	10	U	U	10	U	10	U	-	-
	4/8/97	10	10	U	U	10	U	10	U	-	-
	1/15/98	10	10	U	U	10	U	10	U	-	-
	6/20/94	1	23	10	U	59	J	2	J	-	-
	9/27/94	-	-	-	-	-	-	10	U	10	U
	2/06/95	10	10	U	U	45	J	10	U	-	-
	4/11/95	-	-	-	-	-	-	10	U	-	-
	7/10/95	6	20	10	U	41	J	2	J	-	-
	4/10/96	3	15	10	U	30	J	2	J	-	-
1,1-Dichloroethane	4/8/97	10	14	10	U	12	U	10	U	-	-
	1/15/98	10	15	10	U	10	U	10	U	-	-
	6/20/94	10	10	U	U	10	U	10	U	-	-
	9/27/94	-	-	-	-	-	-	10	U	10	U
	2/06/95	10	10	U	U	10	U	10	U	-	-
	4/11/95	-	-	-	-	-	-	10	U	-	-
	7/10/95	10	10	U	U	10	U	10	U	-	-
	4/10/96	10	10	U	U	35	U	10	U	-	-
	4/8/97	10	10	U	U	15	U	10	U	-	-
	cis-1,2-Dichloroethene (3)	1/15/98	10	10	U	U	1	J	10	U	-
6/20/94		10	4	J	U	58	U	10	U	-	-
9/27/94		-	-	-	-	-	-	10	U	10	U
2/06/95		10	10	U	U	42	U	10	U	-	-
4/11/95		-	-	-	-	-	-	10	U	-	-
7/10/95		1	3	J	U	42	U	10	U	-	-
4/10/96		10	5	J	U	10	U	10	U	-	-
4/8/97		10	6	J	U	10	U	10	U	-	-
1/15/98		10	5	J	U	10	U	10	U	-	-
trans-1,3-Dichloropropene		6/20/94	10	10	U	U	10	U	10	U	-
	9/27/94	-	-	-	-	-	-	10	U	10	U
	2/06/95	10	10	U	U	10	U	10	U	-	-
	4/11/95	-	-	-	-	-	-	10	U	-	-
	7/10/95	10	10	U	U	10	U	10	U	-	-



Watauga County Landfill  
Watauga County, North Carolina  
Upgradient Well: MW-1  
02/27/98

Table 5D  
Background Assessment Metal Target Parameter Analytical Results  
Core Groundwater Monitoring Wells

Parameter	Event	Results ug/(ppb)											Analysis Type	NCS (ug/L)	MCL (ug/L)		
		MW-1	MW-2	MW-3	MW-4	MW-6	MW-8	MW-9 METALS	MW-10 TOTAL	MW-11	MW-12	MW-17					
Barium, Total	6/7094	203	199	123	24.2	652	281	710	117	101	117	117	117	117	CLP	2000	2000
	9/27/94	129	204	119	23.5	502	86.9	632	133	101	133	133	133	133	CLP	2000	2000
	2/6/95	157	192	160	27.2	418	70.4	478	176	104	176	176	176	176	CLP	2000	2000
	4/11/95	143	212	87	23.2	477	65	628	295	97.7	295	295	295	295	CLP	2000	2000
	7/10/95	153	216	94.5	23.8	499	70.6	612	199	110	199	199	199	199	CLP	2000	2000
	4/10/96	144	178	82	-	570	63.5	507	268	119	268	268	268	268	CLP	2000	2000
Iron, Total	4/8/97	171	217	9	-	370	259	659	83	145	137	137	137	137	CLP	2000	2000
	6/20/94	168	244	9950	24.4	24900	16100	7060	337	1800	337	337	337	337	CLP	300	300*
	9/27/94	1390	140	9320	71.8	9170	418	42	3100	16	149	149	149	149	CLP	300	300*
	2/6/95	2350	46	6610	552	5930	368	735	2240	61.3	296	296	296	296	CLP	300	300*
	4/11/95	2490	245	3600	54.4	8300	149	81.7	234	54.4	63.7	63.7	63.7	63.7	CLP	300*	300*
	7/10/95	646	U*	4480	U*	7980	U*	U*	508	U*	48.5	48.5	48.5	48.5	CLP	300*	300*
Cadmium, Total	4/10/96	660	257	8550	-	9760	334	348	3340	13.3	U*	U*	U*	U*	CLP	300*	300*
	4/8/97	8760	U*	4480	-	-	11500	U*	U*	U*	U*	U*	U*	U*	CLP	300*	300*
	6/20/94	6.0	4.5	U	4.5	U	4.5	U	4.5	U	4.5	U	4.5	U	CLP	5	5
	9/27/94	4.3	4.6	U	4.6	U	4.3	U	4.6	U	4.3	U	4.6	U	CLP	5	5
	2/6/95	0.3	4.4	U	4.4	U	4.4	U	4.4	U	4.4	U	4.4	U	CLP	5	5
	4/11/95	0.3	U	0.3	U	0.3	U	0.3	U	0.3	U	0.3	U	0.3	CLP	5	5
Mercury, Total	7/10/95	0.3	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	CLP	5	5
	4/10/96	-	-	-	-	-	-	-	-	-	-	-	-	-	CLP	5	5
	4/8/97	-	-	-	-	-	-	-	-	-	-	-	-	-	CLP	5	5
	6/20/94	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	0.2	CLP	5	5
	9/27/94	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	0.2	CLP	1.1	2
	2/6/95	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	0.2	CLP	1.1	2
4/11/95	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	0.2	CLP	1.1	2	
7/10/95	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	0.2	CLP	1.1	2	
4/10/96	-	-	-	-	-	-	-	-	-	-	-	-	-	CLP	1.1	2	
4/8/97	-	-	-	-	-	-	-	-	-	-	-	-	-	CLP	1.1	2	

TABLE 5D NOTES:

- NCS Denotes North Carolina Groundwater Quality Standard (T15A: 02L .0200)
- MCL Denotes EPA Maximum Contaminant Level (EPA 822-R-94-001)
- U Denotes not detected (the associated numerical value is the Instrument Detection Level (IDL)).
- U\* Denotes result less than 5X method blank concentration.
- Denotes an estimated value
- \* Denotes a Secondary Maximum Contaminant Level (SMCL) for Total Iron
- Denotes Not Available or Not Sampled
- Shading: - denotes parameter results that exceed U.S. EPA Maximum Contaminant Levels.

ANALYSIS TYPE:  
CLP analytical methods utilize relevant Atomic Adsorption technique and Inductively Coupled Plasma (ICP) method in accordance with EPA Contract Laboratory Program (CLP) Statement of Work ILMO 3.0 for metal analysis.

Watauga County Landfill  
Watauga County, North Carolina  
Upgradient Well: MW-1  
02/27/98

Table 5E  
Background Assessment Metal Target Parameter Analytical Results  
Boundary Groundwater Monitoring Wells and Surface Water Sampling Locations

Parameter	Event	Results ug/(ppb)																MCL (ug/L)
		MW-5	MW-7	MW-13	MW-14	MW-15	MW-16	MW-18 METALS TOTAL	SI	S2	S3	S4	S5	L1	Mt Spring	NCS (ug/L)		
Barium, Total	6/20/94	-	439	54.2	18.4	94.9	66.8	73.6	133	755	366	94.1	197	-	-	-	2000	
	9/27/94	710	698	59.7	17.4	79	70.6	78.7	-	-	-	-	-	-	-	-	2000	
	2/06/95	591	743	79.4	16.3	82.3	72.5	67.9	86.8	350	235	82.5	472	2240	5.5	-	2000	
	4/11/95	700	426	54.4	16.4	78.4	70.3	83	-	-	-	-	-	-	-	-	2000	
	7/10/95	-	612	116	19.5	56.3	67	90	502	592	277	861	310	-	-	-	2000	
	4/8/97	-	10300	-	-	77.3	-	-	-	122	732	253	72	11500	-	-	2000	
Iron, Total	6/20/94	-	15200	283	100	2110	78.6	24.4	11300	30800	8500	1040	26400	-	-	-	2000	
	9/27/94	475	19200	450	3.8	554	117	12.2	-	-	-	-	-	31.4	-	300*		
	2/06/95	15.7	26400	2370	61.3	975	490	61.3	13200	42000	8790	3110	90300	255000	-	300*		
	4/11/95	9.7	5180	131	40.8	490	331	40.8	19400	36100	5740	1290	87900	-	-	300*		
	7/10/95	-	12000	-	-	194	9.7	9.7	503	4390	1260	285	688	-	-	-	300*	
	4/8/97	-	10300	-	-	U*	-	-	7480	29100	5300	529	2000000	-	-	-	300*	
Cadmium, Total	6/20/94	-	4.5	U	4.5	U	4.5	U	4.5	U	4.5	U	4.5	U	4.5	U	3	
	9/27/94	4.4	4.3	U	4.3	U	4.6	U	4.4	U	4.4	U	4.4	U	4.4	U	3	
	2/06/95	0.3	12.3	0.3	4.4	U	4.4	U	4.4	U	4.4	U	4.4	U	4.4	U	3	
	4/11/95	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	3	
	7/10/95	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	
	4/8/97	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	
Mercury, Total	6/20/94	-	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	1.1	
	9/27/94	0.2	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	1.1	
	2/06/95	0.2	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	1.1	
	4/11/95	0.2	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	1.1	
	7/10/95	0.2	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	0.2	U	1.1	
	4/8/97	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.1	

TABLE 5E NOTES:  
NCS Denotes North Carolina Groundwater Quality Standard (T.15A: 02L .0200)  
MCL Denotes EPA Maximum Contaminant Level (EPA 822-R-94-001)  
U Denotes not detected (the associated numerical value is the Instrument Detection Level (IDL)).  
U\* Denotes result less than 5X method blank concentration.  
} Denotes an estimated value  
\* Denotes a Secondary Maximum Contaminant Level (SMCL) for Total Iron  
- Denotes Not Available or Not Sampled  
Shading: - denotes parameter results that exceed U.S. EPA Maximum Contaminant Levels.

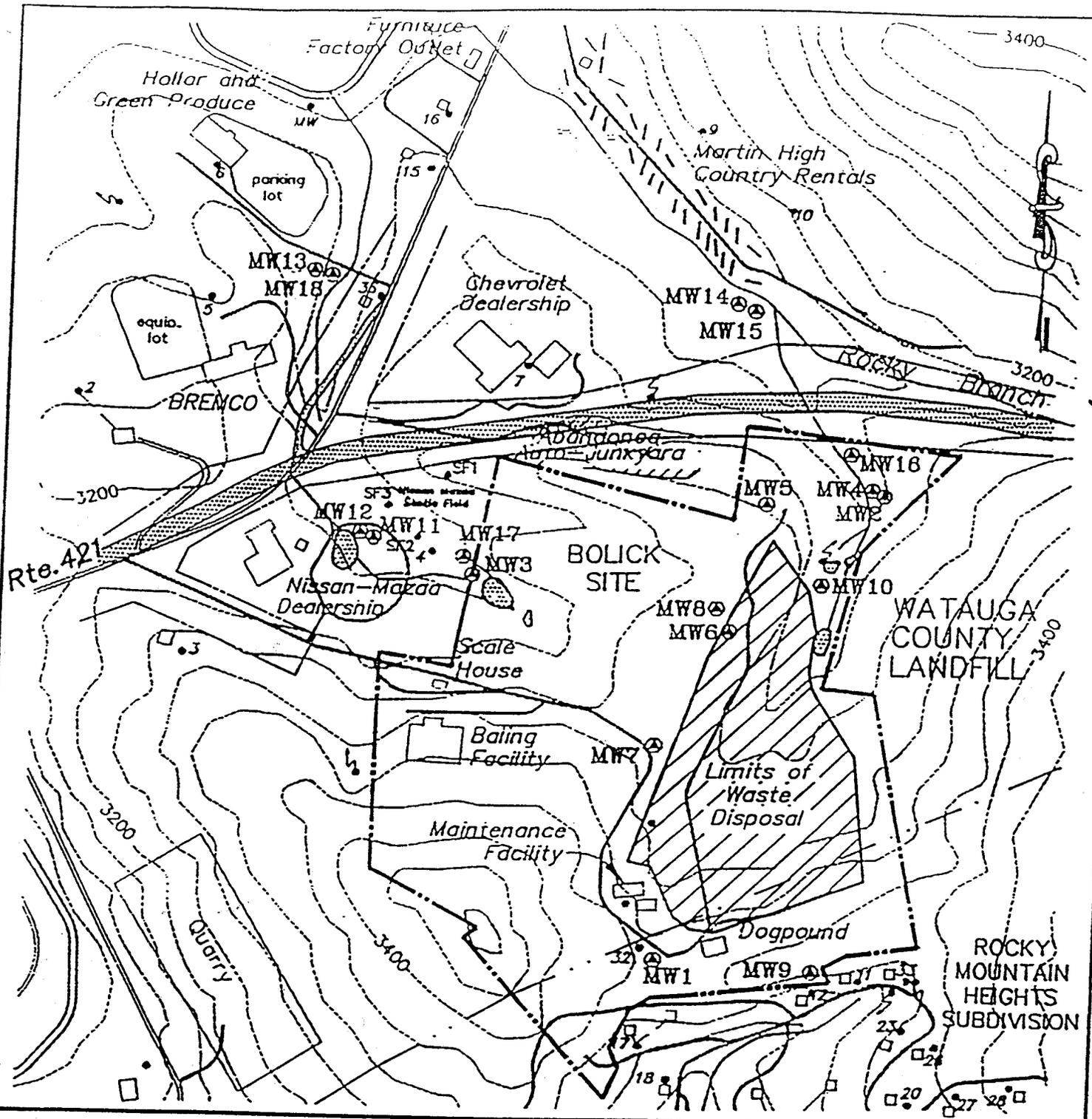
ANALYSIS TYPE:  
CLP analytical methods utilize relevant Atomic Adsorption technique and Inductively Coupled Plasma (ICP) method, in accordance with EPA Contract Laboratory Program (CLP) Statement of Work ILMO 3.0 for metal analysis.



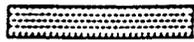


Drawing Under Seperate Cover

Drawing Under Seperate Cover



——— 3200 ——— Existing Ground  
 ——— Proposed Right-of-Way

  
 Proposed Road Improvements

# PROPOSED ROUTE 421 BYPASS MAP



**Draper Aden Associates**  
 CONSULTING ENGINEERS

Blacksburg, Va. - Richmond, Va. - Hot Springs, Texas

JOB No.  
 6520-14

DATE:  
 10 JUN 84

SCALE:  
 1" = 600' ±

FIGURE  
 2

**APPENDIX B**

**FIELD NOTES**

STANDARD FIELD PROTOCOL - INITIAL ACTIVITIES

Project Watauga County Landfill Permit #95-02 Date 1/13/98  
Sampling Sequence see field notes Weather/Temperature cloudy / Low 30's  
Samplers RDR / DLL  
Static Water Level measurement equipment Solinst  
procedure EPA protocol

Well evacuation equipment Grundfos pump  
procedure EPA protocol

Sample withdrawal equipment Grundfos pump  
procedure EPA protocol

Sample filtration equipment None Used  
procedure \_\_\_\_\_

Types of sample containers and method of preservation used for required analysis (in order of sequence of filling containers)

<u>CLP Volatiles</u>	<u>40ml Amber VOA</u>	<u>HCL</u>
<u>CLP Metals</u>	<u>1 liter plastic</u>	<u>MnO<sub>2</sub></u>
_____	_____	_____
_____	_____	_____
_____	_____	_____

Internal temperature of shipping containers at outset of sampling  
> 4°

Temperature equipment Hannah 9023  
calibration procedure Internal  
measurement procedure Immersion

pH equipment Hannah 9023  
calibration procedure pH 7 & 4 Buffer Solution  
measurement procedure Immersion

Conductivity equipment Hannah 9033  
calibration procedure 1413  $\mu$ S standard solution  
measurement procedure Immersion

Conductivity calibration measurements/time 1465  $\mu$ S / not measured

Sampler signatures (date/time) Ric Rojas 1/13/98 1400





**SAMPLE COLLECTION FORM**

Project: Watauga County Landfill Permit No. 95-02

Well # MW-3 Date 1-15-98 Time 13:45 Sampler's Initials \_\_\_\_\_

Condition of well/pad: good

pH Calibration: \_\_\_\_\_ and \_\_\_\_\_ Standard solutions Meter Calibrated to pH \_\_\_\_\_ and \_\_\_\_\_.

Reference Point - Top of Well Casing:

Depth To Water = DTW = 17.51 (in feet)

Total Depth of well = TD = 39.60 (in feet)

Water column length =  $L_{c(ft.)} = (TD-DTW)$  = 22.09 (in feet)

Volume of water in well casing =  $V_{c(gal.)} = L_{c(ft.)} * 0.163$  gal/ft. = 3.68

Minimum Purge Volume (gallons) =  $3 * V_c$  = 11.06

Measurements collected during purging:

14:00 : Purge start time Description of Initial Purge Water:(e.g. silty?) Clear

#	Time	Temp. (C)	pH	mV	Specific Conductivity	Purge Rate(GPM) or # of bails	Estimated volume purged
	<u>14:01</u>	<u>10.9</u>	<u>6.07</u>	<u>-</u>	<u>232 <math>\mu</math>S</u>	<u>1 gpm</u>	<u>1 gallon</u>
	<u>14:06</u>	<u>13.7</u>	<u>5.99</u>	<u>-</u>	<u>247 <math>\mu</math>S</u>	↓	<u>5 gallon</u>
	<u>14:09</u>	<u>14.2</u>	<u>6.02</u>	<u>-</u>	<u>252 <math>\mu</math>S</u>		<u>8 gallon</u>
	<u>14:13</u>	<u>13.1</u>	<u>6.04</u>	<u>-</u>	<u>252 <math>\mu</math>S</u>		<u>12 gallon</u>

14:14 : Dial down time Reduced Flow Rate Time 5.52 min. for 15 sec/ft. of total well depth.

Total volume of water purged \_\_\_\_\_

Description of final purge water (e.g. silty? NAPLs?) Clear

Field pH Adjustments:

Total and Dissolved Metals: pH	Acrylonitrile Adjustment: pH	Field VOA pH Blank: pH
ml of _____ Preservative	# of drops of _____ N HCl	# of drops of _____ N HCl

Sample Collection Time 14:22 1-15-98

Misc. Field Observations \_\_\_\_\_

Sampler signatures (date/time) \_\_\_\_\_  
 \_\_\_\_\_

9 VOAS  
3 1L Plastic

**SAMPLE COLLECTION FORM**

Project: Watauga County Landfill Permit No. 95-02

Well # MW-4 Date 1-14-98 Time 17:01 Sampler's Initials vd/ars

Condition of well/pad: ok

pH Calibration: \_\_\_\_\_ and \_\_\_\_\_ Standard solutions Meter Calibrated to pH \_\_\_\_\_ and \_\_\_\_\_.

Reference Point - Top of Well Casing:

Depth To Water = DTW = 8.54 (in feet)

Total Depth of well = TD = 29.40 (in feet)

Water column length =  $L_{c(ft.)} = (TD-DTW)$  = 20.86 (in feet)

Volume of water in well casing =  $V_{c(gal.)} = L_{c(ft.)} * 0.163 \text{ gal/ft.}$  = 3.48

Minimum Purge Volume (gallons) =  $3 * V_c$  = 10.45

Measurements collected during purging:

17:02 : Purge start time Description of Initial Purge Water:(e.g. silty?) \_\_\_\_\_

#	Time	Temp. (C)	pH	mV	Specific Conductivity	Purge Rate(GPM) or # of bails	Estimated volume purged
	<u>17:05</u>	<u>12.9</u>	<u>6.46</u>	<u>-</u>	<u>55 <math>\mu</math>S</u>	<u>1 gpm</u>	<u>4 gall</u>
	<u>17:07</u>	<u>13.5</u>	<u>6.22</u>	<u>-</u>	<u>51 <math>\mu</math>S</u>	<u>1 gpm</u>	<u>6 gall</u>
	<u>17:09</u>	<u>11.6</u>	<u>6.06</u>	<u>-</u>	<u>47 <math>\mu</math>S</u>	<u>1 gpm</u>	<u>9 gall</u>
	<u>17:12</u>	<u>12.6</u>	<u>6.05</u>	<u>-</u>	<u>47 <math>\mu</math>S</u>	<u>1 gpm</u>	<u>11 gall</u>

17:13 : Dial down time Reduced Flow Rate Time 5.5 min. for 15 sec/ft. of total well depth.

Total volume of water purged \_\_\_\_\_

Description of final purge water (e.g. silty? NAPLs?) clear

Field pH Adjustments:

Total and Dissolved Metals: pH	Acrylonitrile Adjustment: pH	Field VOA pH Blank: pH
ml of Preservative	# of drops of N HCl	# of drops of N HCl

Sample Collection Time 17:20 1-14-98

Misc. Field Observations \_\_\_\_\_

Sampler signatures (date/time) \_\_\_\_\_

\_\_\_\_\_

*3 VOA'S  
1 K Plastic*

**SAMPLE COLLECTION FORM**

Project: Watauga County Landfill Permit No.95-02

Well # MW-5 Date 1/13/98 Time 1500 Sampler's Initials RDR/DLL

Condition of well/pad: Good / Good

pH Calibration: 7 and 4 Standard solutions Meter Calibrated to pH 7 and 4.

Reference Point - Top of Well Casing:

Depth To Water = DTW = 55.46 (in feet)

Total Depth of well = TD = 73.00 (in feet)

Water column length =  $L_{c(ft.)} = (TD-DTW)$  = 17.54 (in feet)

Volume of water in well casing =  $V_{c(gal.)} = L_{c(ft.)} * 0.163$  gal/ft. = 2.86

Minimum Purge Volume (gallons) =  $3 * V_c$  = 8.58

Measurements collected during purging:

1510 : Purge start time Description of Initial Purge Water:(e.g. silty?) Clear, no odor

#	Time	Temp. (C)	pH	mV	Specific Conductivity	Purge Rate(GPM) or # of bails	Estimated volume purged
1	1513	20.7	6.32	-	262 $\mu$ S	2 Bails	1/2 Gall.
2	1517	14.2	6.15	-	246 $\mu$ S	5 Bails	1 1/4 Gall.
3	1522	11.7	6.15	-	276 $\mu$ S	8 Bails	2 Gall
4	1538	11.7	6.21	-	268 $\mu$ S	16 Bails	4 gallons
5	1557	11.6	6.23	-	262 $\mu$ S	26 Bails	6.5 gallons
6	1610	11.6	6.14	-	248 $\mu$ S	<del>26</del> 33 Bails	<del>8.7</del> 5.5 gallons

- : Dial down time Reduced Flow Rate Time - min. for 15 sec/ft. of total well depth.

Total volume of water purged 8 3/4 Gallons

Description of final purge water (e.g. silty? NAPLs?) Clear, NO odor

Field pH Adjustments:

<sup>CLP</sup> Total and Dissolved Metals: pH	Acrylonitrile Adjustment: pH	Field VOA pH Blank: pH
> 1 ml of <u>HNO<sub>3</sub></u> Preservative	# of drops of <u>N HCl</u>	# of drops of <u>N HCl</u>

Sample Collection Time 1-14-98 09:20

Misc. Field Observations \_\_\_\_\_

Sampler signatures (date/time) Donna Lancaster 1-14-98 09:20

3 VOAS  
1 IL Plastic

**SAMPLE COLLECTION FORM**

Project: Watauga County Landfill Permit No. 95-02

Well # MW-7 Date 1/13/98 Time 1415 Sampler's Initials RDR/PLL

Condition of well/pad: Good / Good

pH Calibration: 7 and 4 Standard solutions Meter Calibrated to pH 7 and 4

Reference Point - Top of Well Casing:

Depth To Water = DTW = 44.18 (in feet)

Total Depth of well = TD = 50.00 (in feet)

Water column length =  $L_{c(ft.)} = (TD-DTW)$  = 5.82 (in feet)

Volume of water in well casing =  $V_{c(gal.)} = L_{c(ft.)} * 0.163 \text{ gal/ft.}$  = 0.95

Minimum Purge Volume (gallons) =  $3 * V_c$  = 2.85

Measurements collected during purging:

1420 : Purge start time Description of Initial Purge Water:(e.g. silty?) Slightly Silty, Leachate Odor

#	Time	Temp. (C)	pH	mV	Specific Conductivity	Purge Rate(GPM) or # of bails	Estimated volume purged
1	1420	12.5	6.65	-	12.65 $\mu S$	2 Bails	1/2 Gall.
2	1425	12.5	6.89	-	<del>12.20 <math>\mu S</math></del>	4 Bails	1 Gall.
3	1428	Well went Dry					

- : Dial down time Reduced Flow Rate Time - min. for 15 sec/ft. of total well depth.

Total volume of water purged 1 1/2 Gall.

Description of final purge water (e.g. silty? NAPLs?) Slightly Silty, Slight Leachate Odor

Field pH Adjustments:

<sup>6.18</sup> Total and Dissolved Metals: pH	Acrylonitrile Adjustment: pH	Field VOA pH Blank: pH
<u>&gt; 1</u> ml of <u>HNO<sub>3</sub></u> Preservative	# of drops of <u>NHCl</u>	# of drops of <u>NHCl</u>

Sample Collection Time 1-14-98 08:45

Misc. Field Observations 1st Conductivity Reading Incorrect

Sampler signatures (date/time) Donna Lancaster 1-14-98 8:45 am

3 VOA's  
1 1L Plastic

### SAMPLE COLLECTION FORM

Project: Watauga County Landfill Permit No. 95-02

Well # MW-8 Date 1-15-98 Time 12:35 Sampler's Initials \_\_\_\_\_

Condition of well/pad: Good

pH Calibration: \_\_\_\_\_ and \_\_\_\_\_ Standard solutions Meter Calibrated to pH \_\_\_\_\_ and \_\_\_\_\_.

Reference Point - Top of Well Casing:

Depth To Water = DTW = 20.32 (in feet)

Total Depth of well = TD = 67.00 (in feet)

Water column length =  $L_{c(ft.)} = (TD-DTW)$  = 46.68 (in feet)

Volume of water in well casing =  $V_{c(gal.)} = L_{c(ft.)} * 0.163 \text{ gal/ft.}$  = 7.79

Minimum Purge Volume (gallons) =  $3 * V_c$  = 23.38

Measurements collected during purging:

12:45 : Purge start time Description of Initial Purge Water:(e.g. silty?) Clear

#	Time	Temp. (C)	pH	mV	Specific Conductivity	Purge Rate(GPM) or # of bails	Estimated volume purged
	12:47	12.3	6.64	—	555 $\mu S$	1 gpm	2 gal
	12:50	12.3	6.69		522 $\mu S$	1 gpm	5 gal
	12:55	13.3	6.70		492 $\mu S$	}	10 gal
	13:05	DRY @	13:05				20 gal
	<del>13:04</del>					✓	<del>24 gal</del>

13:10 : Dial down time Reduced Flow Rate Time 11.67 min. for 15 sec/ft. of total well depth.

Total volume of water purged Revised ~ 15 gallons

Description of final purge water (e.g. silty? NAPLs?) Greenish, cloudy see silt

Field pH Adjustments:

Total and Dissolved Metals: pH	Acrylonitrile Adjustment: pH	Field VOA pH Blank: pH
ml of Preservative	# of drops of N HCl	# of drops of N HCl

Sample Collection Time 13:25 1-15-98

Misc. Field Observations MW-8 purged until dry wait to 13:25 then collect sample.

Sampler signatures (date/time) \_\_\_\_\_

3 VOAS  
1 1L Plastic

### SAMPLE COLLECTION FORM

Project: Watauga County Landfill Permit No. 95-02

Well # MW-9      <sup>Time</sup> 10:30      <sup>DATE</sup> 1-15-98      Sampler's Initials DL

Condition of well/pad: Good

pH Calibration: \_\_\_\_\_ and \_\_\_\_\_ Standard solutions      Meter Calibrated to pH \_\_\_\_\_ and \_\_\_\_\_.

Reference Point - Top of Well Casing:

Depth To Water = DTW = 63.56 (in feet)

Total Depth of well = TD = 86.40 (in feet)

Water column length =  $L_{c(ft.)} = (TD-DTW)$  = 22.84 (in feet)

Volume of water in well casing =  $V_{c(gal.)} = L_{c(ft.)} * 0.163 \text{ gal/ft.}$  = 3.81

Minimum Purge Volume (gallons) =  $3 * V_c$  = 11.44

Measurements collected during purging:

10:31 : Purge start time      Description of Initial Purge Water:(e.g. silty?) Clear

#	Time	Temp. (C)	pH	mV	Specific Conductivity	Purge Rate(GPM) or # of bails	Estimated volume purged
	10:32	13.6	6.13	~	510 $\mu$ S	1 gpm	1 gal
	10:37	13.0	6.18	~	463	1 gpm	5 gal
	10:42	12.9	6.17	-	445	1 gpm	10 gal
	10:44	13.2	6.13	-	494	1 gpm	12 gal

10:45 : Dial down time      Reduced Flow Rate Time 5.71 min. for 15 sec/ft. of total well depth.

Total volume of water purged \_\_\_\_\_

Description of final purge water (e.g. silty? NAPLs?) Clear

Field pH Adjustments:

Total and Dissolved Metals: pH	Acrylonitrile Adjustment: pH	Field VOA pH Blank: pH
ml of Preservative	# of drops of N HCl	# of drops of N HCl

Sample Collection Time 1-15-98 11:05

Misc. Field Observations \_\_\_\_\_

Sampler signatures (date/time) \_\_\_\_\_

3 Vials  
1 IL Plastic

**SAMPLE COLLECTION FORM**

Project: Watauga County Landfill Permit No. 95-02

Well # MW-10 Date 11/3/98 Time 1625 Sampler's Initials ROR/DLL

Condition of well/pad: Good / Good

pH Calibration: 7 and 4 Standard solutions Meter Calibrated to pH 7 and 4.

Reference Point - Top of Well Casing:

Depth To Water = DTW = 8.25 (in feet)  
 Total Depth of well = TD = 70.03 (in feet)  
 Water column length =  $L_{c(ft)} = (TD-DTW)$  = 61.78 (in feet)  
 Volume of water in well casing =  $V_{c(gal.)} = L_{c(ft)} * 0.163 \text{ gal/ft.}$  = 10.07

Minimum Purge Volume (gallons) =  $3 * V_c$  = 30.21

Measurements collected during purging:

1628 : Purge start time Description of Initial Purge Water:(e.g. silty?) Clear, NO odor

#	Time	Temp. (C)	pH	mV	Specific Conductivity	Purge Rate(GPM) or # of bails	Estimated volume purged
1	1628	11.5	6.82	-	178 $\mu$ S	1 GPM	1 Gall.
2	1632	13.0	6.80	-	133 $\mu$ S	"	4 Gall.
3	1635	13.3	6.76	-	126 $\mu$ S	"	7 Gall.
4	1639	13.2	6.84	-	131 $\mu$ S	"	11 Gall.
5	1645	13.6	6.85	-	139 $\mu$ S	"	17 Gall.
6	1653	13.6	7.05	-	180 $\mu$ S	"	28 Gall.
7	<del>1658</del> 1654		well went dry				30 Gall.

- : Dial down time Reduced Flow Rate Time - min. for 15 sec/ft. of total well depth.

Total volume of water purged 26 Gallons

Description of final purge water (e.g. silty? NAPLs?) Clear, NO odor

Field pH Adjustments:

<del>Total and Dissolved</del> <sup>CUP</sup> Metals: pH	Acrylonitrile Adjustment: pH	Field VOA pH Blank: pH
<u>0</u> 1 ml of <u>HNO<sub>3</sub></u> Preservative	# of drops of <u>N HCl</u>	# of drops of <u>N HCl</u>

Sample Collection Time 1-14-98 10:00

Misc. Field Observations \_\_\_\_\_

Sampler signatures (date/time) Donna Lancaster

*3 VOAS  
1 IL Plastic*

### SAMPLE COLLECTION FORM

Project: Watauga County Landfill Permit No. 95-02

Well # MW-11

Date 1/15/98

Time 1-15-98

Sampler's Initials \_\_\_\_\_

Condition of well/pad: Good

pH Calibration: \_\_\_\_\_ and \_\_\_\_\_ Standard solutions

Meter Calibrated to pH \_\_\_\_\_ and \_\_\_\_\_.

Reference Point - Top of Well Casing:

Depth To Water = DTW = 12.48 (in feet)

Total Depth of well = TD = 25.80 (in feet)

Water column length =  $L_{c(ft.)} = (TD-DTW)$  = 13.32 (in feet)

Volume of water in well casing =  $V_{c(gal.)} = L_{c(ft.)} * 0.163$  gal/ft. = 2.22

Minimum Purge Volume (gallons) =  $3 * V_c$

= 6.67

Measurements collected during purging:

16:13 : Purge start time

Description of Initial Purge Water:(e.g. silty?) Clear

#	Time	Temp. (C)	pH	mV	Specific Conductivity	Purge Rate(GPM) or # of bails	Estimated volume purged
	16:15	11.3	6.19		136 $\mu S$	1/2 gal	1 gal
	16:21	12.4	6.09		135 $\mu S$	1/2 gal	3 gal
	16:25	11.9	6.03		119 $\mu S$	↓ ✓	5 gal
	16:29	11.8	6.01		122 $\mu S$		7 gal

16:30 : Dial down time

Reduced Flow Rate Time 3.33 min. for 15 sec/ft. of total well depth.

Total volume of water purged \_\_\_\_\_

Description of final purge water (e.g. silty? NAPLs?) Clear

Field pH Adjustments:

Total and Dissolved Metals: pH	Acrylonitrile Adjustment: pH	Field VOA pH Blank: pH
ml of _____ Preservative	# of drops of _____ N HCl	# of drops of _____ N HCl

Sample Collection Time 16:40 1-15-98

Misc. Field Observations \_\_\_\_\_

Sampler signatures (date/time) \_\_\_\_\_

S-6  
1630  
1-15-98

3 vials  
1 1L Plastic

### SAMPLE COLLECTION FORM

Project: Watauga County Landfill Permit No. 95-02

Well # MW-12 Date 1-15-98 Time 1648 Sampler's Initials \_\_\_\_\_

Condition of well/pad: good

pH Calibration: \_\_\_\_\_ and \_\_\_\_\_ Standard solutions Meter Calibrated to pH \_\_\_\_\_ and \_\_\_\_\_.

Reference Point - Top of Well Casing:

Depth To Water = DTW = 9.65 (in feet)

Total Depth of well = TD = 72.75 (in feet)

Water column length =  $L_{c(ft.)} = (TD-DTW)$  = 63.10 (in feet)

Volume of water in well casing =  $V_{c(gal.)} = L_{c(ft.)} * 0.163 \text{ gal/ft.}$  = 10.53

Minimum Purge Volume (gallons) =  $3 * V_c$  = 31.61

Measurements collected during purging:

1650 : Purge start time Description of Initial Purge Water:(e.g. silty?) clear

#	Time	Temp. (C)	pH	mV	Specific Conductivity	Purge Rate(GPM) or # of bails	Estimated volume purged
	16:52	11.3	6.30	—	221 $\mu S$	1 gpm	2 gall
	17:04	12.2	6.37	—	251 $\mu S$	✓	15 gall
	17:17	12.1	6.35	—	246 $\mu S$		28 gall
	17:21	12.3	6.33	—	235 $\mu S$		32 gall

17:22 : Dial down time Reduced Flow Rate Time 15.77 min. for 15 sec/ft. of total well depth.

Total volume of water purged \_\_\_\_\_

Description of final purge water (e.g. silty? NAPLs?) \_\_\_\_\_

Field pH Adjustments:

Total and Dissolved Metals: pH	Acrylonitrile Adjustment: pH	Field VOA pH Blank: pH
ml of Preservative	# of drops of N HCl	# of drops of N HCl

Sample Collection Time 17:40 1-15-98

Misc. Field Observations \_\_\_\_\_

Sampler signatures (date/time) \_\_\_\_\_

3 vials  
1/2 Plastic

**SAMPLE COLLECTION FORM**

Project: Watauga County Landfill Permit No. 95-02

Well # MW-13 Date 1-14-98 Time 1516 Sampler's Initials \_\_\_\_\_

Condition of well/pad: good

pH Calibration: \_\_\_\_\_ and \_\_\_\_\_ Standard solutions Meter Calibrated to pH \_\_\_\_\_ and \_\_\_\_\_.

Reference Point - Top of Well Casing:

Depth To Water = DTW = 19.75 (in feet)

Total Depth of well = TD = 31.65 (in feet)

Water column length =  $L_{c(ft.)} = (TD-DTW)$  = 11.9 (in feet)

Volume of water in well casing =  $V_{c(gal.)} = L_{c(ft.)} * 0.163$  gal/ft. = 1.98

Minimum Purge Volume (gallons) =  $3 * V_c$  = 5.96

Measurements collected during purging:

1516 : Purge start time Description of Initial Purge Water:(e.g. silty?) Slightly Silty, NO odor

#	Time	Temp. (C)	pH	mV	Specific Conductivity	Purge Rate(GPM) or # of bails	Estimated volume purged
1	1519	11.1	6.44	-	33 $\mu$ S	$\frac{1}{2}$ GPM	$\frac{1}{2}$ Gall.
2	1523	12.5	6.07	-	31 $\mu$ S	"	2 $\frac{1}{2}$ Gall
3	1525	12.7	5.85	-	30 $\mu$ S	"	3 $\frac{1}{2}$ Gall
4	1527	12.9	5.75	-	30 $\mu$ S	"	4 $\frac{1}{2}$ Gall
5	1530	13.0	5.69	-	29 $\mu$ S	"	6 Gall

1530 : Dial down time Reduced Flow Rate Time 2.97 min. for 15 sec/ft. of total well depth.

Total volume of water purged 6 \* Gallons

Description of final purge water (e.g. silty? NAPLs?) Clear, NO odor

Field pH Adjustments:

Total and Dissolved Metals: pH	Acrylonitrile Adjustment: pH	Field VOA pH Blank: pH
<u>&gt; 1</u> ml of <u>HNO<sub>3</sub></u> Preservative	# of drops of <u>NHCl</u>	# of drops of <u>NHCl</u>

Sample Collection Time 1530 1/14/98

Misc. Field Observations \_\_\_\_\_

Sampler signatures (date/time) Ric Rogers 1/14/98 1535

*3 SOAS  
1 IL Plastic*

**SAMPLE COLLECTION FORM**

Project: Watauga County Landfill Permit No. 95-02

Well # MW-14 Date 1-14-98 Time 11:15 Sampler's Initials DL

Condition of well/pad: good

pH Calibration: 7 and 4 Standard solutions Meter Calibrated to pH 7 and 4.

Reference Point - Top of Well Casing:

Depth To Water = DTW = 7.44 (in feet)  
 Total Depth of well = TD = 71.00 (in feet)  
 Water column length =  $L_{c(ft.)} = (TD-DTW)$  = 63.56 (in feet)  
 Volume of water in well casing =  $V_{c(gal.)} = L_{c(ft.)} * 0.163 \text{ gal/ft.}$  = 10.61

Minimum Purge Volume (gallons) =  $3 * V_c$  = 31.8

Measurements collected during purging:

11:20 : Purge start time Description of Initial Purge Water:(e.g. silty?) clear

#	Time	Temp. (C)	pH	mV	Specific Conductivity	Purge Rate(GPM) or # of bails	Estimated volume purged
	<u>11:25</u>	<u>11.8</u>	<u>7.23</u>	<u>-</u>	<u>83 <math>\mu</math>S</u>	<u>1 gpm</u>	<u>5 gal</u>
	<u>11:35</u>	<u>11.8</u>	<u>6.96</u>	<u>-</u>	<u>79 <math>\mu</math>S</u>	<u>1 gpm</u>	<u>15 gal</u>
	<u>11:45</u>	<u>11.8</u>	<u>6.96</u>	<u>-</u>	<u>76 <math>\mu</math>S</u>	<u>1 gpm</u>	<u>25 gal</u>
	<u>11:52</u>	<u>11.8</u>	<u>6.68</u>	<u>-</u>	<u>75 <math>\mu</math>S</u>	<u>1 gpm</u>	<u>32 gal</u>

11:53 : Dial down time Reduced Flow Rate Time 15.89 min. for 15 sec/ft. of total well depth.

Total volume of water purged 39 gallons

Description of final purge water (e.g. silty? NAPLs?) clear

Field pH Adjustments:

Total and Dissolved Metals: pH	Acrylonitrile Adjustment: pH	Field VOA pH Blank: pH
ml of Preservative	# of drops of N HCl	# of drops of N HCl

Sample Collection Time 12:15 1-14-98

Misc. Field Observations Broke VOA, replace w/ extra

Sampler signatures (date/time) Dave Landon

3 VOA's  
1 1/2 Plastic

**SAMPLE COLLECTION FORM**

Project: Watauga County Landfill Permit No. 95-02

Well # MW-15 Date 1-14-98 Time 11:15 Sampler's Initials DLL

Condition of well/pad: \_\_\_\_\_

pH Calibration: \_\_\_\_\_ and \_\_\_\_\_ Standard solutions Meter Calibrated to pH \_\_\_\_\_ and \_\_\_\_\_.

Reference Point - Top of Well Casing:

Depth To Water = DTW = 11.74 (in feet)

Total Depth of well = TD = 178.00 (in feet)

Water column length =  $L_{c(ft.)} = (TD-DTW)$  = 166.26 (in feet)

Volume of water in well casing =  $V_{c(gal.)} = L_{c(ft.)} * 0.163 \text{ gal/ft.}$  = 27.76

Minimum Purge Volume (gallons) =  $3 * V_c$  = 83.29

Measurements collected during purging:

12:20 : Purge start time Description of Initial Purge Water:(e.g. silty?) \_\_\_\_\_

#	Time	Temp. (C)	pH	mV	Specific Conductivity	Purge Rate(GPM) or # of bails	Estimated volume purged
	12:25	12.0	7.13	-	138	2 gpm	10 gals
	12:40	12.9	7.31	-	139	2 gpm	25 gals
	12:55	13.9	7.34	-	148	2 gpm	45 gals
	13:05	14.3	7.52	-	145	2 gpm	65 gals
	13:15	14.7	7.42	-	149	2 gpm	85 gals

13:16 : Dial down time Reduced Flow Rate Time 41.5 min. for 15 sec/ft. of total well depth.

Total volume of water purged 87 gallons

Description of final purge water (e.g. silty? NAPLs?) Clear

Field pH Adjustments:

Total and Dissolved Metals: pH	Acrylonitrile Adjustment: pH	Field VOA pH Blank: pH
ml of Preservative	# of drops of NHCl	# of drops of NHCl

Sample Collection Time 1-14-98 14:00

Misc. Field Observations \_\_\_\_\_

Sampler signatures (date/time) Dan Lancaster

3 vials  
1 IL Plastic

**SAMPLE COLLECTION FORM**

Project: Watauga County Landfill Permit No. 95-02

Well # MW-17 Date 1-15-98 Time 14:48 Sampler's Initials \_\_\_\_\_

Condition of well/pad: \_\_\_\_\_

pH Calibration: \_\_\_\_\_ and \_\_\_\_\_ Standard solutions Meter Calibrated to pH \_\_\_\_\_ and \_\_\_\_\_.

Reference Point - Top of Well Casing:

Depth To Water = DTW = 18.60 (in feet)

Total Depth of well = TD = 94.54 (in feet)

Water column length =  $L_{c(ft.)} = (TD-DTW)$  = 75.94 (in feet)

Volume of water in well casing =  $V_{c(gal.)} = L_{c(ft.)} * 0.163 \text{ gal/ft.}$  = 12.68

Minimum Purge Volume (gallons) =  $3 * V_c$  = 38.04

Measurements collected during purging:

14:50 : Purge start time Description of Initial Purge Water:(e.g. silty?) silty

#	Time	Temp. (C)	pH	mV	Specific Conductivity	Purge Rate(GPM) or # of bails	Estimated volume purged
	14:51	11.2	6.27	-	265 $\mu S$	1 gpm	1 gallon
	14:58	12.2	6.25	-	254 $\mu S$	↓	8 gallon
	15:08	12.4	6.11	-	239 $\mu S$		18 gallon
	15:18	13.1	6.04	-	224 $\mu S$		28 gallon
	15:29	13.1	6.05	-	224 $\mu S$		39 gallon

15:30 : Dial down time Reduced Flow Rate Time 18.98 min. for 15 sec/ft. of total well depth.

Total volume of water purged \_\_\_\_\_

Description of final purge water (e.g. silty? NAPLs?) Clear

Field pH Adjustments:

Total and Dissolved Metals: pH	Acrylonitrile Adjustment: pH	Field VOA pH Blank: pH
ml of _____ Preservative	# of drops of _____ N HCl	# of drops of _____ N HCl

Sample Collection Time 15:50 1-15-98

Misc. Field Observations \_\_\_\_\_

Sampler signatures (date/time) \_\_\_\_\_

*2 VOAS  
1 plastic*

### SAMPLE COLLECTION FORM

Project: Watauga County Landfill Permit No. 95-02

Well # MW-18 Date 1639 Time 1114/98 Sampler's Initials RDR/DLL

Condition of well/pad: Good / Good

pH Calibration: 7 and 4 Standard solutions Meter Calibrated to pH 7 and 4.

Reference Point - Top of Well Casing:

Depth To Water = DTW = 18.32 (in feet)

Total Depth of well = TD = 73.20 (in feet)

Water column length =  $L_{c(ft)} = (TD-DTW)$  = 54.88 (in feet)

Volume of water in well casing =  $V_{c(gal.)} = L_{c(ft.)} * 0.163$  gal/ft. = 9.14

Minimum Purge Volume (gallons) =  $3 * V_c$  = 27.49

Measurements collected during purging:

1639 : Purge start time Description of Initial Purge Water: (e.g. silty?) Clear, no odor

#	Time	Temp. (C)	pH	mV	Specific Conductivity	Purge Rate(GPM) or # of bails	Estimated volume purged
1	1640	11.9	6.18	-	86 $\mu S$	1 GPM	1 Gall.
2	1645	12.2	6.34	-	95 $\mu S$	"	6 Gall.
3	1651	12.2	6.53	-	97 $\mu S$	"	12 Gall.
4	1658	12.3	6.61	-	96 $\mu S$	"	19 Gall.
5	1607	12.2	6.41	-	99 $\mu S$	"	28 Gall.

1607 : Dial down time Reduced Flow Rate Time 13.72 min. for 15 sec/ft. of total well depth.

Total volume of water purged 28<sup>+</sup> Gallons

Description of final purge water (e.g. silty? NAPLs?) Clear, NO odor

Field pH Adjustments:

Total and Dissolved Metals: pH	Acrylonitrile Adjustment: pH	Field VOA pH Blank: pH
ml of Preservative	# of drops of N HCl	# of drops of N HCl

Sample Collection Time 1635 1/14/98

Misc. Field Observations \_\_\_\_\_

Sampler signatures (date/time) Ric Rogers 1/14/98 1635

3 JOABs  
1 2L Plastic

**SAMPLE COLLECTION FORM**

Project: \_\_\_\_\_

Well # MW-19      Date 1-15-98      Time \_\_\_\_\_      Sampler's Initials \_\_\_\_\_

Condition of well/pad: good, no (6' dia) protective cover

pH Calibration: \_\_\_\_\_ and \_\_\_\_\_ Standard Solutions      Meter Calibrated to pH \_\_\_\_\_ and \_\_\_\_\_

Reference Point - Top of Well Casing:

Reference Point - Top of Well Casing:

Depth to Water = DTW = 10.21 (in feet)

Total Depth of Well = TD = 69.60 (in feet)

Water Column Length =  $L_{c(ft)} = (TD-DTW)$  = 59.39 (in feet)

Volume of Water in Well Casing =  $V_{c(gal.)} = L_{c(ft)} * 0.163 \text{ gal/ft}$  = 9.92

Minimum Purge Volume (gallons) =  $3 * V_c$  = 29.76

Measurements Collected During Purging:

8:04: Purge Start Time      Description of Initial Purge Water: (e.g. silty) Clear

#	Time	Temp. (C)	pH	mV	Specific Conductivity	Purge Rate GPM) or # of bails	Estimated Volume Purged
	8:05	10.6	7.61	—	76 $\mu S$	1 gpm	1 gall
	8:17	12.3	7.43	—	77 $\mu S$	1 gpm	12 gall
	8:28	12.7	7.20	—	79 $\mu S$	1 gpm	22 gall
	8:36	12.5	7.14	—	75 $\mu S$	1 gpm	30 gall

8:37: Dial down Time      Reduced Flow Rate Time 14.8 min. for 15 sec/ft. of total well depth

Total volume of water purged ~~9.92~~ 30 gallons

Description of final purge water (e.g. silty? NAPLs?) Clear

Field pH Adjustment:

Total and Dissolved Metals: pH

\_\_\_\_\_ ml of \_\_\_\_\_ Preservative

OTHERS:

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

*3 VOPS  
1 1L Plastic*

Sample Collection Time 1-15-98 8:57

Misc. Field Observations \_\_\_\_\_

Sampler signature (date/time) \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_

Waterbury Co LF

January 13, 1998

DAA JNH CS20-21

DAA Event:

DAA Personnel: RBR/DLL

- 0700 @ Office

- Load Truck, Get Supplies

- 0800 Leave Office

- 1115 Arrive Onsite

- Notify Scalehouse Attendant

- Obtain Keys from J.V.

Weather: mostly cloudy, Temp in low 40's, Wind calm.

Area has received heavy rains during week prior to arrival

Liquid Level Measurements

Well	SWL	SIZE
MW-1	43.71	4"
MW-9	63.56	2"
MW-7	44.18	2"
MW-8	20.32	2"
MW-10	8.25	2"
MW-14	7.44	2"
MW-15	11.74	2"
MW-4	8.54	2"
MW-2		
MW-5	55.46	2"
MW-17	18.60	2"
MW-11	17.51	2"
MW-12	9.65	2"
MW-11	12.48	2"
MW-13	19.75	2"
MW-18	18.32	2"
MW-19	10.21	2"
MW-2	7.00	4"

- pH meter calibrated / Conductivity not tested

- 1415 Begin Purge for MW19  
Initial Purge Slightly Silty  
Slight Leachate Odor

- Conductivity Readings not stable

1425 - Well Dry after 2 1/2 Gall Purged  
Final Purge Slightly Silty w/ Leachate Odor

NO access needed

no pump

no pump

January 14, 1997

6700 - Leave Hotel

- Stop for Fuel @ Texaco

0730 - Arrive Onsite

Weather: mostly cloudy, Temps in low 30's, Wind calm

DLL to Sample mms, mms, mms-10 RPR to DO Gas monitoring

Barometric Pressure 31.80 inches  
Wind Calm

Sampler: RPR

- Areas to be reading Temp Probes will be marked on map

- 1500 J.N. opened mms-2. RTW 7.00'

- 1010 mms-5 Begin Purge

Initial Purge clear, NO odor

- 1615 Final Purge clear, NO odor

- 1620 Begin Purging mms-10 @ 16PM

Initial Purge clear, NO odor

Control Box must be turned up continuously while purging to maintain 1 GPM probe flow rate.

- 1651 Well Dry after purging & 26 Gallons. Final purge clear, NO odor

- 1700 Leave Site

Area 1 - Approximate Location

Length of Area  $\approx 260'$

TP-1  $\approx 75$  feet  
from beginning of fence.

TP-1  $\approx 12-15"$  in ground

TP-2 Begin 9:32:00

Peak 9:37:15

6.3% CH<sub>4</sub>

132.70 CH<sub>4</sub> LEL

Steady State 9:54:15

6.3% CH<sub>4</sub>

132.70 CH<sub>4</sub> LEL

TP-2  $\approx 14-16"$  in ground

Begin 9:45:00

Peak 9:48:50

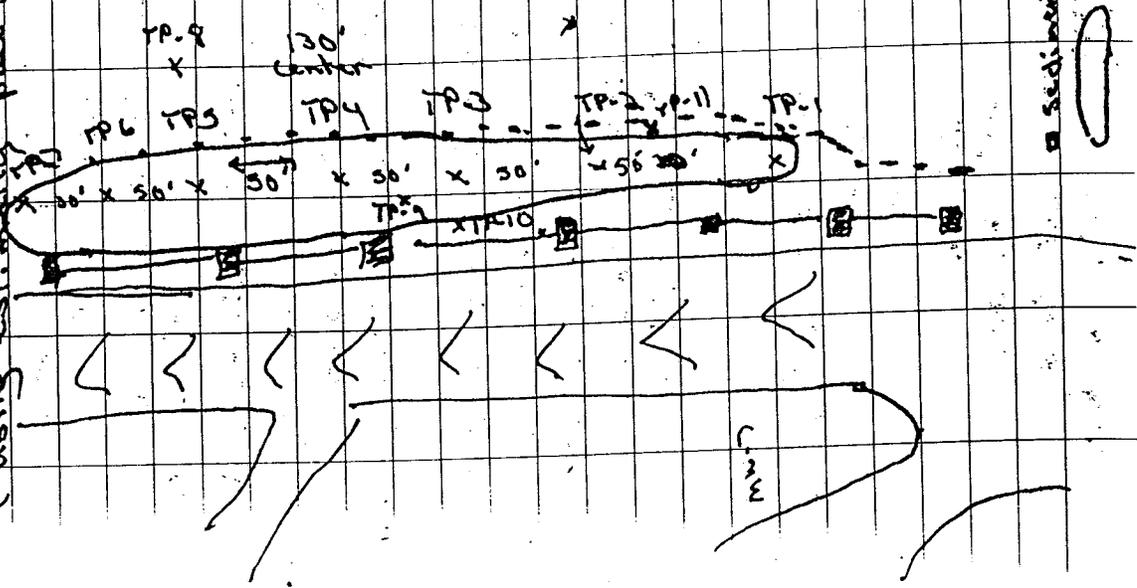
13.6% CH<sub>4</sub>

264% CH<sub>4</sub> LEL

Steady State 9:55:20

4.9 % CH<sub>4</sub>

98% CH<sub>4</sub> LEL



Area 1 - Approximate Location

Return  $\approx 260'$

Length of Area  $\approx 260'$

(Using estimated piece length of 2')

Sediment Panels

Sample Area