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ENVIRONMENT

Mr. George Jacob
United States Environmental Protection Agency – Region 2
290 Broadway, 20th Floor
New York, New York 10007-1866

Subject:
Operational Year 6 Quarter 1 Monitoring Report,
Colesville Landfill, Broome County, New York. (Site No. 704010).

Date:
September 2, 2008

Dear Mr. Jacob:

On behalf of Broome County, ARCADIS is providing the Operational Year 6 Quarter 1 Monitoring Report for the Colesville Landfill, Broome County, New York.

Please feel free to contact me if you have any questions or comments.

Sincerely,

ARCADIS

Steven M. Feldman
Project Manager

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Broome County
Division of Solid Waste Management

Operational Year 6
Quarter Number 1
Monitoring Report

September 2, 2008

ARCADIS

Kenneth Zegel, P.E.
Senior Engineer

Steven M. Feldman
Project Director

Operational Year 6
Quarter Number 1
Monitoring Report

Colesville Landfill,
Broome County, New York
NYSDEC Site 704010

Prepared for:
Broome County Division of Solid Waste Management

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Our Ref.:
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Date:
September 2, 2008

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1. Introduction

This Monitoring Report (Report) was prepared on behalf of the Broome County Division of Solid Waste Management for the Colesville Landfill, located in Broome County, New York (site) to evaluate and document long-term monitoring (LTM) activities at the site. Remediation and monitoring activities are being conducted pursuant to the Record of Decision (ROD) and Explanation of Significant Difference (ESD) that were issued in March 1991 and September 2000, respectively. LTM activities (which include environmental effectiveness and remediation system performance monitoring) were performed in accordance with the LTM Plan (ARCADIS G&M, Inc. 2002), LTM Plan Addendum for Spring Water Remediation Systems (ARCADIS 2003), and Interim Remedial Action Report (ARCADIS 2004), which were approved by the United States Environmental Protection Agency (USEPA) and New York State Department of Environmental Conservation (NYSDEC). These documents provide a detailed description of the LTM program, methodology, and rationale. Where applicable these elements are either summarized or incorporated by reference herein.

This report describes the results of the December 2007 groundwater quality monitoring event conducted during Operational Year 6, Quarter Number 1. A description of the operation, maintenance, and monitoring (OM&M) associated with the Groundwater Remediation System from September 2007 through December 2007 has also been provided. Following the detailed data analysis and discussion is a summary of findings, conclusions, and recommendations.

As described in the Operational Year 5, Quarter Number 1 Monitoring Report (ARCADIS 2007), an alternate electron donor and hydraulic injection test was completed during the week of December 18, 2006 in accordance with the Hydraulic Injection Test and Alternate Electron Donor Pilot Test Letter Work Plan (herein referred to as "the Work Plan" [ARCADIS 2006]). Discussion of the injection methodology and monitoring results as of December 2007 is provided herein.

2. Methodology

The following section provides a summary of the environmental effectiveness and remedial system performance monitoring methodology for Operational Year 6, Quarter Number 1. A site plan, which shows the location of environmental effectiveness monitoring, is provided on Figure 1.

2.1 Environmental Effectiveness Monitoring

The environmental effectiveness monitoring performed during Operational Year 6, Quarter Number 1, included the following:

- Groundwater samples were collected from six monitoring wells (Year 6, Q1 list of wells plus monitoring well GMMW-7), during the week of December 17, 2007. The samples were selectively analyzed for volatile organic compounds (VOCs), dissolved gases, and total organic carbon (TOC). Field parameters were also recorded at these monitoring locations.

- Samples (VOCs only) were collected at the SP-4 and F-6 surface water locations on December 17, 2007.

In accordance with the Proposed Modifications to the Long-Term Monitoring Program (ARCADIS 2005), groundwater samples were collected from monitoring wells utilizing passive diffusive bag (PDB) samplers.

2.2 Groundwater Remediation System Performance Monitoring

Groundwater Remediation System performance monitoring activities during Operational Year 6, Quarter Number 1, were as follows:

- Pump-and-treat (PT) system recovery well influent and effluent samples were collected on January 17, 2008. The samples were selectively analyzed for VOCs and total iron.

- One vapor sample from the PT system air stripper effluent was collected on January 17, 2008. The sample was analyzed for VOCs.

- PT system operating parameters were recorded during the quarterly OM&M site visit.

- Total organic carbon (TOC) samples were collected from select injection wells during the week of December 19, 2007.

- A TOC sample was collected from alternate electron donor monitoring well TW-1 on December 18, 2007.

- Automated reagent injection (ARI) system operating parameters were recorded during each injection event.

PT system groundwater samples were collected as grab samples directly from the individual recovery pipelines connected to recovery wells GMPW-3, GMPW-4, GMPW-5, the combined influent water to the low profile air stripper, and the combined effluent after the cartridge filters. The effluent air sample was collected as a grab sample directly from the designated point located on the low profile air stripper stack.

2.3 Spring Water Remediation System Performance Monitoring

Standard SP-5 Spring Water Remediation System performance monitoring could not be conducted during the current reporting period due to the presence of tailwater at the discharge monitoring location (i.e., outfall). Accordingly, three (3) troubleshooting samples were collected from the SP-5 Spring Water Remediation System influent, effluent (in this instance, the effluent sample was collected immediately above the carbon unit), and "tailwater" on January 17, 2008. Further discussion is provided in Section 8.0 of this report.

3. Groundwater Flow

A synoptic round of water level measurements is conducted during Quarters 2 and 4 for evaluation of groundwater flow conditions.

4. Groundwater Quality

The following sections describe the analytical results for groundwater samples collected during the December 2007 monitoring round (Operational Year 6, Quarter Number 1). Groundwater analytical results are provided in Tables 1 and 2. Where applicable, the previous round of analytical results for the respective sampling location has been provided in the same table for comparative purposes.

4.1 Volatile Organic Compounds

As shown in Table 1, total VOC (TVOC) concentrations in all monitoring wells sampled during the reporting period remained generally consistent when compared to analytical results from the previous round. Specifically, the TVOC concentration in monitoring wells GMMW-2, GMMW-5, W-5, GMMW-6, PW-4, and TW-1 were 334.5, 74.1, 241.3, 408.0, 46.5, 219.1 ug/L, respectively.

PT system analytical TVOC results are provided in Table 4. During the current reporting period, the TVOC concentration at recovery wells GMPW-3, GMPW-4, and GMPW-5 were consistent with prior rounds of data. Specifically, TVOC concentrations in recovery wells GMPW-3, GMPW-4, and GMPW-5 were 284.4 ug/L, 297.4 ug/L, and 0.0 ug/L, respectively. A complete evaluation of performance monitoring conducted on the PT system is provided in Section 8.1.2 of this report.

4.2 Indicators of Reducing Conditions

Groundwater analytical results for biogeochemical parameters and field parameters were collected in accordance with the LTM plan and are provided in Table 2. In summary, field and laboratory groundwater data for Wells GMMW-5 and GMMW-6 indicate that reducing conditions are being maintained within the IRZ. This is evidenced by the presence of reduced forms of alternate electron acceptors (i.e., methane). Further details of the ARI system performance monitoring are provided in Section 8.2.2 of this report.

4.3 Evidence of Biodegradation

Table 2 provides the results of biodegradation end product concentrations in monitoring wells and indicates the continued occurrence of bioactivity and biodegradation of VOCs within the IRZ. Specifically, the concentrations of ethene at monitoring well GMMW-6 continue to be elevated when compared to baseline conditions. Similarly, the concentration of ethane remained elevated at monitoring wells GMMW-5 and GMMW-6 during the reporting period. Additional details on the results of biogeochemical monitoring as evidence of Groundwater Remediation System performance and effectiveness are discussed in Section 8.2.2 of this report.

5. Spring Water Quality

Spring water locations SP-2 and SP-3 were observed during the OM&M site visit on December 19, 2007. The SP-2 and SP-3 locations were covered with approximately 6 inches of snow, and no snow melt or wet areas were observed. Digging through the snow to the ground surface revealed an absence of moving spring water at these locations; therefore, samples were not collected.

6. Surface Water Quality

Surface water quality analytical results for the Operational Year 6, Quarter Number 1 monitoring round are summarized in Table 1. As shown in Table 1, surface water quality at the F-6 and SP-4 sampling locations remained consistent with previous analytical data. Specifically, TVOC concentrations at the F-6 and SP-4 sampling locations were 0.0 µg/L and 1.1 µg/L, respectively. The data indicate that surface water quality is not being adversely impacted.

7. Groundwater Remediation System Performance

The following section describes the results of the Groundwater Remediation System performance monitoring conducted during Operational Year 6, Quarter Number 1.

7.1 PT System

The following section describes the results of the PT system performance monitoring conducted during Operational Year 6, Quarter Number 1.

7.1.1 Summary of Operation, Maintenance, and Monitoring

During Operational Year 6, Quarter Number 1, the PT system operated continuously with the exception of brief system shutdowns as a result of minor system alarms and routine OM&M activities.

PT system OM&M for Operational Year 6, Quarter Number 1 was conducted during the week of December 17, 2007 and included operation and maintenance of system equipment, the collection of system performance samples (water and vapor), and recording system operating parameters. Table 3 provides a summary of the recorded system operating parameters for the current operating period. As shown in Table 3, the total effluent groundwater recovery rate for Operational Year 6, Quarter Number 1 was approximately 0.41 gallon per minute (gpm), with individual recovery rates of 0.04 gpm, 0.17 gpm, and 0.02 gpm in GMPW-3, GMPW-4, and GMPW-5, respectively. The average individual recovery well rate during Operational Year 6, Quarter Number 1 in recovery wells GMPW-3 and GMPW-5 continued to be lower when compared to previous operation. The decrease in recovery rate was most likely due to clogging of the filter socks which protect the pumps. The filter socks were replaced during the OM&M visit.

A total of 68,914 gallons of groundwater was recovered during Operational Year 6, Quarter Number 1 and a total of 1,393,436 gallons of groundwater has been recovered since system startup. The low profile air stripper operated in accordance with the design specifications and had a blower flow rate of 225 standard cubic feet per minute (scfm).

7.1.2 Results of Performance Sampling

PT system performance sampling for Operational Year 6, Quarter Number 1 was conducted on January 17, 2008. As discussed previously, five groundwater samples and one vapor sample were collected. Groundwater samples included collection of individual recovery well samples (GMPW-3, GMPW-4, and GMPW-5), total influent, and total effluent after the cartridge filters. The vapor sample was collected from the effluent stack of the low profile air stripper.

Table 4 provides a summary of the PT system performance groundwater sampling analytical results. As shown in Table 4, all groundwater VOCs were treated to below their respective Best Professional Judgment (BPJ) limits via the low profile air stripper. The total iron concentration after the cartridge filter is below the respective recommended daily maximum BPJ limit. Based on the total groundwater recovered during the reporting period and total influent groundwater concentration, an estimated 0.08 pounds (lbs) of VOC mass were removed from the subsurface during the quarterly reporting period, as shown in Table 5. A total of approximately 2.67 lbs of VOCs have been removed from the subsurface since system startup.

Table 6 provides a summary of the PT system performance vapor sampling analytical results. As shown in Table 6, VOCs were not detected above their respective detection limits. To be conservative, a NYSDEC DAR-1 air model was calculated using the actual analytical data for detected constituents and the detection limit of all constituents that were not detected but have historically been detected in the influent groundwater. All COCs were below their respective short-term guidance concentrations (SGCs) and annual guidance concentrations (AGCs). Appendix B contains the NYSDEC DAR-1 AGC screening simulation based on the hand calculations provided in the NYSDEC DAR-1 AGC/SGC tables dated December 22, 2003.

7.2 ARI System

The following section describes the results of the ARI system performance monitoring conducted during Operational Year 6, Quarter Number 1.

7.2.1 Summary of Operation, Maintenance, and Monitoring

ARI system OM&M was conducted during the Operational Year 6, Quarter Number 1 OM&M site visit, during the week of December 17, 2007. The visit included operation and maintenance of system equipment and the collection of samples for analysis of TOC from injection wells IW-2 and IW-13. In addition, a TOC sample was collected from monitoring well TW-1 to evaluate the long- term performance of the alternate electron donor in providing TOC to the subsurface.

One reagent injection was conducted during Operational Year 6, Quarter Number 1. The injection was initiated on September 27, 2007 and was completed on October 29, 2007. As described in the Hydraulic Injection Test and Alternate Electron Donor Pilot Test Letter Work Plan (ARCADIS 2006), an alternate electron donor (e.g., emulsified edible oil [EOS]) was injected into existing injection well IW-8 during the week of December 18, 2006. Accordingly, IW-8 was not included in the current reagent injection to allow for long-term groundwater monitoring of the alternate electron donor.

Based on the number of injection events, quantity of molasses solution delivered to each injection well, and molasses solution percentage, approximately 13,705-gallons of molasses solution were delivered to the subsurface during Operational Year 6, Quarter Number 1. A total of 144,636-gallons of molasses solution have been injected since system startup. Appendix C provides a summary of the recorded system operating parameters for each of the injection events for Operational Year 6, Quarter Number 1.

7.2.2 Results of Performance Sampling

ARI system performance sampling was conducted on December 18, 2007. As discussed previously, this event consisted of collecting TOC samples at two injection wells. In addition, analytical results from select monitoring wells under the environmental effectiveness monitoring program were used to determine the effectiveness of the ARI system. A summary of key observations is as follows:

- The TOC concentration at monitoring well GMMW-5 (20 mg/L) and injection wells IW-13 (300 mg/L) indicated that sufficient organic carbon is being delivered to the subsurface to maintain the IRZ.

- The TOC in monitoring well TW-1 was 150 mg/L. The data indicate that the alternate electron donor EOS continues to provide sufficient organic carbon to the subsurface following the one time injection in injection well IW-8.

- The methane concentration in monitoring well GMMW-5 remained elevated at 16,000 ug/L. These data provide evidence that strongly reducing conditions (methanogenic) are being maintained within the IRZ.

- The ethene concentration in monitoring well GMMW-6 remained elevated at 67,000 ng/L.

- The ethane concentration remained elevated in monitoring wells GMMW-5 and GMMW-6 at 18,000 and 12,000 ng/L, respectively.

7.2.3 Hydraulic Injection Test and Alternate Electron Donor Pilot Test Summary

An annual summary of the hydraulic injection and alternate electron donor pilot test is provided below.

Hydraulic injection test and alternate electron donor pilot test reagent injections were completed during the week of December 18, 2007 as described in the Work Plan. The Work Plan was approved by the NYSDEC in a letter dated December 8, 2006. The objective of the hydraulic injection tests was to collect field data to assess migratory porosity, seepage velocity, whether or not preferential flow paths exist in the formation, and to refine the injection volume needed to affect the desired treatment area. The objective of the alternate electron donor pilot test is to assess the efficacy of an alternate carbon source at providing a source of carbon to the formation for an extended period of time with minimal injection frequency. A brief description of the injection and pilot test methodology and results (as of December 2007) is provided below.

7.2.3.1 Injection and Monitoring Methodology

7.2.3.1.1 Injection Methodology

Hydraulic injection and alternate electron donor pilot tests were completed in existing injection wells IW-2 and IW-8. The two injection/pilot tests were conducted simultaneously and consisted of injecting approximately 7,000-gallons of solution containing dilute molasses, fluoroscein dye and bromide into injection well IW-2; and, injecting approximately 6,875-gallons of solution containing dilute edible oil substrate (EOS) 598B2, fluorescein dye and bromide into injection well IW-8. Because of the relatively large injection volumes, injections were completed with an in-line mixing process that utilized pneumatic diaphragm pumps (e.g., one pump connected to IW-2 and one pump connected to IW-8) followed by individual in-line static mixers. First, the raw reagents (e.g., EOS or molasses, bromide, fluorescein dye, and approximately 200 to 300 gallons of potable water) were premixed into 400 gallon batch solutions using existing mixing tank MT-800 to mix the molasses batch solution and existing storage tank ST-701 to mix the EOS batch solution. Then, the premixed batches were diluted further to the desired final injection strength using the in-line mixing process. A process flow diagram presenting the overall injection process is provided on Figure D1 of Appendix D. Potable water was delivered to the site in 4,000 gallon tanker trucks due to the limited availability of potable and/or treated process water. A summary of the final reagent injection volumes/quantities used during the injection is provided in Appendix D, Table D1.

7.2.3.1.2 Monitoring Methodology

Injection reagent quality control monitoring and groundwater monitoring were used to collect the necessary data for evaluating the injection tests and alternate electron donor performance with respect to the test objectives. Monitoring wells GMMW-4 and GMMW-5 were used to monitor the injection at injection well IW-2. Monitoring wells TW-1 and W-5 were used to monitor the injection at injection well IW-8. Injection reagent quality control grab samples were collected prior to and during the reagent injections and included the collection of premixed batch solution samples and final/diluted injection solution samples for the qualitative analysis of fluoroscein dye and quantitative analysis of TOC and bromide. Groundwater monitoring was conducted prior to, during, and following the reagent injection (i.e., pre-injection, during injection and post-injection). In general, pre-injection (baseline) and during injection monitoring included the collection of water levels, field parameters (i.e., conductivity) and samples for laboratory analysis of total organic carbon (TOC) and bromide from select injection and/or monitoring wells. TROLL 9500 data loggers were deployed in monitoring wells

GMMW-4 and TW-1 to monitor and record changes in conductivity and water level during the injection and approximately two-weeks after the injections. Water levels were used to evaluate mounding and the overall hydraulic response at the monitoring location. Conductivity is a qualitative indicator of injectant presence and responds (e.g., increases) as a result of the ions (e.g., bromide, natural salts present within molasses, etc.) present within the injection solutions. In addition to the automatic monitoring, periodic grab samples of groundwater were collected at a regular frequency during and subsequent to the injections. Grab samples were screened for the relative presence of fluorescein dye using a black light and submitted to Microbac Laboratories in Cortland, NY for laboratory analysis of TOC and bromide.

Post-injection monitoring included the periodic collection of groundwater samples for field parameters, TOC, and bromide from select monitoring wells.

7.2.3.2 Results and Conclusions

A summary of the injection reagent quality control samples that were collected is provided in Appendix D, Table D2. A summary of the groundwater monitoring results submitted for laboratory analysis is provided in Appendix D, Tables D3 and D4 (injection test wells IW-2 and IW-8, respectively). Figures D2 and D3 of Appendix D provide a summary of the field parameters (water level and conductivity) recorded during and following the reagent injections in monitoring wells GMMW-4 and TW-1, respectively.

7.2.3.2.1 Hydraulic Injection Testing

A summary of the results and conclusions for the hydraulic injection tests and alternate electron donor (EOS) performance (as of December 2007) is provided below.

7.2.3.2.1.1 Results

As shown in Table D2, the concentration of bromide in the EOS batch was comparable to the design concentration; however, the concentration of bromide in the molasses batch was lower than designed. The exact cause of the discrepancy within the molasses batch is unknown; however, it is anticipated that the natural salts contained within the molasses batch limited the ability to dissolve the potassium bromide (another salt) within the batch. The bromide injection concentration (e.g., Sample ID- "Molasses Injection 2") was generally consistent with the desired batch solution to dilution water ratio (e.g., the batch solution volume [approximately 400 gallons] divided by the total injection volume). The bromide injection concentration in the EOS (e.g., Sample ID-

"EOS Injection 2") was generally lower than the anticipated dilution ratio, but within an acceptable range. Flourescein dye was observed in all QC samples collected.

As shown on Figures D1 and D2, both injection test monitoring points GMMW-4 and TW-1 showed an overall hydraulic response (i.e., water table elevation increase) as a result of the injections. Specifically, the water column increased a maximum of approximately 1.5 feet in monitoring well GMMW-4 and approximately 3.5 feet in monitoring well TW-1. A significant conductivity response was observed in monitoring well TW-1. Specifically, the conductivity increased by approximately 35 percent during the injection and approximately 80 percent during the post-injection monitoring period. A significant conductivity response was not observed in monitoring well GMMW-4 during or following the injection.

Bromide was detected at low concentrations in monitoring wells GMMW-4 and TW-1 during the injection. Specifically, the concentration of bromide ranged from 0.14 to 3.0 mg/L at monitoring well GMMW-4 and from <0.1 to 1.3 mg/L at monitoring well TW-1. Bromide increased significantly in monitoring well TW-1 during the post-injection monitoring period with the highest concentration (12.0 mg/L) observed approximately 50 days following the injection. Bromide was observed at relatively low levels during the post-injection monitoring period of GMMW-4. Fluorescein dye was generally observed with a weak relative response at monitoring well GMMW-4 during the injection and with a weak to medium relative response at monitoring well TW-1 during the injection.

TOC was detected at low concentrations in monitoring well GMMW-4 during the injection. Specifically, the concentration of TOC ranged from 5.1 to 37 mg/L with the majority of the values <10 mg/L. TOC declined in monitoring well TW-1 during the injection when compared to baseline conditions and ranged from 107 to 46.5 mg/L during the injection; with the lowest value occurring at the final sample collected during the injection.

7.2.3.2.1.2 Conclusions

The following conclusions are made based on the hydraulic injection test results:

- Overall, the concentration of electron donor (e.g., TOC) and bromide within the batch mixes and diluted/final injection reagents was of sufficient quality/quantity for implementation of the injection test/electron donor injections.

- The concentration of bromide was significantly lower than anticipated within the molasses solution. It is hypothesized that this was caused by the limited salt solubility caused by the existing dissolved salts within the molasses solution.

- The concentration of bromide was consistent with the design concentration in the EOS solution.

- In general, the "during injection" observation/recovery of bromide was much lower than anticipated at both TW-1 and GMMW-4. Significant bromide was observed subsequent to the injection at TW-1 but not GMMW-4. The data indicate the following possibilities:

    - Consistent with existing site boring/well installation logs, the geology in the saturated zone is heterogeneous, resulting in erratic preferential flow paths around the injection wells. Specifically, injections may result in injectant "fingers" around the injection well as opposed to an ovular or round injection cloud.

    - The observation of consistent post-injection TOC and elevated bromide at TW-1 supports the above theory.

    - The lack of during-injection and post-injection TOC, bromide, and/or conductivity response at monitoring well GMMW-4 suggests that either –

        - The monitoring well screen/pack is fouled resulting in poor communication with the aquifer;

        - The aquifer in the vicinity of GMMW-4 is not connected to the injection cloud from injection well IW-2 due to natural soil heterogeneity; or,

        - The injectant is being delivered above the well screen or through a non-natural (e.g., hydraulic fracture, etc.) preferential pathway resulting in poor distribution within the aquifer.

- The decrease in TOC at monitoring well TW-1 could indicate that the aquifer has a high sorption capacity for the EOS. Specifically, the effective injection radius

of the oil substrate was lower than anticipated resulting in "clean" water flushing through TW-1 during the injection. Although corroborated by TOC data, this theory is not supported by the bromide data.

- The average advective transport velocity in the vicinity of TW-1 appears consistent with previous data and is estimated at approximately 0.1 feet per day based on the available bromide data. The observation of bromide within the injection well at 1.58 mg/L, six months following the injection provides further support that the advective transport velocity is generally low. The average advective transport velocity could not be calculated at GMMW-4 due to the lack of bromide response within the monitoring well.

- Finally, the calculation of migratory porosity could not be completed due to the limited bromide response during the reagent injection.

7.2.3.2.2 Alternate Electron Donor Performance

7.2.3.2.2.1 Results

As referenced previously, the primary goal of the alternate electron donor pilot test is to evaluate the efficacy of EOS at providing a source of carbon to the formation for an extended period of time with minimal injection frequency. Accordingly, the primary indicator of test performance is the observation of post-injection TOC at monitoring well TW-1 at a concentration sufficient to maintain strongly reducing conditions (i.e., > 20 mg/L). The concentration of VOCs at monitoring well TW-1 was also considered.

As shown in Table D4, the concentration of TOC at monitoring well TW-1 ranged from 88.5 to 223 mg/L during the 1-year post injection monitoring period. The concentration of TOC during the December 2007 monitoring event was 150 mg/L. VOC analytical results for monitoring well TW-1 are presented in Table 1. As shown in Table 1, VOCs remained stable when compared to the previous quarter of monitoring data.

7.2.3.2.2.2 Conclusions

Based on the continuous presence of TOC at levels sufficient to maintain strongly reducing conditions, it is concluded that EOS has achieved its objective of providing a long-term carbon source in the subsurface as of December 2007. VOC data are consistent with previous results; however, conclusions cannot be drawn at this juncture with respect to alternate electron donor performance since there are limited data (e.g., two data points) for long-term evaluation. Long-term TOC delivery and VOC

degradation performance will continue to be evaluated during subsequent routine monitoring events.

8. Spring Water Remediation System Performance

SP-5 Spring Water Remediation System OM&M could not be conducted during Operational Year 6, Quarter Number 1 due to the presence of tailwater (i.e., backed up water) at the discharge sampling location. In an effort to evaluate the source/cause of the tailwater, the tailwater was manually evacuated and three (3) grab samples were collected. Sample ID SP-5 INF was collected from the influent well within the carbon unit. Sample ID SP-5 EFF was collected from the tailwater at the discharge outfall location. Sample ID SP-5 EFF Surf was collected from the treated spring water, directly on top of the carbon unit. SP-5 remediation system analytical results are provided in Table 7.

As shown in Table 7, analytical data for SP-5 INF and SP-5 EFF are generally equal while analytical data for SP-5 EFF SURF is below the limits of detection. Combined, the data suggest that the SP-5 remediation system is treating spring water as designed and that the tailwater is untreated water discharging in the vicinity of the outfall from an unknown location.

9. Conclusions

Based on the data obtained from the Operational Year 6, Quarter Number 1 monitoring, ARCADIS concludes the following:

- The anaerobic IRZ established downgradient of the injection transect is successfully reducing the concentration of site-related VOCs through enhanced reductive dechlorination.
- The PT system is operating as designed and is treating recovered groundwater VOCs to below BPJ limits prior to discharge.
- Sufficient organic carbon was delivered to the subsurface to maintain the IRZ.
- Surface water quality continues to be consistent with historical data indicating that impacted groundwater and/or flood related damages are not causing an adverse impact to surface water along the North Stream.

- The SP-5 remediation system is treating collected spring water to below their respective BPT limits; however, untreated water of unknown origin is emerging at the low-lying discharge outfall location.

- Hydraulic injection test data suggest that the formation is heterogeneous, resulting in non-predictable delivery of reagents to the subsurface.

- Hydraulic injection test data confirm previous data and indicate the advective groundwater velocity is approximately 0.1 feet per day in the vicinity of injection well IW-8.

- Ongoing alternate electron donor TOC data indicate the EOS is an effective product to provide sufficient organic carbon to the subsurface over long periods of time.

10. Recommendations

The following recommendations are made for Operational Year 6, Quarter Number 1 activities:

- Continue to inspect the former spring locations and the side slopes of the North Stream.

- Continue to operate the ARI system without injection well IW-8. Continue to obtain and evaluate data related to the ongoing alternate electron donor pilot program.

- Evaluate the instantaneous and long-term performance of recovery well pump GMPW-3 and GMPW-5 to determine if the filter sock replacement period needs to be adjusted.

- Evaluate and determine the source of water emerging at the SP-5 spring water remediation system outfall location.

- Consider additional injection testing or other hydrogeologic testing to better understand the geology within the injected area and optimize injection strategies.

11. Project Schedule

Groundwater environmental effectiveness monitoring is scheduled to be conducted for Operational Year 6 on the quarterly schedule set forth in the Proposed Modifications to Long-Term Monitoring Program (ARCADIS 2005). System OM&M of the Groundwater Remediation System will continue to be performed on a quarterly basis consistent with the LTM Plan. Evaluation of the SP-5 spring water remediation system will be completed during the first half of 2008.

12. References

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ARCADIS G&M, Inc. 2006. Hydraulic Injection Test and Alternate Electron Donor Pilot Test, Colesville Landfill, Broome County, New York (Site No. 704010). November 30, 2006.

ARCADIS of New York, Inc. 2008. Operational Year 5, Quarter Number 4 Monitoring Report, Colesville Landfill, Broome County, New York (Site No. 704010).

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Table 1. Concentrations of Volatile Organic Compounds Detected in Groundwater and Surface Water, Operational Year 6, Quarter Number 1, Colesville Landfill, Broome County, New York.

(units in ug/L)	Sample ID: / Date:	GMMW-02 9/18/2007	GMMW-02 12/19/2007	GMMW-05 9/18/2007	GMMW-05 12/18/2007	GMMW-05 * 12/18/2007	GMMW-06 9/19/2007	GMMW-06 12/18/2007	PW-04 9/19/2007	PW-04 12/18/2007
1,1,1-Trichloroethane		**9.2**	**9.5**	<1.0	<1.0	<1.0	**7.2**	**3.1**	**10**	**9**
1,1,2-Trichloroethane		<1.0	<1.0	<1.0	<1.0	<1.0	**1.1**	<1.0	<1.0	<1.0
1,1-Dichloroethane		**91**	**92**	**16**	**16**	**17**	**150**	**120**	**11**	**4.6**
1,1-Dichloroethene		<1.0	**1.3**	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,2-Dichloroethane		<1.0	<1.0	**1.0**	<1.0	<1.0	**1.1**	<1.0	<1.0	<1.0
1,2-Dichloropropane		<1.0	<1.0	<1.0	<1.0	<1.0	**1.1**	**1.1**	<1.0	<1.0
1,2,4-Trimethylbenzene		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	**1.4**	<1.0	<1.0
Benzene		<1.0	**3**	<1.0	<1.0	<1.0	**7.8**	**9.5**	<1.0	<1.0
Carbon Tetrachloride		**1.3**	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	**1.8**	<1.0
Chlorobenzene		**31**	**34**	**20**	**16**	**17**	**37**	**37**	<1.0	<1.0
Chloroethane		**26**	**32**	**41**	**34**	**35**	**120**	**180**	**3.8**	**1.8**
Chloroform		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	**1.2**
cis-1,2-Dichloroethene		**100**	**100**	**1.7**	**2.3**	**2.5**	**36**	**14**	**12**	**5.6**
Dichlorodifluoromethane		<1.0	**1.6**	<1.0	<1.0	<1.0	**5.5**	**5.8**	**1.5**	**2.3**
Ethylbenzene		<1.0	<1.0	<1.0	<1.0	<1.0	**2.8**	**2.9**	<1.0	<1.0
Methylene chloride		<1.0	<1.0	<1.0	<1.0	<1.0	**5**	**5.5**	<1.0	<1.0
Methyl tert-butyl ether		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Naphthalene		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
o-Xylene		<1.0	<1.0	**2.5**	**2.0**	**2.1**	**2.7**	**2.7**	<1.0	<1.0
m,p-Xylene		<2.0	<2.0	<2.0	<1.0	<1.0	**6.3**	**7.0**	<2.0	<2.0
Tetrachloroethene		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Toluene		<1.0	<1.0	**3.3**	**2.5**	**2.5**	**2.7**	**3.0**	<1.0	<1.0
trans-1,2-Dichloroethene		<1.0	**1.1**	<1.0	<1.0	<1.0	**1.8**	**1.6**	<1.0	<1.0
Trichloroethene		**40**	**40**	<1.0	**1.3**	**1.3**	**4.5**	**3.4**	**22**	**22**
Vinyl chloride		**18**	**20**	<1.0	<1.0	<1.0	**17**	**10**	<1.0	<1.0
Total VOCs		**316.5**	**334.5**	**85.5**	**74.1**	**77.4**	**409.6**	**408.0**	**62.1**	**46.5**

Bold Constituent detected above MDL.

VOCs Volatile Organic Compounds.

ug/L Micrograms per liter.

* Field replicate.

J Estimated value.

MDL Method detection limit.

NA Not analyzed.

Table 1. Concentrations of Volatile Organic Compounds Detected in Groundwater and Surface Water, Operational Year 6, Quarter Number 1, Colesville Landfill, Broome County, New York.

Constituents (units in ug/L)	Sample ID: / Date:	W-05 9/19/2007	W-05 12/18/2007	TW-01 9/18/07	TW-01 12/18/2007	SP-04 9/19/2007	SP-04 12/19/2007	F-06 6/19/2007	F-06 12/19/2007	FBV121906 12/192007
1,1,1-Trichloroethane		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,1,2-Trichloroethane		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,1-Dichloroethane		**66**	**57**	**45**	**34**	**3.8**	**1.1**	**1.2**	<1.0	<1.0
1,1-Dichloroethene		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,2-Dichloroethane		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,2-Dichloropropane		**1.2**	**1.2**	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,2,4-Trimethylbenzene		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Benzene		**6.2**	**8**	**2.4**	**3.2**	<1.0	<1.0	<1.0	<1.0	<1.0
Carbon Tetrachloride		<1.0	<1.0	<1.0	<1.1	<1.0	<1.0	<1.0	<1.0	<1.0
Chlorobenzene		**11**	**11**	**14**	**16**	<1.0	<1.0	<1.0	<1.0	<1.0
Chloroethane		**120**	**150**	**51**	**110**	<1.0	<1.0	<1.0	<1.0	<1.0
Chloroform		<1.0	<1.1	<1.0	<1.1	<1.0	<1.0	<1.0	<1.0	<1.0
cis-1,2-Dichloroethene		**2.4**	**3.0**	**12**	**14**	**1.1**	<1.0	<1.0	<1.0	<1.0
Dichlorodifluoromethane		<1.0	**2.4**	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Ethylbenzene		<1.0	<1.1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Methylene chloride		**3.2**	**3.6**	**1.0**	**1.6**	<1.0	<1.0	<1.0	<1.0	<1.0
Methyl tert-butyl ether		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Naphthalene		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
o-Xylene		**2.3**	**3.3**	**1.0**	**1.6**	<1.0	<1.0	<1.0	<1.0	<1.0
m,p-Xylene		<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Tetrachloroethene		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Toluene		<1.0	<1.0	**53**	**29**	<1.0	<1.0	<1.0	<1.0	<1.0
trans-1,2-Dichloroethene		<1.0	<1.0	<1.0	<1.1	<1.0	<1.0	<1.0	<1.0	<1.0
Trichloroethene		<1.0	**1.8**	<1.0	**2.2**	<1.0	<1.0	<1.0	<1.0	<1.0
Vinyl chloride		**1.2**	<1.0	**6.9**	**7.5**	<1.0	<1.0	<1.0	<1.0	<1.0
Total VOCs		**213.5**	**241.3**	**186.3**	**219.1**	**4.9**	**1.1**	**1.2**	**0.0**	**0.0**

Bold Constituent detected above MDL.

VOCs Volatile Organic Compounds.

ug/L Micrograms per liter.

* Field replicate.

J Estimated value.

MDL Method detection limit.

NA Not analyzed.

Table 2. Concentrations of General Chemistry, Field Parameters, and Dissolved Gases Detected in Groundwater, Operational Year 6, Quarter Number 1, Colesville Landfill, Broome County, New York.

Parameters	Sample ID: / Date:	GMMW-02 9/19/07	GMMW-02 12/19/07	GMMW-05 9/19/07	GMMW-05 12/18/07	GMMW-06 9/19/07	GMMW-06 12/18/07
	UNITS						
GENERAL CHEMISTRY							
Bromide	mg/L	--	--	<1.00	--	--	--
Total Organic Carbon	mg/L	**8.8**	**2.1**	**9**	**20**	--	**3.9**
FIELD PARAMETERS							
pH	Standard units	**6.48**	**6.67**	**6.41**	**6.65**	**6.47**	**6.71**
Specific Conductance	mmhos/cm	**0.746**	**0.621**	**1.9**	**0.36**	**0.799**	**0.869**
Turbidity	NTU	**9.7**	--	**33.8**	--	**16.3**	--
Dissolved Oxygen	mg/L	**12.3**	**1.8**	**13.39**	**1.17**	**13.01**	**2.05**
Temperature	deg C	**11.1**	**8.1**	**12.7**	**8.4**	**11.2**	**8.35**
ORP	mV	**15**	**5**	**-94**	**-105**	**-63**	**-89**
DISSOLVED GASES							
Carbon dioxide	mg/L	--	--	--	--	--	--
Carbon monoxide	mg/L	--	--	--	--	--	--
Ethane	ng/L	**670**	**790**	**14,000**	**18,000**	**5,200**	**12,000**
Ethene	ng/L	**7,500**	**12,000**	**370**	**470**	**73,000**	**67,000**
Methane	ug/L	**3,900**	**3,900**	**24,000**	**16,000**	**1,700**	**1,600**
Nitrogen	mg/L	--	--	--	--	--	--
Oxygen	mg/L	--	--	--	--	--	--

Bold Constituent detected above MDL.

mg/L	Milligrams per liter.
mmhos/cm	Millimhos per centimeter.
NTU	Nephelometric Turbidity Units.
deg C	Degrees Celsius.
mV	Millivolts.
ng/L	Nanograms per liter.
--	Not analyzed or collected.
ug/L	Micrograms per liter.
IW	Injection well.
ORP	Oxidation-reduction potential.
J	Qualifier assigned to analytical data indicating result is estimated.

Table 2. Concentrations of General Chemistry, Field Parameters, and Dissolved Gases Detected in Groundwater, Operational Year 6, Quarter Number 1, Colesville Landfill, Broome County, New York.

Parameters	Sample ID: / Date:	PW-04 9/18/07	PW-04 12/19/07	W-05 9/19/07	W-05 12/18/07	IW-02 9/19/07	IW-02 12/19/07
	UNITS						
GENERAL CHEMISTRY							
Bromide	mg/L	--	--	<1.00	--	<1.00	--
Total Organic Carbon	mg/L	**8.0**	**0.8**	**13**	**7.7**	**240**	**20**
FIELD PARAMETERS							
pH	Standard units	**5.69**	**5.85**	**6.17**	**6.46**	**5.71**	**5.14**
Specific Conductance	mmhos/cm	**1.28**	**0.473**	**0.945**	**1.006**	**1.08**	**0.106**
Turbidity	NTU	**35.1**	--	**950**	--	**177**	--
Dissolved Oxygen	mg/L	**8.95**	**2.24**	**11.91**	**1.49**	**14.02**	**1.12**
Temperature	deg C	**12.6**	**9.35**	**12.4**	**8.12**	**11.6**	**1.69**
ORP	mV	**131**	**130**	**-84**	**-111**	**-37**	**169**
DISSOLVED GASES							
Carbon dioxide	mg/L	--	--	--		--	--
Carbon monoxide	mg/L	--	--	--		--	--
Ethane	ng/L	<25	<25	**20,000**	**17,000**	--	--
Ethene	ng/L	<25	<25	**2,300**	**1,500**	--	--
Methane	ug/L	**0.940**	**0.33**	**3,000**	**3,100**	--	--
Nitrogen	mg/L	--	--	--	--	--	--
Oxygen	mg/L	--	--	--	--	--	--

Bold Constituent detected above MDL.

mg/L	Milligrams per liter.
mmhos/cm	Millimhos per centimeter.
NTU	Nephelometric Turbidity Units.
deg C	Degrees Celsius.
mV	Millivolts.
ng/L	Nanograms per liter.
--	Not analyzed or collected.
ug/L	Micrograms per liter.
IW	Injection well.
ORP	Oxidation-reduction potential.
J	Qualifier assigned to analytical data indicating result is estimated.

Table 2. Concentrations of General Chemistry, Field Parameters, and Dissolved Gases Detected in Groundwater, Operational Year 6, Quarter Number 1, Colesville Landfill, Broome County, New York.

Parameters	Sample ID: / Date:	IW-13 9/19/07	IW-13 12/19/07	TW-01 9/19/07	TW-01 12/18/07
	UNITS				
GENERAL CHEMISTRY					
Bromide	mg/L	--	--	<1.00	--
Total Organic Carbon	mg/L	**34**	**300**	**120**	**150**
FIELD PARAMETERS					
pH	Standard units	**5.98**	**5.69**	**6.33**	**6.52**
Specific Conductance	mmhos/cm	**0.51**	**0.686**	**1.21**	**1.445**
Turbidity	NTU	**273**	--	**440**	--
Dissolved Oxygen	mg/L	**3.21**	**1.65**	**2.74**	**1.07**
Temperature	deg C	**13**	**6.82**	**11.1**	**8.26**
ORP	mV	**-26**	**-62**	**-98**	**-109**
DISSOLVED GASES					
Carbon dioxide	mg/L	--	--	--	--
Carbon monoxide	mg/L	--	--	--	--
Ethane	ng/L	--	--	--	**840**
Ethene	ng/L	--	--	--	**3,900**
Methane	ug/L	--	--	--	**21,000**
Nitrogen	mg/L	--	--	--	--
Oxygen	mg/L	--	--	--	--

Bold Constituent detected above MDL.

mg/L	Milligrams per liter.
mmhos/cm	Millimhos per centimeter.
NTU	Nephelometric Turbidity Units.
deg C	Degrees Celsius.
mV	Millivolts.
ng/L	Nanograms per liter.
--	Not analyzed or collected.
ug/L	Micrograms per liter.
IW	Injection well.
ORP	Oxidation-reduction potential.
J	Qualifier assigned to analytical data indicating result is estimated.

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Table 3. PT System Operating Parameters, Operational Year 6, Quarter Number 1, Groundwater Remediation System, Colesville Landfill, Broome County, New York.

Date	Time Recorded	Air Stripper Measurements: Blower Discharge Pressure PI-301 (i.w.c.)	Air Stripper Measurements: Blower Effluent Flowrate (scfm)	Total[1] Effluent Totalizer FQI-401 (gallons)	Water Bypass[2] Totalizer FQI-402 (gallons)	Flow Measurements: GMPW-3 Totalizer FQI-101 (gallons)	Flow Measurements: GMPW-4 Totalizer FQI-102 (gallons)	Flow Measurements: GMPW-5 Totalizer FQI-103 (gallons)
9/20/2007	2:00 PM	8.5	208	148,692.6	NM	515,116.9	181,497.3	420,576.2
1/16/2008	4:00 PM	9.0	225	217,606.1	NM	522,529.9	211,185.1	423,152.9
Average Daily Flowrate During Reporting Period (gpm) =				**0.41**	NA	**0.04**	**0.17**	**0.02**
Total Groundwater Recovered During Reporting Period (gallons) =				**68,914**	NA	**7,413**	**29,688**	**2,577**

NA Not applicable
NM Not measured.
gpm Gallons per minute.
i.w.c. Inches of water column.
scfm Standard cubic feet per minute.

Notes:
1. Total effluent totalizer replaced on 12/23/2005
2. Water bypass totalizer damaged as a result of freezing in February, 2007.

Table 4. Concentrations of Volatile Organic Compounds and Selected Metals Detected in Aqueous Samples Collected from the PT System, Operational Year 6, Quarter Number 1, Colesville Landfill, Broome County, New York[5,6].

Constituents	Model Technology BPJ Limits[1,2] (ug/L)	Sample ID: Date:	GMPW-3 INF 1/17/2008	GMPW-4 INF 1/17/2008	GMPW-5 INF 1/17/2008	COMBINED INF 1/17/2008	EFFLUENT AC II 1/17/2008
1,1,1-Trichloroethane	39741		**27**	**16**	<1.0	**20**	<1.0
1,1,2-Trichloroethane	10		<1.0	<1.0	<1.0	<1.0	<1.0
1,1-Dichloroethane	10		**48**	**65**	<1.0	**38**	<1.0
1,1-Dichloroethene	10		**2.4**	**1.5**	<1.0	**1.7**	<1.0
1,2-Dichloroethane	10-30		<1.0	<1.0	<1.0	<1.0	<1.0
1,2-Dichloropropane	NA		<1.0	<1.0	<1.0	<1.0	<1.0
Benzene	5		**4.6**	**4.2**	<1.0	**3.6**	<1.0
Carbon Tetrachloride	NA		<1.0	<1.0	<1.0	<1.0	<1.0
Chlorobenzene	NA		**1.7**	**7.8**	<1.0	**1.4**	<1.0
Chloroethane	NA		**24**	**39**	<1.0	**19**	<1.0
Chloroform	NA		<1.0	<1.0	<1.0	<1.0	<1.0
cis-1,2-Dichloroethene	10		**81**	**66**	<1.0	**62**	<1.0
Dichlorodifluoromethane	NA		**2.7**	**2.8**	<1.0	**2.2**	<1.0
Ethylbenzene	5		<1.0	<1.0	<1.0	<1.0	<1.0
Methylene Chloride	10-50		**2.7**	**2.0**	<1.0	**2.2**	<1.0
Methyl tert-butyl ether	50		<1.0	<1.0	<1.0	<1.0	<1.0
Naphthalene	10		<1.0	<1.0	<1.0	<1.0	<1.0
o-Xylene	5		<1.0	<1.0	<1.0	<1.0	<1.0
Tetrachloroethene	10		**1.3**	<1.0	<1.0	**1.0**	<1.0
Toluene	5		<1.0	<1.0	<1.0	<1.0	<1.0
trans-1,2-Dichloroethene	10-50		<1.0	**1.1**	<1.0	<1.0	<1.0
Trichloroethene	10		**74**	**71**	<1.0	**57**	<1.0
Vinyl Chloride	10-50		**15**	**21**	<1.0	**12**	<1.0
Total VOCs			**284.4**	**297.4**	**0.0**	**220.1**	**0.0**

Metals (units in mg/L)	Model Technology BPJ Limits[3,4] (mg/L)						
Total Iron	1.2 / 0.61		**0.784**	**1.61**	<0.040	**2.73**	**0.095**

See Notes on Last Page.

Table 4. Concentrations of Volatile Organic Compounds and Selected Metals Detected in Aqueous Samples Collected from the PT System, Operational Year 6, Quarter Number 1, Colesville Landfill, Broome County, New York[5,6].

Notes:

1. Model Technology Best Professional Judgment (BPJ) Limits recommended for Air Stripping with appropriate pretreatment from Attachment C of TOGS 1.2.1.
2. When a range is listed for the BPJ limit, a variation in available references was found. Recommended daily maximum limits should be in this range.
3. Model Technology BPJ Limits recommended for Lime, Settle and Filter treatment.
4. The recommended daily maximum permit limit is 1.2 mg/L and the recommended daily average permit limit is 0.61 mg/L.
5. Production wells were sampled in accordance with the schedule set forth in Table 3 of the Long-Term Monitoring Plan (ARCADIS 2002).
6. Bold values indicate compound detected above method detection limit.

NA	No BPJ limit listed.
J	Estimated Value.
ug/L	Micrograms Per Liter.
mg/L	Milligrams Per Liter.
VOCs	Volatile Organic Compounds.
AC	After Cartridge Filter.
BC	Before Cartridge Filter.
PT	Pump and Treat.
--	Not Analyzed or Collected.
<	Analyte Below Detection Limit.

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Table 5. PT Groundwater Remediation System Mass Removal Rate of Volatile Organic Compounds, Operational Year 6, Quarter Number 1, Colesville Landfill, Broome County, New York.

Date Sampled	Total VOC Influent Concentration (ug/L)	Total Effluent Totalizer[4] FQI-401 (gallons)	Total Groundwater Recovered[1] Between Sampling Intervals (gal)	Influent Concentration[2] Geometric Mean (ug/L)	Total Estimated Mass[3] Removed (lbs)
9/20/2007	93.3	148,693	NA	NA	NA
1/17/2008	220.1	217,606	68,914	143	0.08
			Total Estimated Mass Removed During Operational Year 6, Quarter Number 1 (lbs) =		**0.08**
			Total Estimated Mass Removed Since System Startup (lbs) =		**2.67**

Notes:

NA	Not applicable.
ug/L	Micrograms per liter.
gal	Gallons.
lbs	Pounds.
VOC	Volatile organic compound.

1. Total Groundwater Recovered Between Sampling Intervals = Well Totalizer Reading for current sampling event - Well Totalizer Reading for prior sampling event.
2. Influent Concentration Geometric Mean = (Influent Concentration for prior sampling event x Influent Concentration for current sampling event) ^ (1/2).
3. Total Mass Removed = (Total Groundwater Recovered Between Intervals) x Influent Concentration Geometric Mean x 3.7854 L/gallon x (1 lb / 453,592,370 ug).
4. Total effluent totalizer was replaced on Masrch 13, 2007.

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Table 6. Concentrations of Volatile Organic Compounds Detected in Air Stripper Effluent, Operational Year 6, Quarter Number 1, Groundwater Remediation System, Colesville Landfill, Broome County, New York.

Compounds	CAS Numbers	Sample ID: Date Sampled:	Effluent 1/17/2008 ppbv
Vinyl Chloride	75-01-4		<7.0
Chloroethane(Ethyl Chloride)	75-00-3		<7.0
1,1-Dichloroethene(Vinylidene Chloride)	75-35-4		<7.0
Methylene Chloride(Dichloromethane)	75-09-2		<7.0
1,1-Dichloroethane	75-34-3		<7.0
cis-1,2-Dichloroethylene	156-59-2		<7.0
Chloroform	67-66-3		<7.0
1,1,1-Trichloroethane(Methyl Chloroform)	71-55-6		<7.0
Benzene	71-43-2		<7.0
Trichloroethene	79-01-6		<7.0
Toluene	108-88-3		<7.0
Ethyl benzene	100-41-4		<7.0
m,p-Xylene	108-38-3/106-42-3		<7.0
o-Xylene	95-47-6		<7.0
1,2,4-Trimethylbenzene	95-63-6		<7.0
2-Propanol (Isopropyl alcohol)	67-63-0		<7.0
Dichlorodifluoromethane(Freon 12)	75-71-8		<7.0

Bold Constituent detected above MDL.
ppbv: parts per billion by volume

Notes/Assumptions:

1. Samples collected by ARCADIS personnel on the dates shown and submitted to Air Toxics Laboratories LTD. for volatile organic compound (VOC) analyses using a modified USEPA Method TO-14A.

Table 7. Concentrations of Volatile Organic Compounds Detected in Aqueous Samples Collected from the SP-5 Spring Water Remediation System, Operational Year 6, Quarter 1, Colesville Landfill, Broome County, New York.

Constituents	Model Technology BPJ Limits[1,2] (ug/L)	Sample ID: Date:	SP-5 INF 1/17/2008	SP-5 EFF 1/17/2008	SP-5 EFF SURF 1/18/2008
VOCs (units in ug/L)					
1,1,1-Trichloroethane	10		<1.0	<1.0	<1.0
1,1-Dichloroethane	10		**25**	**21**	<1.0
1,2-Dichloroethane	10-100		<1.0	<1.0	<1.0
Benzene	5		**3.2**	**2.2**	<1.0
Chlorobenzene	10-25		**36**	**33**	<1.0
Chloroethane	NA		<1.0	**6.7**	<1.0
cis-1,2-Dichloroethene	10		**1.5**	**1.7**	<1.0
Dichlorodifluoromethane	NA		**2.0**	**1.6**	<1.0
Ethylbenzene	5		<1.0	<1.0	<1.0
Toluene	5		<1.0	<1.0	<1.0
trans-1,2-Dichloroethene	10-100		<1.0	<1.0	<1.0
Trichloroethene	10		**3.5**	**3.8**	<1.0
Vinyl Chloride	10		<1.0	<1.0	<1.0
Total VOCs			**71.2**	**70.0**	**0.0**

Bold Constituent detected above MDL.

ug/L	Micrograms per liter.
VOCs	Volatile organic compounds.
<	Analyte below detection limit.
INF.	Influent.
EFF.	Effluent.
NA	No BPJ limit listed.

Notes:

1. Model Technology Best Professional Judgment (BPJ) Limits recommended for carbon adsorption with appropriate pretreatment from Attachment C of TOGS 1.2.1.
2. When a range is listed for the BPJ limit, a variation in available references was found. Recommended daily maximum limits should be in this range.

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Appendix A

Groundwater Sampling Logs

Table 3. Field Measurements of Depth to Water in Select Wells, Colesville Landfill, Broome County, New York.

Date: 12/18/07

Well Identification		Depth to Water (feet below MP)	Comments
GMMW-3		34.91	Needs a new J-plug
GMMW-4		46.22	
PW-3		12.81	
PW-11		52.90	

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Water Sampling Log

Project	Colesville Landfill	Project No.	NY000949.0020	Page	1 of 1
Site Location	Harpursville, NY			Date	12/15/17
Site/Well No.	W-5	Replicate No.	—	Code No.	—
Weather	Sun 32°	Sampling Time: Begin	11:00	End	1106

Evacuation Data

Measuring Point	Top of PVC
MP Elevation (ft)	—
Land Surface Elevation (ft)	—
Sounded Well Depth (ft bmp)	—
Depth to Water (ft bmp)	52.25
Water-Level Elevation (ft)	—
Water Column in Well (ft)	
Casing Diameter/Type	2"
Gallons in Well	—
Gallons Pumped/Bailed Prior to Sampling	—
Sample Pump Intake Setting (ft bmp)	FDB
Purge Time	begin ____ end ____
Pumping Rate (gpm)	—
Evacuation Method	2" Disposable poly bailer

Field Parameters

Color	Clear
Odor	None
Appearance	Slightly Cloudy (TOC)
pH (s.u.)	6.46
Conductivity (mS/cm)	1.006
(µmhos/cm)	
Turbidity (NTU)	
Temperature (°C)	8.12
Dissolved Oxygen (mg/L)	1.49
ORP	-111
Sampling Method	Bailer-(TOC) FDB
Remarks	Duplicate @ FDB

Purged 0.5 gallons before sampling TOC / Tiny organisms in ~~Grossed~~ Water.

Constituents Sampled	Container Description	Number	Preservative
8021 VOLATILES	40 ML VOA VIALS	2	HCL
Ethene, Ethane, Methane	40 ML VOA Vials	2	
TOC	~~250 ML Plastic~~ 40 ML VOA	2	Unpres.
Total Iron	250 ML Plastic Amber	0	HNO3

Sampling Personnel: KA / Ecan

Well Casing Volumes

Gal./Ft.				
	1-¼" = 0.06	2" = 0.16	3" = 0.37	4" = 0.65
	1-½" = 0.09	2-½" = 0.26	3-½" = 0.50	6" = 1.47

bmp	below measuring point	ml	milliliter	NTU	Nephelometric Turbidity Units
°C	Degrees Celsius	mS/cm	Milisiemens per centimeter	PVC	Polyvinyl chloride
ft	feet	msl	mean sea-level	s.u.	Standard units
gpm	Gallons per minute	N/A	Not Applicable	umhos/cm	Micromhos per centimeter
mg/L	Miligrams per liter	NR	Not Recorded	VOC	Volatile Organic Compounds

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Water Sampling Log

Project	Colesville Landfill	Project No.	NY000949.0020	Page	1 of 1
Site Location	Harpursville, NY			Date	12/18/07
Site/Well No.	TW-1	Replicate No.	—	Code No.	—
Weather	Sun 32°	Sampling Time: Begin	1140	End	1154

Evacuation Data

Measuring Point	Top of PVC
MP Elevation (ft)	
Land Surface Elevation (ft)	
Sounded Well Depth (ft bmp)	
Depth to Water (ft bmp)	51.75
Water-Level Elevation (ft)	
Water Column in Well (ft)	
Casing Diameter/Type	2"
Gallons in Well	
Gallons Pumped/Bailed Prior to Sampling	
Sample Pump Intake Setting (ft bmp)	
Purge Time	begin ____ end ____
Pumping Rate (gpm)	
Evacuation Method	2" Disposable poly bailer / PDB

Field Parameters

Color	Clear / yellow (cleared) toC
Odor	mid
Appearance	clear / cloudy
pH (s.u.)	6.52
Conductivity (mS/cm)	1.445
(µmhos/cm)	
Turbidity (NTU)	
Temperature (°C)	8.26
Dissolved Oxygen (mg/L)	1.07
ORP	-109
Sampling Method	Bailer / PDB
Remarks	Redeployed a PDB
	Purged 0.5 gallons

Constituents Sampled	Container Description	Number	Preservative
8021 VOLATILES	40 ML VOA VIALS	2	HCL
Ethene, Ethane, Methane	40 ML VOA Vials	2	
TOC	~~250 ML Plastic~~ 40 ML Vials amber	2	Unpres.
Total Iron	~~250 ML Plastic~~	0	HNO3

Sampling Personnel: KA / FCon

Well Casing Volumes

Gal./Ft.				
	1-¼" = 0.06	2" = 0.16	3" = 0.37	4" = 0.65
	1-½" = 0.09	2-½" = 0.26	3-½" = 0.50	6" = 1.47

bmp	below measuring point	ml	milliliter	NTU	Nephelometric Turbidity Units
°C	Degrees Celsius	mS/cm	Milisiemens per centimeter	PVC	Polyvinyl chloride
ft	feet	msl	mean sea-level	s.u.	Standard units
gpm	Gallons per minute	N/A	Not Applicable	umhos/cm	Micromhos per centimeter
mg/L	Miligrams per liter	NR	Not Recorded	VOC	Volatile Organic Compounds

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Water Sampling Log

Project: Colesville Landfill | Project No.: NY000949.0020 | Page 1 of 1

Site Location: Harpursville, NY | Date: 12/18/07

Site/Well No.: GMMW-5 | Replicate No.: REPV 121807 | Code No.: —

Weather: Sun 32° | Sampling Time: Begin 1320 End 1330

Evacuation Data

Measuring Point	Top of PVC
MP Elevation (ft)	—
Land Surface Elevation (ft)	—
Sounded Well Depth (ft bmp)	
Depth to Water (ft bmp)	49.51
Water-Level Elevation (ft)	
Water Column in Well (ft)	3
Casing Diameter/Type	2"
Gallons in Well	—
Gallons Pumped/Bailed Prior to Sampling	PDB / 0.4
Sample Pump Intake Setting (ft bmp)	—
Purge Time	begin ____ end ____
Pumping Rate (gpm)	—
Evacuation Method	2" Disposable poly bailer / PDB

Field Parameters

Color	Clear / yellow (TOC)
Odor	Med
Appearance	Tiny black debris (TOC)
pH (s.u.)	6.65
Conductivity (mS/cm)	0.360
(µmhos/cm)	
Turbidity (NTU)	
Temperature (°C)	8.40
Dissolved Oxygen (mg/L)	1.17
ORP	-105
Sampling Method	Bailer / PDB
Remarks	Redployed a PDB purged about 0.4 gallons before sampling TOC

Constituents Sampled	Container Description	Number	Preservative	
8021 VOLATILES	40 ML VOA VIALS	2	HCL	PDB
Ethene, Ethane, Methane	40 ML VOA Vials	2		PDB
TOC	~~250 ML Plastic~~ 40 ML Vial Amber	2	Unpres.	Bailer
Total Iron	250 ML Plastic	1	HNO3	

Sampling Personnel: KA / Fran

Well Casing Volumes

Gal./Ft.				
	1-¼" = 0.06	2" = 0.16	3" = 0.37	4" = 0.65
	1-½" = 0.09	2-½" = 0.26	3-½" = 0.50	6" = 1.47

bmp	below measuring point	ml	milliliter	NTU	Nephelometric Turbidity Units
°C	Degrees Celsius	mS/cm	Milisiemens per centimeter	PVC	Polyvinyl chloride
ft	feet	msl	mean sea-level	s.u.	Standard units
gpm	Gallons per minute	N/A	Not Applicable	umhos/cm	Micromhos per centimeter
mg/L	Miligrams per liter	NR	Not Recorded	VOC	Volatile Organic Compounds

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Water Sampling Log

Project	Colesville Landfill	Project No.	NY000949.0020	Page	1 of 1
Site Location	Harpursville, NY			Date	12/18/07
Site/Well No.	GMMW-6	Replicate No.	MS/MSD	Code No.	
Weather	Sun 32°	Sampling Time: Begin	1400	End	1401

Evacuation Data

Measuring Point	Top of PVC
MP Elevation (ft)	—
Land Surface Elevation (ft)	
Sounded Well Depth (ft bmp)	
Depth to Water (ft bmp)	38.84
Water-Level Elevation (ft)	
Water Column in Well (ft)	
Casing Diameter/Type	2"
Gallons in Well	
Gallons Pumped/Bailed Prior to Sampling	PDB / 0.4 gallons
Sample Pump Intake Setting (ft bmp)	—
Purge Time	begin ____ end ____
Pumping Rate (gpm)	
Evacuation Method	2" Disposable poly bailer / PDB

Field Parameters

Color	Clear
Odor	none
Appearance	Clear (Tiny black debris) TOC
pH (s.u.)	6.71
Conductivity (mS/cm)	0.864
(µmhos/cm)	
Turbidity (NTU)	
Temperature (°C)	8.35
Dissolved Oxygen (mg/L)	2.05
ORP	-89
Sampling Method	Bailer / PDB
Remarks	Redeployed a PDB purged about 0.4 gallons befor Sampling TOC

Constituents Sampled	Container Description	Number	Preservative	
8021 VOLATILES	40 ML VOA VIALS	2	HCL	PDB
Ethene, Ethane, Methane	40 ML VOA Vials	2		PDB
TOC	~~250 ML Plastic~~ 40 ML VIAL Amber	2	Unpres.	Bailer
Total Iron	250 ML Plastic	1	HNO3	

Sampling Personnel: KA

Well Casing Volumes

Gal./Ft.				
	1-¼" = 0.06	2" = 0.16	3" = 0.37	4" = 0.65
	1-½" = 0.09	2-½" = 0.26	3-½" = 0.50	6" = 1.47

bmp	below measuring point	ml	milliliter	NTU	Nephelometric Turbidity Units
°C	Degrees Celsius	mS/cm	Milisiemens per centimeter	PVC	Polyvinyl chloride
ft	feet	msl	mean sea-level	s.u.	Standard units
gpm	Gallons per minute	N/A	Not Applicable	umhos/cm	Micromhos per centimeter
mg/L	Miligrams per liter	NR	Not Recorded	VOC	Volatile Organic Compounds

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Water Sampling Log

Project: Colesville Landfill | Project No.: NY000949.0020 | Page 1 of 1

Site Location: Harpursville, NY | Date: 12/19/07

Site/Well No.: GMMW-2 | Replicate No.: — | Code No.: ____

Weather: Cloudy 28° | Sampling Time: Begin 0900 End 0710

Evacuation Data

Measuring Point	—
MP Elevation (ft)	
Land Surface Elevation (ft)	
Sounded Well Depth (ft bmp)	
Depth to Water (ft bmp)	36.95
Water-Level Elevation (ft)	
Water Column in Well (ft)	
Casing Diameter/Type	2"
Gallons in Well	
Gallons Pumped/Bailed Prior to Sampling	
Sample Pump Intake Setting (ft bmp)	
Purge Time	begin ____ end ____
Pumping Rate (gpm)	
Evacuation Method	2" Disposable poly bailer

Field Parameters

Color	Clear
Odor	Slight
Appearance	Clear
pH (s.u.)	6.67
Conductivity (mS/cm)	0.621
(µmhos/cm)	
Turbidity (NTU)	
Temperature (°C)	8.08
Dissolved Oxygen (mg/L)	1.80
ORP	5.0
Sampling Method	Bailer / PDB
Remarks	Redeployed a PDB

Constituents Sampled	Container Description	Number	Preservative
8021 VOLATILES	40 ML VOA VIALS	2	HCL
Ethene, Ethane, Methane	40 ML VOA Vials	2	
TOC	~~250 ML Plastic~~ 40 ML VOA	2	Unpres.
Total Iron	250 ML Plastic	0	HNO3

Sampling Personnel: KA / FCAD

Well Casing Volumes

Gal./Ft.				
	1-¼" = 0.06	2" = 0.16	3" = 0.37	4" = 0.65
	1-½" = 0.09	2-½" = 0.26	3-½" = 0.50	6" = 1.47

bmp	below measuring point	ml	milliliter	NTU	Nephelometric Turbidity Units
°C	Degrees Celsius	mS/cm	Milisiemens per centimeter	PVC	Polyvinyl chloride
ft	feet	msl	mean sea-level	s.u.	Standard units
gpm	Gallons per minute	N/A	Not Applicable	umhos/cm	Micromhos per centimeter
mg/L	Miligrams per liter	NR	Not Recorded	VOC	Volatile Organic Compounds

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Water Sampling Log

Project: Colesville Landfill | Project No.: NY000949.0020 | Page 1 of 1

Site Location: Harpursville, NY | Date: 12/19/07

Site/Well No.: PW-4 | Replicate No.: — | Code No.: ____

Weather: Cloudy 25° | Sampling Time: Begin 0922 End 0930

Evacuation Data

Measuring Point	—
MP Elevation (ft)	
Land Surface Elevation (ft)	
Sounded Well Depth (ft bmp)	
Depth to Water (ft bmp)	17.70
Water-Level Elevation (ft)	
Water Column in Well (ft)	
Casing Diameter/Type	2"
Gallons in Well	
Gallons Pumped/Bailed Prior to Sampling	
Sample Pump Intake Setting (ft bmp)	
Purge Time	begin ____ end ____
Pumping Rate (gpm)	
Evacuation Method	2" Disposable poly bailer

Field Parameters

Color	Clear
Odor	none
Appearance	Cloudy
pH (s.u.)	5.85
Conductivity (mS/cm)	0.473
(µmhos/cm)	
Turbidity (NTU)	
Temperature (°C)	9.35
Dissolved Oxygen (mg/L)	2.24
ORP	130
Sampling Method	Bailer / PDB
Remarks	Redeployed a PDB

Constituents Sampled	Container Description	Number	Preservative	
8021 VOLATILES	40 ML VOA VIALS	2	HCL	PDB
Ethene, Ethane, Methane	40 ML VOA Vials	2		PDB
TOC	~~250 ML Plastic~~ 40 ML Vial	2	Unpres.	Bailer
Total Iron	~~250 ML Plastic~~	0	HNO3	

Sampling Personnel: KA

Well Casing Volumes

Gal./Ft.				
	1-¼" = 0.06	2" = 0.16	3" = 0.37	4" = 0.65
	1-½" = 0.09	2-½" = 0.26	3-½" = 0.50	6" = 1.47

below measuring point	ml	milliliter	NTU	Nephelometric Turbidity Units
°grees Celsius	mS/cm	Milisiemens per centimeter	PVC	Polyvinyl chloride
	msl	mean sea-level	s.u.	Standard units
°er minute	N/A	Not Applicable	umhos/cm	Micromhos per centimeter
°r liter	NR	Not Recorded	VOC	Volatile Organic Compounds

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Water Sampling Log

Project: Colesville Landfill | Project No.: NY000949.0020 | Page 1 of 1

Site Location: Harpursville, NY | Date: 12/19/07

Site/Well No.: IW-2 | Replicate No.: — | Code No.: ____

Weather: Cloudy 30° | Sampling Time: Begin ____ End 1331

Evacuation Data

Measuring Point	—
MP Elevation (ft)	
Land Surface Elevation (ft)	
Sounded Well Depth (ft bmp)	
Depth to Water (ft bmp)	
Water-Level Elevation (ft)	
Water Column in Well (ft)	
Casing Diameter/Type	2"
Gallons in Well	
Gallons Pumped/Bailed Prior to Sampling	
Sample Pump Intake Setting (ft bmp)	
Purge Time	begin ____ end ____
Pumping Rate (gpm)	
Evacuation Method	2" Disposable poly bailer

Field Parameters

Color	Yellow
Odor	Strong
Appearance	Clear
pH (s.u.)	5.14
Conductivity (mS/cm)	0.106
(µmhos/cm)	
Turbidity (NTU)	
Temperature (°C)	1.69
Dissolved Oxygen (mg/L)	1.12
ORP	169
Sampling Method	Bailer
Remarks	Purged 0.25 gallons

Constituents Sampled	Container Description	Number	Preservative
8021 VOLATILES	40 ML VOA VIALS	0	HCL
Ethene, Ethane, Methane	40 ML VOA Vials	0	
TOC	~~250 ML Plastic~~ 40 ML Vial	2	Unpres.
Total Iron	250 ML Plastic	0	HNO3

Sampling Personnel: KA

Well Casing Volumes

Gal./Ft.				
	1-¼" = 0.06	2" = 0.16	3" = 0.37	4" = 0.65
	1-½" = 0.09	2-½" = 0.26	3-½" = 0.50	6" = 1.47

bmp	below measuring point	ml	milliliter	NTU	Nephelometric Turbidity Units
°C	Degrees Celsius	mS/cm	Milisiemens per centimeter	PVC	Polyvinyl chloride
ft	feet	msl	mean sea-level	s.u.	Standard units
gpm	Gallons per minute	N/A	Not Applicable	umhos/cm	Micromhos per centimeter
mg/L	Miligrams per liter	NR	Not Recorded	VOC	Volatile Organic Compounds

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Water Sampling Log

Project	Colesville Landfill	Project No.	NY000949.0020	Page	1 of 1
Site Location	Harpursville, NY			Date	12/19/07
Site/Well No.	IW-13	Replicate No.	—	Code No.	
Weather	Snow 30°	Sampling Time: Begin		End	1340

Evacuation Data

Measuring Point	—
MP Elevation (ft)	
Land Surface Elevation (ft)	
Sounded Well Depth (ft bmp)	
Depth to Water (ft bmp)	
Water-Level Elevation (ft)	
Water Column in Well (ft)	
Casing Diameter/Type	2"
Gallons in Well	
Gallons Pumped/Bailed Prior to Sampling	
Sample Pump Intake Setting (ft bmp)	
Purge Time	begin ____ end ____
Pumping Rate (gpm)	
Evacuation Method	2" Disposable poly bailer

Field Parameters

Color	dark yellow
Odor	strong
Appearance	clear
pH (s.u.)	5.69
Conductivity (mS/cm)	0.686
(µmhos/cm)	
Turbidity (NTU)	
Temperature (°C)	6.82
Dissolved Oxygen (mg/L)	1.65
ORP	-62
Sampling Method	Bailer
Remarks	purged 0.25 gallons before sampling

Constituents Sampled	Container Description	Number	Preservative
8021 VOLATILES	40 ML VOA VIALS	0	HCL
Ethene, Ethane, Methane	40 ML VOA Vials	0	
TOC	~~250 ML Plastic~~ 40 mL vial	2	Unpres.
Total Iron	250 ML Plastic Amber	0	HNO3

Sampling Personnel: KA

Well Casing Volumes

Gal./Ft.				
	1-¼" = 0.06	2" = 0.16	3" = 0.37	4" = 0.65
	1-½" = 0.09	2-½" = 0.26	3-½" = 0.50	6" = 1.47

bmp	below measuring point	ml	milliliter	NTU	Nephelometric Turbidity Units
°C	Degrees Celsius	mS/cm	Milisiemens per centimeter	PVC	Polyvinyl chloride
ft	feet	msl	mean sea-level	s.u.	Standard units
gpm	Gallons per minute	N/A	Not Applicable	umhos/cm	Micromhos per centimeter
mg/L	Miligrams per liter	NR	Not Recorded	VOC	Volatile Organic Compounds

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Surface Water Sampling Form

Project Colesville Landfill Project No. NY000949.0020 Page 1 of 1

Site Location Harpursville NY Date 12/19/07

Site/Well No. F-6 Replicate No. —

Weather Cloudy 30° Sampling Time: Begin 1158 End 1200

Site Conditions

Water Quality Meter: Quanta

Location Condition: good

Vegetation: dead due to season / snow covered

Depth of Water:

Estimated Flow Rate: 10 Sec / 15'

Collection Method: direct

Field Parameters

Color	Clear
Odor	none
Appearance	Clear
pH (s.u.)	7.74
Conductivity (mS/cm)	0.101
Temperature (°C)	1.48
DO (mg/L)	8.50
Turbidity (NTU)	
ORP	34
Time	

Remarks:

Constituents Sampled: See COC Sampling Personnel: KA

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Surface Water Sampling Form

Project: Colesville Landfill Project No.: NY000949.0020 Page: 1 of 1

Site Location: Harpursville NY Date: 12/19/07

Site/Well No.: SP-4 Replicate No.: -

Weather: Cloudy 30° Sampling Time: Begin 1206 End 1208

Site Conditions

Water Quality Meter: Quanta

Location Condition: good
Snow covered

Vegetation: dead due to Season - Snow Covered

Depth of Water:

Estimated Flow Rate: 10 sec / 15'

Collection Method: direct

Field Parameters

Color	clear
Odor	none
Appearance	clear
pH (s.u.)	7.57
Conductivity (mS/cm)	0.095
Temperature (°C)	1.49
DO (mg/L)	8.23
Turbidity (NTU)	
ORP	36
Time	

Remarks: a little evidence of a Spring - Little Sheen
pics taken

Constituents Sampled: See COC Sampling Personnel: KA

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Appendix B

New York State Department of Environmental Conservation DAR-1 Air Modeling Data

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Table B-1. NYSDEC DAR-1 Air Modeling Data, Operational Year 6, Quarter Number 1, Colesville Landfill, Broome County, New York.

Parameters for 1/17/2008 Sampling Event			
Discharge Temperature	T	506	°R
Ambient Temperature	Ta	484	°R
Stack Diameter	D	6	in
Stack Radius	R	0.25	ft
Stack Area	A	0.20	ft^2
Exit Velocity	V	18.3	fps
Exit Flow	Q	216	acfm
Exit Flow	Q	225	scfm
Stack Height	h_s	17	ft
Building Height	h_b	13.25	ft
Ratio of Heights	h_s/h_b	1.28	
Plume rise credit? $h_s/h_b > 1.5$?	(If no, $h_e=h_s$)	(If Yes, $h_e = h_s + 1.1 (F_m)^{1/3}$)	
Momentum Flux	Fm = Ta/T * V2 * R2	n/a	ft^4/s^2
Effective Stack Height	h_e	17.0	ft
Reduction Factor? $2.5 > h_s/h_b > 1.5$?		No, do not reduce impact	
Actual Annual Impact	C_a	$RF*6*Q_a/h_e^{2.25}$	
Mass Flow	Q_a	S lbs emitted for last 12 months	

fps: feet per second
acfm: actual cubic feet per minute
ug/m^3: micrograms per cubic meter
lb/yr: pounds per year
lb/hr: pounds per hour
ppb: parts per billion

Notes/Assumptions:

1. The stack discharge temperature is 46°F based on recorded parameters.
2. The ambient temperature is approximately 24°F based on recorded conditions.
3. Calculations assume that the system will run with the maximum allowable concentrations between quarterly readings.
4. AGC refers to the Annual Guideline Concentration as determined using the hand calculations in the DAR-1 AGC/SGC Tables dated December 22, 2003.
5. To be conservative the lower detection limit was used for compounds that were below the limit of detection, but are found in the influent groundwater of the Groundwater Remediation System.

Table B-2. NYSDEC DAR-1 Air Modeling Data, Operational Year 6, Quarter Number 1, Colesville Landfill, Broome County, New York.

Calculation of the Short-Term Guideline Concentration (SGC) for Sampling Event on 1/17/2008

Compounds	CAS Numbers	Maximum Limit (SGC) (ug/m^3)	Analytical Concentration (ppb)	Detection Limit Used	Actual Emissions C_a (ug/m^3)	Mass/hour (lb/hr)	Maximum Potential Impact (Step III.A.3 in DAR-1) (ug/m^3)	Short Term Impact (Step III.A.5 in DAR-1) (ug/m^3)	Percent of the SGC (%)
Vinyl Chloride	75-01-4	180,000	7.0	*	18.19	2.55E-05	0.0044	0.28380	1.6E-04
Chloroethane(Ethyl Chloride)	75-00-3	--	7.0	*	18.78	2.64E-05	0.0045	0.29297	NA
1,1-Dichloroethene(Vinylidene Chloride)	75-35-4	--	7.0	*	28.21	3.96E-05	0.0068	0.44023	NA
Methylene Chloride(Dichloromethane)	75-09-2	14,000	7.0	*	24.72	3.47E-05	0.0059	0.38569	2.8E-03
1,1-Dichloroethane	75-34-3	--	7.0	*	28.80	4.05E-05	0.0069	0.44940	NA
cis-1,2 - Dichloroethylene	156-59-2	--	7.0	*	28.21	3.96E-05	0.0068	0.44023	NA
1,1,1-Trichloroethane(Methyl Chloroform)	71-55-6	68,000	7.0	*	38.83	5.45E-05	0.0093	0.60583	8.9E-04
Trichloroethene	79-01-6	54,000	7.0	*	38.24	5.37E-05	0.0092	0.59666	1.1E-03
m,p-Xylene	108-38-3/106-42-3	4,300	7.0	*	30.30	4.26E-05	0.0073	0.47287	1.1E-02
Dichlorofluoromethane(Freon 12)	75-71-8	--	7.0	*	35.18	4.94E-05	0.0084	0.54898	NA

ug/m^3: Micrograms per cubic meter
ppb: parts per billion
*: Analyte concentration below detection limit, detection limit was used in calculations
lb/hr: pounds per hour
--: No SGC listed for compound
NA: Not applicable

Notes:
1. DAR-1 refers to DAR-1 AGC/SGC Tables dated December 22, 2003.
2. SGC refers to the Short-Term Guideline Concentration as determined using the hand calculations in the DAR-1 AGC/SGC Tables dated December 22, 2003.
3. To be conservative the lower detection limit was used for compounds that were below the limit of detection, but are found in the influent groundwater of the Groundwater Remediation System.

Table B-2. NYSDEC DAR-1 Air Modeling Data, Operational Year 6, Quarter Number 1, Colesville Landfill, Broome County, New York.

Calculation of AGC based on 1/17/2008 Sampling Event

Compounds	CAS Numbers	Maximum Limit on C_a (AGC[4]) ug/m^3	Maximum Mass Flow Q_a lb/yr	Lab Data ppb	Detection Limit Used[5]	Actual Emissions C_a ug/m^3	Actual Mass Flow per Hour lb/hr	Actual Mass Flow per Year lb/yr	**Percent of Annual** %
Vinyl Chloride	75-01-4	0.11	10.76	7.0	*	18.19	1.54E-05	0.12889	**1.20**
Chloroethane(Ethyl Chloride)	75-00-3	10,000	978,044.97	7.0	*	18.78	1.59E-05	0.13306	**0.00**
1,1-Dichloroethene(Vinylidene Chloride)	75-35-4	70	6,846.31	7.0	*	28.21	2.38E-05	0.19994	**0.00**
Methylene Chloride(Dichloromethane)	75-09-2	2.1	205.39	7.0	*	24.72	2.09E-05	0.17517	**0.09**
1,1-Dichloroethane	75-34-3	0.63	61.62	7.0	*	28.80	2.43E-05	0.20410	**0.33**
cis-1,2-Dichloroethylene	156-59-2	1,900	185,828.54	7.0	*	28.21	2.38E-05	0.19994	**0.00**
1,1,1-Trichloroethane(Methyl Chloroform)	71-55-6	1,000	97,804.50	7.0	*	38.83	3.28E-05	0.27515	**0.00**
Trichloroethene	79-01-6	0.5	48.90	7.0	*	38.24	3.23E-05	0.27098	**0.55**
m,p-Xylene	108-38-3/106-42-3	700	68,463.15	7.0	*	30.30	2.56E-05	0.21477	**0.00**
Dichlorodifluoromethane(Freon 12)	75-71-8	12,000	1,173,653.96	7.0	*	17.49	1.48E-05	0.12394	**0.00**

fps: feet per second
acfm: actual cubic feet per minute
ug/m^3: micrograms per cubic meter
lb/yr: pounds per year
lb/hr: pounds per hour
ppb: parts per billion

Notes/Assumptions:

1. The stack discharge temperature is 46°F based on recorded parameters.
2. The ambient temperature is approximately 24°F based on recorded conditions.
3. Calculations assume that the system will run with the maximum allowable concentrations between quarterly readings.
4. AGC refers to the Annual Guideline Concentration as determined using the hand calculations in the DAR-1 AGC/SGC Tables dated December 22, 2003.
5. To be conservative the lower detection limit was used for compounds that were below the limit of detection, but are found in the influent groundwater of the Groundwater Remediation System.

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Appendix C

Automated Reagent Injection System
Operating Parameters

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Table C-1. Automated Reagent Injection System Summary of Operational Year 6, Quarter Number 1 Injection Quantities, Groundwater Remediation System, Colesville Landfill, Broome County, New York.

Summary of Automated Reagant Injections

Date	Total Quantity of Molasses Solution Injected (gal.)	Total Quantity of Molasses Injected (gal.)	Total Quantity of Rinse Water Injected (gal.)
10/29/2007	13,705	153	137
Quarter Totals (gal.) =	**13,705**	**153**	**137**
Totals Since Startup (gal.) =	**144,636**	**8,739**	**8,103**

Notes:

gal. Gallons

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Table C-2. Automated Reagent Injection System, Operational Year 6, Quarter Number 1 Operating Parameters, Groundwater Remediation System, Colesville Landfill, Broome County, New York.

Injection Number 56

Injection Start Date = 9/27/2007
Injection Completion Date = 10/29/2007

Molasses to Water Ratio (%) = 1.0 Programmed Mixing Time (min.)[1] = 60

Injection Well ID	Molasses Solution Injection Quantity (gal.)	Rinse[2] Quantity (gal.)	Raw Molasses Per Well (gal.)	Min. Injection[3] Flowrate (gpm)	Max. Injection Pressure (psi)
PW-6	530	5	5.3	NM	29
IW-3	530	10	5.3	NM	29
IW-1	210	4	2.1	NM	28
IW-2	210	3	2.1	NM	29
GMMW-1	140	3	1.4	NM	7
IW-4	989	4	9.9	NM	29
IW-5	989	5	9.9	NM	29
IW-6	989	7	9.9	NM	29
IW-7	989	8	9.9	NM	29
IW-8[4]	0	0	0.0	NM	0
IW-9	1,230	11	12.3	NM	0
IW-10	1,230	12	12.3	NM	28
IW-11	1,230	13	12.3	NM	28
IW-12	1,230	15	12.3	NM	27
IW-13	1,230	16	12.3	NM	27
IW-14	989	18	9.9	NM	25
IW-15	989	19	9.9	NM	26
Totals (gal.) =	13,705	153	137.1	NA	NA

Notes:

gal. Gallons.
min. Minutes.
i.w.c. Inches of water column.
psi Pounds per square inch.
gpm Gallons per minute.
NA Not applicable.
NM Not measured.

1. Programmed mixing time is calculated from the expiration time of the molasses injection countdown timer to the startup of transfer pump TP-900 during an injection sequence or from the end of transfer pump TP-600 operation to the restart of an injection during a mixing sequence.
2. Rinse quantity is approximately 1-pipeline volume for each injection well.
3. Parameter not measured due to SCADA system malfunction.
4. Injection not conducted into IW-8 for ongoing Alternate Electron Donor Pilot test evaluation.

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Appendix D

Hydraulic Injection Test and Alternate Electron Donor Pilot Test Results

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Table D1. Summary of Hydraulic Injection and Alternate Electron Donor Pilot Test Reagant Injection Quantities, Colesville Landfill, Broome County, New York.

Injection Well/Electron Donor	Total Injection Volume (gal)	Raw Electron Donor Volume (gal)	Fluorescein Dye Volume (gal)	Potassium Bromide Weight (kg)
Injection Well IW-2				
Molasses Solution	7,000	100	1.5	11
Injection Well IW-8				
Edible Oil Substrate Solution	6,875	165	1.5	11

Abbreviations -

gal	gallons
kg	kilograms

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Table D2. Total Organic Carbon and Bromide Quality Control Results, Hydraulic Injection and Alternate Electron Donor Pilot Test, Colesville Landfill, Broome County, New York.

Sample ID	Date Sampled	Total Organic Carbon[1,2] Concentration (mg/L)	Bromide[3] Concentration (mg/L)	Relative Presence of Flourescein Dye
EOS QC Samples				
EOS Batch	12/16/2006	201000	6850	Very Strong
EOS Injection 1	12/16/2006	7090	148	Strong
EOS Injection 2	12/17/2006	13600	145	Strong
Molasses QC Samples				
Molasses Batch	12/16/2006	72300	288	Very Strong
Molasses Injection 1	12/16/2006	3650	26.3	Strong
Molasses Injection 2	12/17/2006	738	17.3	Strong

Notes -

1. Anticipated organic carbon concentration in each molasses batch is ~75,000 mg/L. Anticipated final injection concentration is 3,500 mg/L.
2. Anticipated organic carbon concentration in each EOS batch is ~500,000 mg/L. Anticipated final injection concentration is 25,000 mg/L.
3. Target bromide concentration in each batch is ~6,300 mg/L. Target injection concentration is ~ 300 mg/L.
4. All "batch" samples collected from their respective mixing tank following mixing of reagents but prior to injection.
5. "Injection 1" samples collected from their respective sample ports AFTER in-line mixing but prior to injection at the end of day 1 (approximately 3,000 gallons injected).
6. "Injection 2" samples collected from their respective sample ports AFTER in-line mixing but prior to injection at the end of day 2.

Abbreviations -

mg/L	Milligrams per liter.
EOS	Edible oil substrate.
QC	Quality control.

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Table D3. Summary of IW-2 (Molasses) Injection Test Conservative Tracer and Total Organic Carbon Results, Hydraulic Injection and Alternate Electron Donor Pilot Test, Colesville Landfill, Broome County, New York.

Date Sampled	Volume Injected (gal)	Bromide Concentration (mg/L)			Total Organic Carbon Concentration (mg/L)			Relative Presence of Flourescein Dye in GMMW-4
		IW-2	GMMW-5	GMMW-4	IW-2	GMMW-5	GMMW-4	
Injection Test Samples								
12/14/2006	Baseline	--	--	--	--	34.1	<2.0	--
12/16/2006	625	--	--	0.154	--	--	--	Weak
	1722	--	--	0.141	--	--	7.13	Weak
	1950	--	--	0.145	--	--	6.02	Weak
	2800	--	--	0.197	--	--	6.39	Weak
	3150	--	--	0.141	--	--	5.10	Weak
	3775	--	--	0.188	--	--	5.55	Weak
	4420	--	--	0.202	--	--	7.56	Weak
	5000	--	--	3.00	--	--	5.66	Weak
	5625	--	<0.1	0.153	--	48.1	8.88	Weak
	6250	--	--	0.371	--	--	7.00	Weak
	7000	--	--	0.158	--	--	37.0	Weak
Post Injection Test Samples								
2/5/2007	NA	--	0.10	0.23	--	142	3.26	--
3/26/2007	NA	1.07	0.31	--	56.3	96.4	--	--
5/4/2007	NA	<1.0	<1.0	<1.0	19.6	160	5.10	--
6/19/2007	NA	<1.0	<1.0	<1.0	26.3	130	7.60	--
9/19/2007	NA	<1.0	<1.0	<1.0	240	9.00	6.90	--
12/18/2007	NA	--	--	--	20.0	20.0	--	--

continued on following page.

Table D3. Summary of IW-2 (Molasses) Injection Test Conservative Tracer and Total Organic Carbon Results, Hydraulic Injection and Alternate Electron Donor Pilot Test, Colesville Landfill, Broome County, New York.

Abbreviations -

gal	Gallons.
mg/L	Milligrams per liter.
--	Parameter not collected.
NA	Not applicable.

Table D4. Summary of IW-8 (Edible Oil Substrate) Injection Test Conservative Tracer and Total Organic Carbon Results, Hydraulic Injection andAlternate Electron Donor Pilot Test, Colesville Landfill, Broome County, New York.

Date Sampled	Volume Injected (gal)	Bromide Concentration (mg/L)				Total Organic Carbon Concentration (mg/L)				Relative Presence of Flourescein Dye in TW-1
		IW-8	IW-9	TW-1	W-5	IW-8	IW-9	TW-1	W-5	
Injection Test Samples										
12/14/2006	Baseline	--	--	--	--	--	--	124	--	--
	625	--	--	0.110	--	--	--	--	--	Weak
	1225	--	--	0.118	--	--	--	64.5	--	Weak
	1750	--	--	1.31	--	--	--	99.6	--	Weak
	2000	--	--	<0.1	--	--	--	97.2	--	Weak
	2450	--	--	<0.1	--	--	--	106	--	Medium
	3230	--	--	<0.1	--	--	--	107	--	Medium
	3750	--	--	<0.1	--	--	--	80.3	--	Medium
12/17/2006	4375	--	--	<0.1	--	--	--	78.3	--	Medium
	5000	--	--	0.845	--	--	--	80.7	4.02	Medium
	5625	--	--	<0.1	<0.1	--	--	79.7	--	Medium
	6875	--	--	0.162	--	--	--	46.5	--	Medium
Post Injection Test Samples										
2/5/2007	NA	--	--	12.0	0.27	--	--	223	7.86	--
3/26/2007	NA	--	<0.1	3.87	0.45	--	426	88.5	7.61	--
5/4/2007	NA	--	--	4.60	<1.0	--	--	136	10.1	--
6/19/2007	NA	1.59	--	2.06	<1.0	1,370	--	169	9.51	--
9/19/2007	NA	<1.0	--	<1.0	<1.0	1,600	--	120	13.0	--
12/18/2007	NA	--	--	--	--	--	--	150	7.7	--

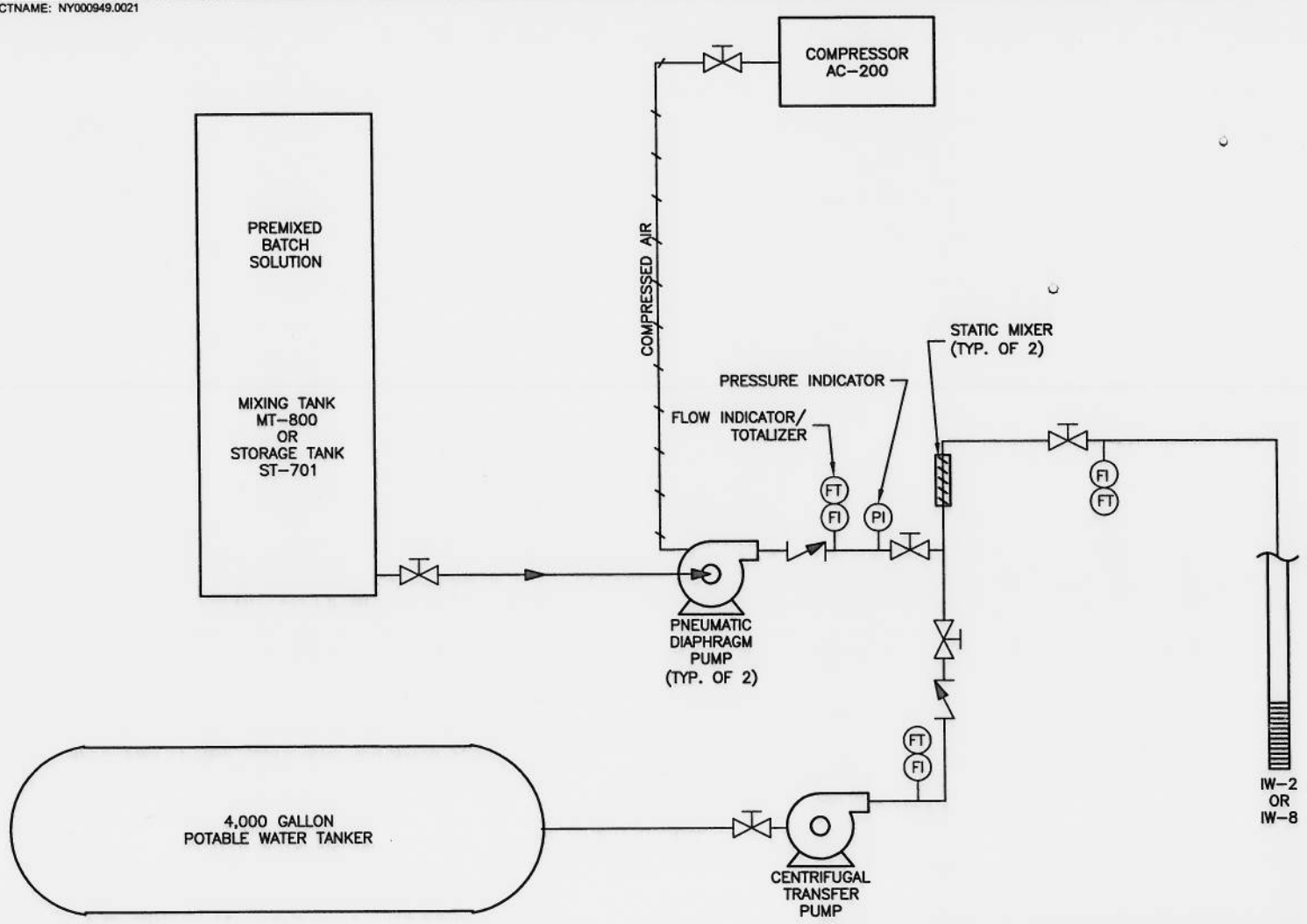
continued on following page.

Table D4. Summary of IW-8 (Edible Oil Substrate) Injection Test Conservative Tracer and Total Organic Carbon Results, Hydraulic Injection andAlternate Electron Donor Pilot Test, Colesville Landfill, Broome County, New York.

Abbreviations -

gal	Gallons.
mg/L	Milligrams per liter.
--	Parameter not collected.
NA	Not applicable.

CITY:MELVILLE DIV/GROUP:ENV DB:ALS LD: PIC: PM:SF TM:KZ LYR:ON=*;OFF=*REF*
G:\APROJECT\BROOME\NY0949.021\CADD\PFD 080710.dwg LAYOUT: D1 SAVED: 8/13/2008 11:29 AM ACADVER: 17.1S (LMS TECH) PAGESETUP: 8.5X11 PLOTSTYLETABLE: ARCADIS_MELVILLE.CTB PLOTTED: 8/13/2008 11:31 AM BY: SANCHEZ, ADRIAN
XREFS: IMAGES: PROJECTNAME: NY000949.0021



COLESVILLE LANDFILL
BROOME COUNTY, NEW YORK

PROCESS FLOW DIAGRAM
HYDRAULIC INJECTION AND ALTERNATE ELECTRON DONOR PILOT TEST

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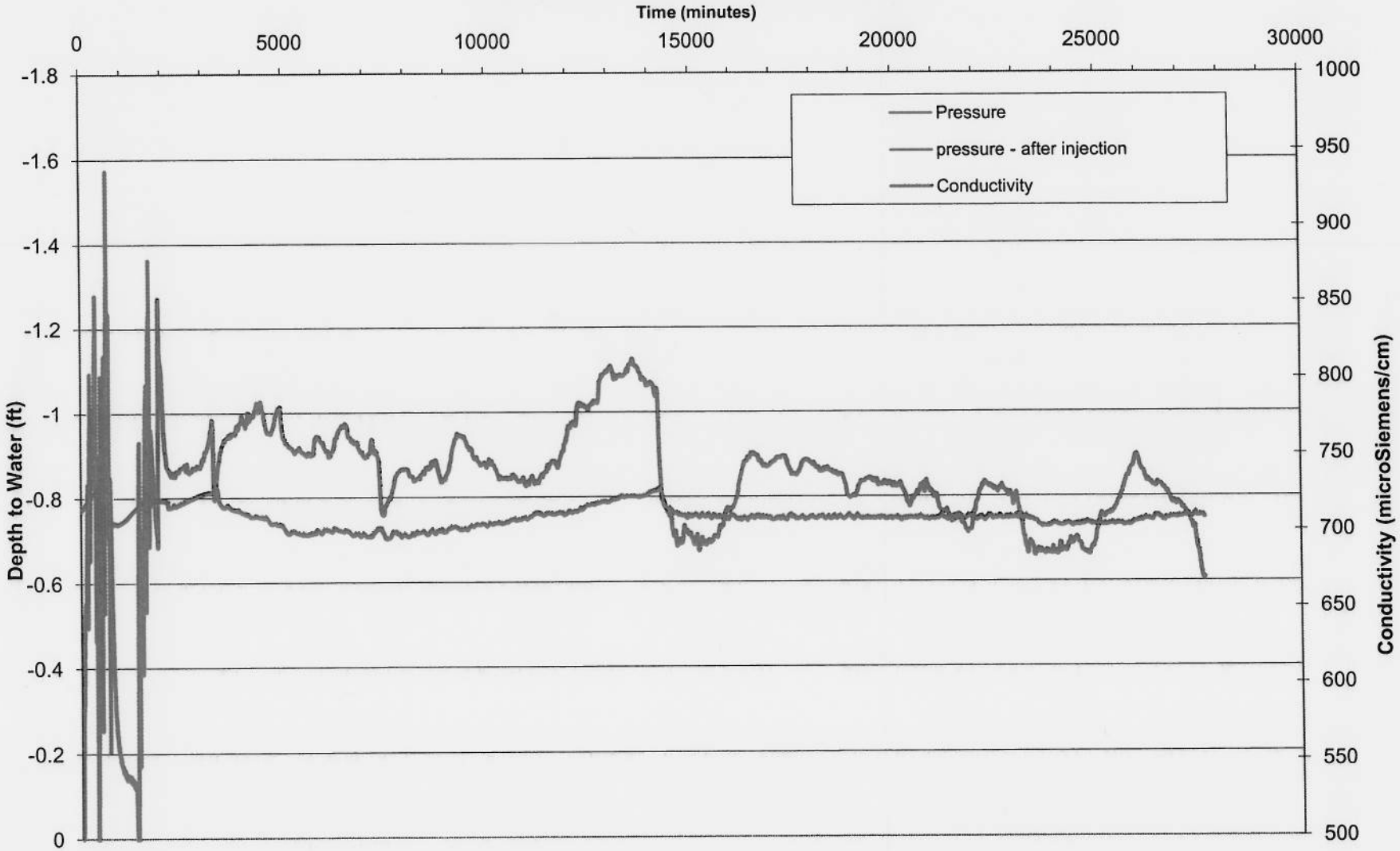
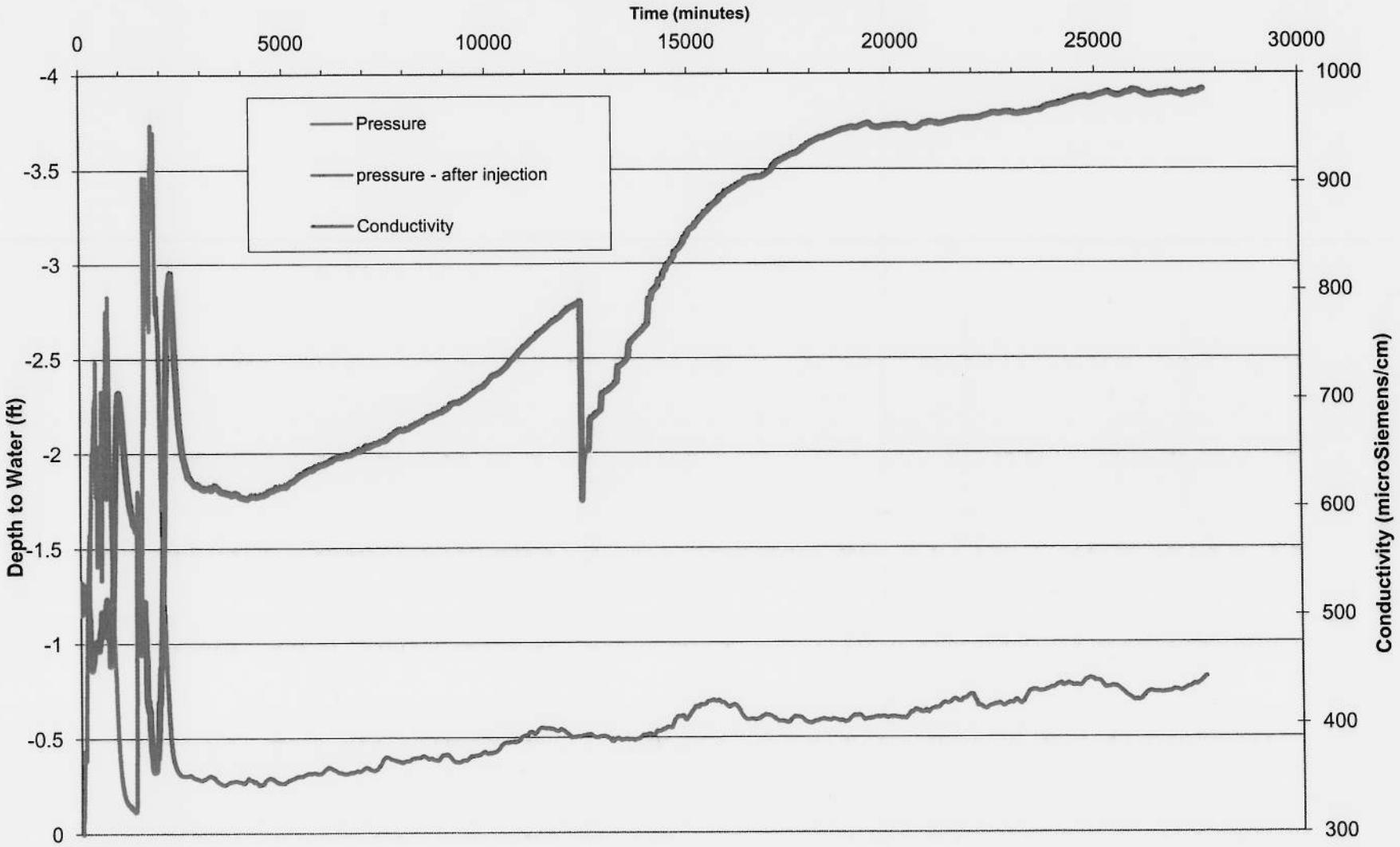
FIGURE
D1

Figure D2. Injection Test at Well IW-2
(response data from monitoring well GMMW-4)



G:\APROJECT\BROOME\NY0949.021\Injection Test\injection_test_tables_4_29_08.xlsChart-IW2-conductivity

Figure D3. Injection Test at Well IW-8
(response data from TW-1)



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