New York, Geneva Monarch
Remedial Investigation

REMEDIAL INVESTIGATION REPORT

FORMER MONARCH CHEMICALS DIVISION
61 GATES AVENUE
GENEVA, NEW YORK

DELTA PROJECT NO. S096-015-1.0021

Delta
Environmental
Consultants, Inc.

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1.0 INTRODUCTION

1.1 Purpose

The purpose of this report is to provide a comprehensive discussion of the various phases of remedial investigation (RI) activities performed at the site. Delta Environmental Consultants, Inc. (Delta) was retained by H.B Fuller, the parent company of the previous Monarch Chemicals Division, to perform the RI.

This RI report was prepared in order to better determine the nature, extent and fate of chemicals present in the subsurface. As part of this RI, an evaluation was performed to determine the potential for chlorinated volatile organic compounds (VOCs) to naturally attenuate and to evaluate the impacts of surfactants for their harm to human health and the environment.

The purposes for performing the RI were to:

- identify previous operational activities that may have impacted the soil and ground water;
- delineate the nature and extent of previous releases to the soil and ground water;
- evaluate the risk to human health and the environment posed by the releases;
- determine the potential and time required for the chlorinated VOCs to naturally attenuate; and,
- recommend a long-term ground water monitoring program in order to monitor the VOCs and the rate of natural attenuation.

1.2 Scope of Work

The RI included the following tasks:

- obtaining and chemically analyzing 32 soil samples;
- installing 11 water table monitoring wells, 3 telescoped deep monitoring wells and one piezometer;
- advancing 8 Geoprobe borings within the building;
- obtaining ground water samples from 5 of the Geoprobe borings and from each monitoring well, on one to six occasions;

- analyzing the ground water samples for chlorinated VOCs, surfactants and various indicator parameters in order to delineate the nature and extent of releases to the soil and ground water and evaluate the potential for the VOCs to naturally attenuate;
- performing rising head permeability tests in 6 of the monitoring wells (3 wells in the shallow unconfined zone and the 3 telescoped monitoring wells) to determine order-of-magnitude hydraulic conductivity;
- installing 3 stream gauges to record the surface water elevations of the stream located immediately east of the site;
- obtaining 3 surface water samples from the perennial stream on three occasions;
- a literature search was conducted to review viable geologic publications in order to better characterize the local geology;
- performing a toxicological evaluation of methyl blue active substance (MBAS), a common surfactant that was used at the facility; and,
- performing fate and transport modeling to determine the ratio of VOC degradation and movement.

2.0 SITE SETTING

2.1 Site Location

The site, which consists of approximately 1.7 acres, is located at 61 Gates Avenue in Ontario County, Geneva, New York, as illustrated in Figures 1 and 2. The site is accessed by Gates Avenue, which is contiguous to the southern property boundary, as illustrated in Figure 2.

The site is located in an industrial area of Geneva. A furniture manufacture borders the site to the north. The New York Central Railroad, an intermittent drainage ditch, vacant lots and residences border the site to the east. Vacant manufacturing facilities are located south of Gates Avenue and on the contiguous property to the west of the site.

2.2 Site History

The site history was determined by reviewing a Phase I Environmental Assessment Report (prepared by Environmental Strategies Corporation - ESC - in 1996) and interviewing former H.B. Fuller personnel that were employed at the facility.

The facility was reportedly constructed in the 1910's and was improved with additions in the 1930's and 1950's. A boiler and circuit board manufacturer operated the facility until it was purchased in 1979 by Monarch Chemical

(Monarch), a former operating division of H.B. Fuller Company. Monarch used the facility to manufacturer food grade cleaners/sanitizers used in the dairy and related industries. In 1996, H.B. Fuller Company sold the property and the business to Haltrachem. Haltrachem continues to engage in the same production activities that were performed by Monarch.

Aerial photographs and Sanborn maps were reviewed by ESC as part of the Phase I. The 1967 Sanborn map indicates the site was occupied by Magnetic Components, Inc. The north portions of the building were used for circuit board manufacturing and impregnation of capacitors and associated board components. The 1971 aerial photograph indicates the storage of material in containers, north of the building.

2.3 Site Conditions and Operations

The main structures present at the site include:

- a 33,700 square foot production building;
- exterior bulk liquid powder loading and unloading areas; and,
- parking and truck turnaround areas.

Haltrachem stores, mixes and packages powdered and liquid cleaners and sanitizers. The main raw materials include acids, caustics, sodium hypochloride and surfactants. Bulk liquids are delivered by tanker truck. The tankers are connected to pipes located outside of the east side of the building, within a concrete secondary containment area. Additional raw materials are delivered by truck in drums and unloaded at a dock along the southeast corner of the building. Materials are transferred in batches from storage tanks or drums to the mixing tanks located within the building. The mixing tanks are connected by pipes to the bulk loading/unloading area located adjacent to the northeast portion of the building.

VOCs are not used in bulk by Haltrachem and were not used by Monarch. Based on our knowledge of circuit board manufacturing activities, chlorinated and non-chlorinated VOCs were probably used to clean parts of the circuit boards.

In 1992, the former wastewater sump, illustrated in Figure 2, was determined to be leaking. An unknown quantity of untreated wastewater containing dilute solutions of acids, bases and surfactants was released to the underlying soil. The unit was repaired and fitted with a polyvinylchloride (PVC) liner.

3.0 PHYSICAL SETTING

3.1 Regional Geology

The site is located in the Finger Lakes region of New York, which is located along the northern edge of the glaciated Appalachian Plateau Physiographic province. The Finger Lakes region is underlain by one of two surficial units that include:

1. Consolidated, Paleozoic sedimentary rock consisting of shales, sandstones and limestones; or,

2. Unconsolidated, Quaternary surficial deposits of glacial or alluvial origin (sands, gravels, silts and clays).

These surficial deposits are underlain by igneous and/or metamorphic rocks of Precambrian age.

Paleozoic sedimentary rocks underlying this region range in thickness from 4,000 feet in the northern region to approximately 9,000 feet in the southern region. With the exception of jointing and gentle tilting of the formations in the southern region, these beds have been subject to relatively little deformation since they were deposited.

The unconsolidated, Pleistocene material was deposited either directly or indirectly from the Laurentide ice sheet. These deposits vary in thickness ranging from 300 feet in the northern region to an average thickness of 50 feet throughout the remainder of the region. The unconsolidated material is subdivided into three distinct types on the basis of grain size, range in grain size of the component particles and the presence or absence of stratification. These units are:

1. till: unstratified mixture of rock particles ranging in size from clay to boulders;

2. coarse grained deposits: deltas, kames and glacial outwash deposits consisting of stratified material ranging in size from fine sand to cobbles; and

3. fine grained deposits: lake bottom sediments consisting of stratified materials ranging in size from clay through fine sand.

3.2 Regional Hydrogeology

Ground water in the Finger Lakes region occurs in two hydrogeologic units comprised of the surficial glacial drift (unconsolidated sand, gravels and silts and clays) aquifer and the underlying Paleozoic bedrock aquifer. Ground water in the unconsolidated unit usually exists under unconfined conditions in intergranular pores. Ground water within the bedrock exists under confined or unconfined conditions and occurs primarily along bedding features due to a lack of continuous intergranular porosity. Ground water in the saturated, unconsolidated unit is recharged by the infiltration of rainfall and from losing surface water bodies such as streams and ponds. The bedrock aquifer is generally recharged by infiltration of ground water from the overlying unconsolidated aquifer.

3.3 Site Geology

The site geology was characterized by advancing a series of soil borings and installing 14 ground water monitoring wells and one piezometer. The locations of the monitoring wells are illustrated in Figure 3. Boring logs and monitoring well construction characteristics associated with each well are presented in Appendix A.

Based on the information obtained from the soil borings, two geologic cross sections were developed through the areas shown in Figure 3. Figures 4 and 5 are geologic cross sections from A-A' and B-B', respectively. As illustrated on the cross sections, the site is underlain by unconsolidated sedimentary deposits consisting of numerous stratigraphic facies consisting of fine to coarse sands, gravels, silts, clays and glacial till to a depth of approximately 20 feet below ground surface (bgs). Bedrock was not encountered during monitoring well installation, but has been reported in the Geneva, New York area to occur at depths ranging from 30 to 300 feet bgs.

3.4 Site Hydrogeology

Eleven water table monitoring wells were installed in the shallow portion of the unconsolidated aquifer and three telescoping ground water monitoring wells were installed into the lower portion of the unconsolidated aquifer. The purposes of installing these monitoring wells were to evaluate chemical quality of the ground water, obtain ground water levels and to characterize the hydrogeology beneath the site.

The monitoring wells range in depth from 8 to 26 feet bgs. Table 1 summarizes the construction characteristics of each well. Table 2 presents the ground water elevation data for the monitoring wells installed at the facility. Depths to the water table, based on the most recent measurements obtained on July 16, 1998, range from 4.15 feet bgs at monitoring well MW-104 to 10.50 feet bgs at monitoring well MW-107. Review of Table 1 indicates the annual fluctuation of the water table is approximately 5.6 feet. The seasonal high water table elevations were reported in February 1998 and the seasonal low water elevations were reported during August or September.

An anomaly with respect to observed fluctuations within the water table was consistently observed at the location of monitoring well MW-104. The greatest change in water levels observed during the monitoring period at monitoring well MW-104 was 0.66 feet. In an attempt to determine the cause of this anomaly, the following tasks were performed:

- Weekly water level readings were obtained from all of the monitoring wells for a period of 7 continuous weeks (from August 15 through September 26, 1997).
- Daily precipitation values were obtained from the New York Agricultural Experiment Station, Geneva facility, from August 9 through October 3, 1997.
- Weekly water usage was obtained from Haltrachem to monitor the liquid volume of water used to assist in determining the water balance of the facility.

The above data was obtained in order to determine if there was a correlation between precipitation or water usage with respect to the anomalous ground water elevations observed at monitoring well MW-104. Weekly water level readings, daily precipitation values and weekly water usage volumes are included as Appendix B.

Review of the ground water elevations in Table 2 with the precipitation and water usage data indicates that the water table elevation at monitoring well MW-104 is consistently 5 to 10 feet higher than the elevations at proximate monitoring wells MW-103 and MW-105. Fluctuations in the water table elevation at monitoring well MW-104 do not vary with response to precipitation or water usage. In addition, roof drains are not present in the vicinity of monitoring well MW-104.

Review of the boring log that was developed during the installation of monitoring well MW-104 indicates the presence of a sand horizon from 5 to 8 feet bgs. This sand horizon is overlain by 5 feet of sandy, clayey silt. Review of boring logs for monitoring wells MW-103 and MW-105 do not indicate the presence of the sand horizon overlain by the sandy, clayey silt. In order to better determine the lateral extent of the sand horizon, three Geoprobe soil borings (SB-1 through SB-3) were advanced on February 17, 1998 at the locations shown on Figure 2. Review of these soil boring logs does not indicate the presence of the sand horizon that was encountered at monitoring well MW-104. Based on these results, the water table elevation reported at monitoring well MW-104 is believed to be present under semi-confined conditions due to the overlying silt, as indicated by minor changes in the water level with respect to precipitation, water usage and overall changes observed at monitoring wells throughout the remainder of the site.

Water table contour maps, based upon measurements obtained from the water table monitoring wells on October 22, 1996, February 18, 1998 and May 25, 1998, are presented in Figures 6 through 8, respectively. The horizontal hydraulic gradient ($\Delta h/\Delta L$) based on data obtained on February 18, 1998 between monitoring wells MW-101, MW-105 and MW-111 is 0.056 (calculations are presented in Appendix C). Review of these figures indicates that the ground water flow direction at the water table is toward the drainage ditch located east of the railroad tracks. This flow also mimics the surface topography at the site.

Based on water table elevation data obtained from monitoring wells MW-106 and MW-108 (located east of the drainage ditch), ground water also flows toward the drainage ditch.

Static water level readings were obtained from the three nested wells (MW-101/201, MW-102/202 and MW-108/203). Review of this data, as presented in Appendix C, indicates a downward vertical gradient of ground water flow at each well cluster. The average gradient for each cluster is presented below:

Wells	Average Gradient
MW-101/201	0.385
MW-102/202	0.458
MW-108/203	0.673

This data indicates that a downward vertical gradient is present at the site that is greater than the horizontal hydraulic gradient of 0.056 that was calculated for the February 18, 1998 readings.

Review of the vertical gradient data for well cluster MW-108/203 indicates a continuous decrease in the downward gradient since the installation of monitoring well MW-203 in August 1997. Review of the depth to water readings from August 15 through September 26, 1997 at monitoring well MW-203 (with respect to the water table data obtained from deep wells MW-201 and MW-202 during the same time period) indicates a continued increase in the ground water elevation at monitoring well MW-203. The ground water elevation at monitoring wells MW-201 and MW-202 during this time period fluctuated upward and downward at distances less than 0.36 feet.

Review of the ground water elevations for monitoring wells MW-201, MW-202 and MW-203 from February, May and July 1998 indicates a decrease in the water elevations in all three wells from February to May, and an increase in the ground water elevations at all the monitoring wells from May to July. These data indicate that either the water level at monitoring well MW-203 did not reach static conditions until after September 26, 1997, or the continued decreased vertical gradient at monitoring well MW-108/203 is in direct response to changing surface water elevations in the adjacent drainage ditch.

Rising head field permeability (slug) tests were performed at monitoring wells MW-101, MW-102, MW-105, MW-201 and MW-202 in August 1997. The results of the tests are graphically displayed in Appendix D. Based on the test results, the average geometric horizontal hydraulic conductivity of material at the water table is 1.35 feet per day. The average geometric hydraulic conductivity of the material at a depth of 20 to 26 bgs is 0.34 feet per day.

Assuming an effective porosity of 28% for silty sand, the estimated ground water velocity at the water table is approximately 0.27 feet per day.

$$V = \frac{K}{ne} \times \frac{\Delta h}{\Delta L}$$

3.5 Surface Water

An intermittent drainage ditch is located immediately east of the railroad tracks, as illustrated in Figure 2. Flow within this drainage feature varies with response to precipitation, melting of snow and, to a lesser extent, ground water discharge. Three stream staff gauges were installed within the ditch at the locations illustrated in Figure 3 (identified as Stream-A, Stream-B and Stream-C). Depth to surface water measurements were obtained from Stream-A and Stream-B on nine occasions and Stream-C on two occasions, as presented in Table 2. Surface water elevations in the drainage ditch are consistently lower than the water table elevations at monitoring wells MW-103, MW-105 and MW-108, thus the ditch is considered a gaining surface water feature.

According to Tom Rafferty, an engineer with the City of Geneva, surface water within the drainage feature is believed to flow to the Geneva stormwater sewer system. The outfall location is believed to be Seneca Lake. Visual observations and the surface water elevation data indicate that water within this drainage feature flows in a southerly direction. Visual observations during the May 1998 gauging event did not indicate the presence of flowing water within the drainage ditch.

The New York Department of Environmental Conservation (DEC) has established surface water classifications and standards (New York State Code, Rules and Regulations Title 6, Chapter X, Part 700-706). Fresh surface waters are classified into one of four categories, as summarized below:

1. Class A: Best usage as a source of water supply for drinking, culinary or food processing purposes, primary and secondary contact recreation and fishing. The water shall be suitable for fish propagation and survival.
2. Class B: Best usage as primary and secondary contact recreation and fishing. These waters shall be suitable for fish propagation and survival.
3. Class C: Best usage is fishing. These waters shall be suitable for fish propagation and survival.
4. Class D: Best usage is fishing. Due to such natural conditions as intermittency of flow, water conditions are not conducive to propagation game fishery or stream bed conditions, the water will not support fish propagation.

Based on our interpretation of the surface water classification and a telephone conversation with Mr. Jim Beech of the DEC, the drainage ditch is classified as a Class D surface water body.

The closest perennial surface water body is a tributary of Marsh Creek (located approximately 500 feet north of the site), as illustrated in Figure 1. The main branch of March Creek is located approximately 1,500 feet southeast of the site and flows into Seneca Lake.

Seneca Lake's maximum and minimum water levels from October 1996 to September 1997 were 446.65 and 443.49 feet above mean sea level, respectively. Seneca Lake's mean water levels were obtained from "Water Resources Data- New York Water Year 1997".

3.6 Site Topography

Based on a site survey performed by Leonard A. Gardner, a New York licensed surveyor, surface elevation at the site ranges from 463 feet above mean sea level (msl) in the central portion of the site to 458 feet above msl in the southern portion of the site. Immediately east of the railroad tracks, land surface slopes off to 450 feet msl. The regional topographic slope is south towards Seneca Lake which has a surface elevation of approximately 440 feet msl.

Stormwater runoff from the building roof, southern paved parking lot and the southern portion of the gravel driveway, located immediately east of the building, flow into two catch basins located in the southern portion of the site. Water in these catch basins is directed to the City of Geneva stormwater drain line that is located underneath Gates Avenue. Stormwater from the northern, undeveloped portion of the site percolates into the ground.

3.7 Water Resources

The City of Geneva obtains drinking water from Seneca Lake. According to Tom Rafferty, all residences, businesses and industries within the city boundaries of Geneva are connected to the municipal water system. A city ordinance prohibits the consumptive use of ground water from supply wells.

4.0 FIELD ACTIVITIES

The RI field activities were conducted using a phased approach. The subsequent phases of investigation were based upon results obtained from the previous phases. The purposes of performing the field activities were to:

- further investigate the nature and extent of chlorinated VOCs and MBAS;
- better characterize the site geology and hydrogeology;
- obtain data to perform an initial site screening to determine the potential for the chlorinated VOCs to naturally attenuate; and,

- propose realistic, risk-based remedial options.

The following field activities were performed as part of the RI:

- May 1996: Phase II Environmental Assessment performed by Leggette, Brashears & Graham, Inc. (LBG)
  - Installation and sampling of five ground water monitoring wells (MW-101 through MW-105).
  - Performing field permeability tests in each monitoring well.
  - Obtaining seven soil samples for laboratory analysis.
- October 1996: Additional soil and ground water sampling and analysis (performed by Delta).
  - Advancing eight Geoprobe borings within the building to an estimated depth of 10 feet.
  - Obtaining 25 soil and 5 ground water samples from the Geoprobe borings within the building.
  - Obtaining ground water samples from the five existing monitoring wells.
  - Analyzing the samples for VOCs, MBAS and selected biological parameters.
- July 1997: Additional monitoring well installation (performed by Delta).
  - Installation and sampling of three water table monitoring wells (MW-106 though MW-108) and three telescoping monitoring wells (MW-201 through MW-203) and one piezometer (P-1).
  - Installation of two staff gauges (Stream-A and Stream-B).
  - Performing field permeability tests on three water table and two telescoping monitoring wells.
  - Obtaining ground water samples from each monitoring well.
  - Analyzing each sample for VOCs, MBAS and field indicator parameters (pH, dissolved oxygen, specific conductivity, temperature and redox potential).
  - Obtaining water level readings in all monitoring wells on a weekly basis for seven consecutive weeks (as previously discussed in Section 3.4).
  - Obtaining precipitation records and municipal water usage from August 9 through September 29, 1997.
- February 1998 (performed by Delta).
  - Installation of three water table monitoring wells (MW-109 through MW-111).
  - Advancement of three soil borings (SB-1 through SB-3).
  - Obtaining ground water samples from all of the monitoring wells.
  - Obtaining three surface water samples (SW-1 through SW-3).
  - Analyzing each ground water sample for VOCs, MBAS and field indicator parameters (pH, dissolved oxygen, specific conductivity, temperature and redox potential).
- May 1998 (performed by Delta).
  - Installing one additional staff gauge.

- Obtaining ground water samples from monitoring wells MW-101, MW-102 and MW-109. Samples were proposed to be obtained from monitoring wells MW-110 and MW-111, but these wells were dry at the time of the field sampling.
- Obtaining surface water samples from SW-1 through SW-3.
- Analyzing each sample for VOCs and selected biological parameters.

- July 1998 (performed by Delta).
  - Installing one additional staff gauge.
  - Obtaining ground water samples from monitoring wells MW-101, MW-102 and MW-109. Samples were proposed to be obtained from monitoring wells MW-110 and MW-111, but these wells were dry at the time of the field sampling.
  - Obtaining surface water samples from SW-1 through SW-3.
  - Analyzing each sample for VOCs.

4.1 Soil Sampling

A total of 32 soil samples were obtained from 14 locations between May and October 1996. Table 3 summarizes specific information regarding the sample date, depth and analytical protocol. The locations of each sample are illustrated in Figure 2.

Eight soil samples were obtained by LBG for the Phase II Environmental Assessment. The depth of these samples ranged from ground surface to six feet bgs.

In October 1996, ten Geoprobe borings (GP-01 through GP-10) were advanced at the approximate locations shown in Figure 1. Geoprobe GP-01 was advanced to a depth of 31 feet at a likely background location, north of the facility at the edge of the wooded portion of the property. The soil was sampled continuously from the ground surface until refusal was encountered at 31 feet. A Delta geologist recorded the material encountered in order to identify deep stratigraphic zones that could act as potential ground water migration pathways, aquifers and aquacludes. Three soil samples were obtained from Geoprobe boring GP-01 to evaluate physical soil parameters (bulk density, total organic carbon and porosity) in order to assist in evaluating chemical fate and transport processes. Two samples were obtained from the unsaturated soil (4-5 and 5-6 feet bgs) and one sample was obtained from the saturated zone (9-10 feet bgs).

Geoprobe borings GP-02 through GP-10 were advanced in the building at the approximate locations shown in Figure 1. A percussion bit was used to penetrate the concrete floor of the building and continuous split-spoon samples were collected to a depth of 10 feet bgs. Geoprobe location GP-02 was advanced and sampled to a depth of 15.5 feet bgs. The soil samples were visually classified and a portion of the sample from each interval was placed into a pair of glass jars, one of which was used for head space screening using a photoionization detector (PID). The samples that displayed the greatest PID reading from each Geoprobe boring had the other jar of the pair submitted for laboratory analysis. If elevated PID readings were not observed, the sample from the capillary fringe was submitted for analysis. The water table was encountered at depths ranging from 3.5 - 7 feet bgs. Soil samples were not obtained from Geoprobe boring GP-07 since a second foundation was encountered below the existing concrete floor.

In February 1998, three soil borings (SB-1 through SB-3) were advanced at the location illustrated in Figure 2. These samples were advanced in order to better characterize the shallow subsurface geology and hydrogeology, as discussed in Sections 3.3 and 3.4.

4.2 Monitoring Well Installation

Five water table monitoring wells (MW-101 through MW-105) were installed in the shallow unconsolidated aquifer by LBG on May 23 and 24, 1996. In October 1996 and February 1998, Delta installed five additional ground water monitoring wells (MW-106 through MW-111) to further delineate the horizontal extent of the VOC plume in the shallow unconsolidated aquifer. In addition, Delta installed three telescoping ground water monitoring wells in October 1996, to further characterize the subsurface geology and to delineate the vertical extent of the VOC plume.

The water table monitoring wells were constructed of two-inch diameter, schedule 40 PVC casing and completed with 10 feet of factory slotted (0.02 inch) PVC screen. A PVC riser pipe was installed to ground surface after drilling tools were withdrawn from the borings. A silica sand pack was set in the annular space to a level of approximately 2-4 feet above the top of the screened interval. A 2-foot thick bentonite seal was placed above the sand pack and the remaining annular space was grouted to the surface with neat, cement grout. The well was outfitted with a sealing, locking cap and protective manway cover.

The borings for the deep unconsolidated material wells (MW-201 through MW-203) were initially advanced to 20 feet bgs. A 20-foot section of 4-inch diameter steel casing was installed and grouted in place to seal off the water bearing zones above 20 feet. The grout was then allowed to cure approximately 24 hours. The boring was then advanced in the bedrock to a total depth of 25 feet bgs, or placed just above the clay horizon identified in Geoprobe boring GP-01 during Delta's October 1996 investigation. Three to five feet of flush thread, factory slotted (0.02 inch) PVC screen and enough PVC riser pipe to extend to ground surface was installed after drilling tools were withdrawn from the borings. A silica sand pack was set in the annular space to a level of approximately 2-4 feet above the top of the screened interval. A 2-foot thick bentonite seal was placed above the sand pack and the remaining annular space was grouted to the surface with neat, cement grout. The well was completed with a sealing, locking cap and protective manway cover. Monitoring well construction details are included as Appendix A.

The soil cuttings derived from the drilling process were containerized in 55-gallon drums and disposed of appropriately at permitted facilities. The drilling equipment was steam cleaned prior to and between all monitoring well locations to minimize the possibility of cross-contamination.

The monitoring well locations were professionally surveyed by Leonard A. Gardner for horizontal and vertical control. The reference elevation of the ground surface and the monitoring well measuring points are presented in Table 1.

4.3 Ground Water Sampling

Ground water samples were obtained from the various monitoring wells on six occasions between May 1996 and July 1998. Ground water samples were also obtained in October 1996 from five Geoprobe locations identified in Table 3. Temporary PVC screens were placed into the Geoprobe boreholes in order to permit the recovery of the required volumes of water to perform the selected analyses.

Ground water samples were obtained by either bailing or low flow purging techniques. The low flow purging techniques were utilized during the October 1996 and May 1998 sampling events. The purpose of performing the low flow sampling was to minimize exposure of the samples to oxygen in order to obtain representative biological and fate/transport parameters.

For the low flow sampling, a peristaltic pump was used to purge the monitoring wells and develop the temporary Geoprobe wells (several of the Geoprobe wells were observed to have very slow recharge and were pumped dry). The low flow sampling was also performed using a peristaltic pump and a flow-through 0.45 micron in-line filter cartridge. Field measurements including pH, dissolved oxygen (DO), conductivity, temperature, and redox potential were measured during purging and developing to evaluate well stabilization. In addition to the stabilization parameters; alkalinity, total residual chlorine, free chlorine, total iron and soluble iron were also measured in the field.

Three to five well volumes of standing water were removed by bailing prior to obtaining the samples. The samples were obtained using disposable plastic bailers. Field indicator parameters including pH, DO, conductivity, temperature, and redox potential were measured during purging to evaluate well stabilization.

All the groundwater samples were placed on ice and packed in coolers for shipment to the analytical laboratory. The purge and development water was placed in a 55-gallon steel drums.

4.4 Surface Water Sampling

Three surface water samples (SW-1 through SW-3) were obtained from the drainage ditch on three occasions since February 1998. The samples were obtained by placing the sample jar directly into the water. Field measurements were obtained including pH, DO, conductivity and temperature, then the surface water samples were placed on ice and packed in coolers for shipment to the analytical laboratory.

5.0 LABORATORY ANALYSIS AND ANALYTICAL RESULTS

All of the samples collected by Delta and LBG were analyzed by a New York certified laboratory. Table 3 summarizes the analytical protocol for every sample that was collected during the various investigative phases. Tables 4 through 7 present the analytical data collected during the investigations. These tables include only the analytes that were detected above the laboratory method detection limits. The laboratory analytical reports are included as Appendix E.

The soil results are referenced to the DEC Technical Assistance Guidance Manual (TAGM) soil to ground water objectives. These objectives have been established to assist responsible parties in determining the potential for the analytes present in the soil to impact the ground water. The ground water results are referenced to the DEC ground water standards for Class GA fresh ground waters. All fresh water is classified Class GA and the best usage is as a source of potable water. The surface water results are not referenced to objectives or standards since action levels have not been established for Class D surface waters.

In summary, the following analyses were performed:

- VOCs;
- MBAS;
- bio-parameters (includes alkalinity, nitrate/nitrite, ammonia, sulfate, sulfide, sodium, chlorine, chloride, iron, total organic carbon, total dissolved solids, chemical oxygen demand and biological oxygen demand);
- volatile fatty acids;
- light hydrocarbons (methane, ethane and ethylene);
- bulk density; and,
- porosity.

5.1 Volatile Organic Compounds

Volatile organic compounds were analyzed on all of the soil, ground water and soil samples that were obtained during each phase of investigation. The VOC analytical results are discussed below.

5.1.1 Soil

Twenty-two soil samples were obtained from 13 locations and analyzed for VOCs. A summary of VOCs detected in the soil, frequency of detection and the range of concentration is presented below:

Analyte	Frequency of Detection	Range of Concentration (mg/kg)	Amount of detections that exceed cleanup objective	DEC Clean-up Objective (mg/kg)
Tetrachloroethene (PCE)	6/22	<0.0012 - 6.7	1	1.40
Trichloroethene (TCE)	4/22	<0.00066- 0.35	0	0.70
1,1,1-trichloroethene (TCA)	3/22	<0.00068 - 0.034	0	0.76
1,1-dichloroethane (DCA)	2/22	<0.00093 - 0.11	0	0.20
Cis-1,2-dichloroethene	3/22	<0.0097 - 0.21	0	0.30
Chloroform	3/22	<0.00099 - 0.012	0	0.30
Vinyl Chloride (VC)	0/22	<0.00090 - <0.060	0	0.20
Ethylbenzene	1/22	<0.00090 - 0.028	0	5.50
Toluene	1/22	<0.00040 - .0072	0	1.50

The VOC soil analytical results are presented in Table 4. This table contains all VOCs that were reported above the analytical method detection limit. The DEC soil cleanup objectives to protect ground water are also listed for each analyte, where established.

VOCs were not reported in 12 of the 22 soil samples. Detectable levels of VOCs were reported from within the building at two of the eight Geoprobe sample locations (GP-02 and GP-04). Review of Table 4 indicates the presence of PCE, TCE and DCA at Geoprobe location GP-02. All of these reported concentrations, with the exception of the PCE concentration of 6.7 milligrams per kilogram (mg/kg) reported in the 14-foot sample, are below DEC's soil cleanup objectives to protect ground water (1.40 mg/kg). Soil sample GP-04, obtained at a depth of 9 feet, contained a PCE concentration of 0.25 mg/kg.

Detectable levels of VOCs were reported in soil samples obtained from monitoring wells MW-101 through MW-104. All of the reported values are below the DEC soil cleanup objective to protect ground water.

5.1.2 Ground Water

Forty-five ground water samples were obtained from 19 locations and analyzed for VOCs. A summary of VOCs detected in the ground water from the five temporary monitoring wells (installed in Geoprobe borings in October 1996), frequency of detection and the range of concentration is presented below:

Analyte	Frequency of Detection	Range of Concentration (mg/l)	Amount of detections that exceed the DEC ground water standard.	DEC Class GA Standard (mg/l)
PCE	0/5	<0.003 - <0.10	0	0.005
TCE	0/5	<0.00306- <0.10	0	0.005
TCA	0/5	<0.003 - 0.10	0	0.005
DCA	1/5	<0.020 - 0.005	0	0.005
Cis-1,2-dichloroethene	0/5	<0.0030 - <0.10	0	0.010
Chloroform	1/5	<0.020 - 0.003	0	0.007
VC	0/5	<0.003 - <0.10	0	0.002
Ethylbenzene	0/5	<0.0030 - <0.10	0	0.005
Toluene	0/5	<0.0030 - <0.10	0	0.005
Acetone	5/5	0.060 - 0.75	5	0.050
MIBK	2/5	<0.005 - 0.25	2	0.050

The VOC ground water analytical results are presented in Table 5. This table contains all VOCs that were reported above the analytical method detection limit. The DEC ground water standard for Class GA ground waters is also listed for each analyte, where established.

Ground water samples were obtained from all 14 monitoring wells on February 18, 1998. A summary of VOCs detected in the ground water, frequency of detection and the range of concentration from this sampling event is presented below:

Analyte	Frequency of Detection	Range of Concentration (mg/l)	Amount of detections that exceed the DEC ground water standard.	DEC Class GA Standard (mg/l)
PCE	6/14	<0.006 -0.52	5	0.005
TCE	3/14	<0.003- 0.28	3	0.005
TCA	2/14	<0.003 - 0.40	2	0.005
DCA	5/14	<0.003 - 0.14	5	0.005
Cis-1,2-dichloroethene	4/14	<0.0030 - 0.22	0	0.010
Chloroform	2/14	<0.006 - 0.005	0	0.007
VC	3/14	<0.002 - 0.250	3	0.002
Ethylbenzene	0/14	<0.0030 - <0.030	0	0.005
Toluene	0/14	<0.0030 - <0.030	0	0.005
Acetone	3/14	<0.010 - 0.110	2	0.050
MIBK	0/14	<0.010 - <0.10	0	0.050

Based on the results of the February 1998 ground water sampling event, isoconcentration maps were established for the following chlorinated VOCs: PCE, TCE, TCA, DCA, and VC. These isoconcentration maps are presented in Figures 9 through 13, respectively. The isoconcentration contours are inferred based on the existing data and estimated ground water flow directions. Figures 14 and 15 illustrate dissolved TCE isoconcentration cross sections A-A' and B-B', respectively, as inferred from the February 1998 data.

An isoconcentration map was also developed for acetone based on the October 1996 sampling from within the building and monitoring wells MW-101 through MW-105. This map is presented as Figure 16.

All targeted VOCs continue to be reported below method detection limits or DEC standards at water table monitoring wells MW-101, MW-106, MW-108, MW-110 and all three nested monitoring wells.

Ground water at monitoring wells MW-104, MW-105, MW-107 and MW-111 contain VOCs at levels that are below the DEC ground water standards, with the exception of PCE at monitoring well MW-107 (0.006 mg/l) and DCA at monitoring well MW-111 (0.033 mg/l).

Ground water at monitoring wells MW-102, MW-103 and MW-109 historically have exhibited dissolved concentrations of PCE, TCE and associated degradation products in excess of the DEC ground water standards. Figures 17 through 19 present graphs of the chlorinated VOCs with respect to time at monitoring wells MW-102, MW-103 and MW-109. Review of these figures indicates cyclical decreases and increases in the values of dissolved VOCs with respect to fluctuations of the water table. The higher concentrations of TCE are reported during times of higher water levels. The VC levels in the ground water at monitoring well MW-102 continue to increase while the remaining daughter products have leveled off or decreased.

5.1.3 Surface Water

Surface water samples were obtained from locations SW-1 through SW-3 on three occasions (February, March and July 1998). The surface water analytical results are presented in Table 7. Review of Table 7 indicates the presence of DCA and DCE in two (March and July 1998) of the three sample events at locations SW-2 and SW-3. The maximum concentration of DCA and DCE were 0.009 mg/l and 0.005 mg/l, respectively. Surface water quality standards have not been promulgated by DEC for Class D water bodies. None of the VOCs were reported above the analytical detection limit in the water samples obtained in February 1998.

5.2 Methyl Blue Active Substances

5.2.1 Soil

Based on historical information (previous handling of MBAS within the building), eight soil samples were obtained from eight Geoprobe locations within the building and analyzed for MBAS. All of the results indicate that MBAS was reported below the analytical method detection limit as summarized in Table 4.

5.2.2 Ground Water

Thirty-two ground water samples were obtained from 18 locations and analyzed for MBAS. The MBAS ground water analytical results are presented in Table 6. The DEC ground water standard for surfactants is 0.5 mg/l. Review of Table 6 indicates MBAS concentrations in excess of the DEC standard at the location of all Geoprobe ground water sample locations from October 1996. MBAS concentrations at monitoring wells MW-101, MW-102, MW-103, MW-104 and MW-109 continue to show decreasing concentrations with respect to time. Surfactants were not reported in the ground water at monitoring wells MW-105 through MW-108 or the three telescoping monitoring wells during February 1998.

A toxicological evaluation of surfactants was performed in order to provide a general understanding of the definition, risk and biodegradability of surfactants. The evaluation is presented as Appendix G. Based on the information obtained for this evaluation, the aerobic biodegradation rate for most, if not all, surfactants likely to be present in the ground water is rapid, relative to the ground water flow velocity. Surfactants also continue to biodegrade in the presence of the dissolved phase VOCs. For this site, VOCs are the chemicals of concern.

5.2.3 Surface Water

In February 1998, three surface water samples (SW-1 through SW-3) were obtained and analyzed for MBAS. The surface water analytical results, as presented in Table 7, indicate that MBAS were not reported above the analytical detection limit in any of the three samples.

5.3 Field Indicator/ Bioparameters

Field and laboratory bioparameters were measured during each ground water sampling event. The purpose of evaluating these parameters is to characterize the subsurface conditions that assist in predicting the potential of the VOCs to naturally attenuate. Table 6 summarizes the results of the field indicator/bioparameters. Low flow purging techniques were utilized during the October 1996 and March 1998 sampling events, as previously discussed in Section 4.3. A detailed discussion of the interpretation of each bioparameter and the associated concentrations is presented in Section 6.0 and Appendix F.

6.0 NATURAL ATTENUATION ANALYSES

This discussion of natural attenuation (NA) analyses details the results of the laboratory analysis and interpretation of the potential for NA as a potential remediation option for the chlorinated VOCs present in the ground water the site.

6.1 Objective and Background Information

In recent years, NA has become increasingly accepted as remedial alternative for organic compounds dissolved in ground water. The U.S. Environmental Protection Agency's (EPA) Office of Research and Development and Office of Solid Waste and Emergency Response define NA as:

> "The biodegradation, dispersion, dilution, sorption, volatilization, and/or chemical and biochemical stabilization of contaminants to effectively reduce contaminant toxicity, mobility, or volume to levels that are protective of human health and the ecosystem."

The U.S. Air Force Center for Environmental Excellence (AFCEE) and EPA have developed a technical protocol for the evaluation of the NA of chlorinated VOCs in ground water. An overview of the protocol has been presented in the technical paper *Overview of the Technical Protocol for Natural Attenuation of Chlorinated VOCs in Ground Water Under Development for the U.S. Air Force Center for Environmental Excellence (Wiedemeier et al 1996).* Delta is using this document as guidance for the evaluation of the NA of chlorinated VOCs at the site. A copy of the Wiedemeier et al, 1996 article is included in Appendix F.

This initial site screening was performed to determine if NA may be appropriate as a site remedial option and to ultimately obtain closure. The NA evaluation will be completed in the following initial steps:

- Determine Whether Biodegradation Is Occurring
- Determine Ground Water Flow and Solute Transport Parameters
- Locate Sources and Receptor Exposure Points
- Estimate the Biodegradation Rate Constant
- Compare the Rate of Transport to the Rate of Attenuation
- Determine Whether the Screening Criteria Are Met

Soil and ground water data were collected in October 1996 to initiate the site screening process for NA. The laboratory results are presented in Table 6. In addition, total organic carbon, bulk density and porosity analyses were performed on soil samples obtained from Geoprobe boring G-01 (as discussed in Section 4.1). The laboratory results are presented in Table 4.

The initial sampling was primarily focused on the location of potential contaminant sources and evaluation of whether or not active biodegradation of chlorinated VOCs is occurring at the site. Additional data collection was performed in subsequent phases of the RI to better define ground water flow and transport and to determine rates of NA.

6.2 Overview of Chlorinated Aliphatic Hydrocarbon Biodegradation

The destruction of chlorinated VOCs by biodegradation is the most important contaminant reduction process in NA. Chlorinated VOCs may be biodegraded by three processes; electron donor reactions, co-metabolism, and electron acceptor reactions. In electron donor reactions the chlorinated VOCs are used as an energy source by the microbes as in the aerobic biodegradation of VC. It is generally accepted that more highly chlorinated VOCs such as TCE and PCE do not biodegrade by this process under aerobic conditions.

Biodegradation by co-metabolism occurs when an enzyme or cofactor that is used by microbes for their normal metabolism of natural substrates, also catalyzes the degradation of a chlorinated VOC. The microbes receive no energy or any other benefit from the degradation of the VOCs, and their growth must be supported on their natural substrates. An example of co-metabolism is the aerobic biodegradation of TCE, DCE, and VC by methane oxidizing microbes. In this process, an enzyme used to oxidize methane for energy production called methane monooxyenase, will also act as a catalyst to degrade TCE, DCE or VC. Although the methane oxidizing microbes receive no benefit from degrading the chlorinated ethenes, significant amounts of TCE, DCE, and VC will be biodegraded whenever oxygen, methane, and an active population of methane, oxidizing microbes are present.

The most important process for the NA of chlorinated VOCs in ground water is the electron acceptor process, commonly referred to as reductive dechlorination. During this process, the chlorinated VOC is used as an electron acceptor and not as the substrate for energy production or microbial growth. In general, the reductive dechlorination occurs sequentially with more highly chlorinated VOCs such as PCE degrading at the most rapid rates, and less chlorinated compounds such as VC degrading at a much slower rate. Under the right environmental conditions the complete reductive dechlorination of PCE may occur sequentially as follows: PCE → TCE → DCE → VC → Ethylene → Ethane.

In order for reductive dechlorination to occur microbes must have a substrate or food source available to act as an electron acceptor. This substrate or electron donor supplies the microbes with energy and carbon for growth and may take the form of natural organic matter in the aquifer, petroleum hydrocarbons, or other biodegradable VOCs. Many electron acceptors such as oxygen and nitrate are preferentially used by microbes and reductive dechlorination will not occur when these electron acceptors are present in significant concentrations. For this reason an environment predisposed to reductive dechlorination is usually characterized by an negative oxidation reduction potential (ORP), depleted DO, depleted nitrate, evidence of iron reduction, sulfate reduction, or methanogensis. In addition to evidence for the depletion of electron acceptors and a reducing environment, the production of " daughter products " may be used as evidence of natural reductive dechlorination. For example, the appearance of TCE, DCE, and VC at a site where only PCE was spilled is strong evidence of the reductive dechlorination sequence previously described.

6.3 Initial Data To Determine Whether Biodegradation of Chlorinated Solvents Is Occurring

Weidemeir describes a simple method for screening sites for evidence for biodegradation of chlorinated VOCs using preliminary ground water data results. The screening method allows the evaluation of ground water data to produce an overall test score which can be used to determine if further site evaluation of NA should proceed.

Test results for the October, 1996 sampling have been used to complete this screening test as follows:

Analyte	*Concentration in Most Contaminated Zone*	*Interpretation*	*Points Awarded*
Oxygen[a]	< 0.5 mg/L	Tolerated; suppresses reductive dechlorination at higher concentrations.	3
Oxygen[a]	> 1 mg/L	Vinyl chloride may be oxidized aerobically, but reductive dechlorination will not occur.	-3
Site results:	***0.1 mg/L in impacted wells***		***Score +3***
Nitrate[a]	< 1 mg/L	Vinyl chloride may be oxidized, but reductive dechlorination will not occur above 1 mg/L.	2
Site results:	***ND < 0.2 mg/L in impacted wells***		***Score +2***
Iron (II)[a]	> 1 mg/L	Reductive pathway possible.	3
Site results:	***9.9 mg/L in MW-3***		***Score +3***
Sulfate[a]	< 20 mg/L	May compete with reductive pathway at higher concentrations.	2
Site results:	***Concentrations range from 9 to 1,500 mg/L at the site. Sulfate is used as a dilutant in many surfactant formulations. Sulfate concentrations observed in the ground water are likely due to surfactant releases rather than natural sources based on the wide range of concentrations.***		***Score 0***
Sulfide	> 1 mg/L	Reductive pathway possible.	3
Site results:	***0.5 mg/L in MW-3***		***Score 0***
Methane	>0.1 mg/L	Ultimate daughter product.	2
	>1 mg/L	Vinyl chloride accumulates.	3
	<1 mg/L	Vinyl chloride oxidizes.	
Site results:	***>0.3 mg/L at MW-1 - Offscale readings reported could be greater than 1 mg/L***		***Score +2***
ORP[a]	<50 mV	Reductive pathway possible.	<50 mV = 1 <-100 mV = 2
Site results:	***-276 mV in MW-3***		***Score +2***
pH[a]	5 < pH < 9	Tolerated range for reductive pathway.	
Site results:	***pH ranges from 6.5 to 8.96 - These values should not inhibit reductive dechlorination.***		

Analyte	*Concentration in Most Contaminated Zone*	*Interpretation*	*Points Awarded*
DOC/TOC	>20 mg/L	Carbon and energy source; drives reductive dechlorination.	2
Site results:	***280 mg/L in MW-3***		***Score +2***
Temperature	> 20 °C	At T > 20 ° C, biochemical process is accelerated.	1
Site results:	***13.1 to 15.1o C***		
Carbon Dioxide		Ultimate oxidative daughter product.	1
Site results:	***Permanent gases were not analyzed.***		***Score 0***
Alkalinity	2 x background	Results from interaction of carbon dioxide with aquifer minerals.	1
Site results:	***Results ranged from 330 to 9,200 mg/L. Detergent " builders and dilutants " such as phosphates, and sulfates are likely the cause of the high values. These current interferences inhibit the ability to see the increase of alkalinity due to biodegradation.***		***Score 0***
Chloride[a]	2 x background	Daughter product of organic chlorine; compare chloride in plume to background conditions.	2
Site results:	***Chloride ranged from 10 mg/L to 1,100 mg/L. Chloride is a common component of the salts of cationic surfactants. The low concentration of chlorinated VOCs will not produce the observed levels of chloride above background concentrations.***		***Score 0***
Hydrogen	> 1 nM	Reductive pathway possible; vinyl chloride may accumulate.	3
	< 1 nM	Vinyl chloride oxidized.	
Site results:	***Hydrogen was not analyzed during the data collection.***		***Score 0***
Volatile Fatty Acids	>0.1 mg/L	Intermediates resulting from biodegradation of aromatic compounds; carbon and energy source.	2
Site results:	***Lactate at 11 mg/L in MW-3***		***Score +2***
BTEX	>0.1 mg/L	Carbon and energy source; drives dechlorination.	2
Site results:	***Only trace levels have been detected. All below 0.1 mg/L.***		***Score 0***

Analyte	*Concentration in Most Contaminated Zone*	*Interpretation*	*Points Awarded*
PCE[a]		Material used.	
TCE[a]		Material released or daughter product of PCE.	2
Site results:	***Assuming PCE was initially released, some of the TCE may be a daughter product. To be conservative, this was not assumed to be the case.***		***Score 0***
DCE[a]		Material released or daughter product of TCE; if 80 % of DCE is cis-1,2 DCE it is probably a TCE reduction product.	2
Site results:	***Cis-1,2-DCE is present in MW-2 and MW-3 at significant concentrations.***		***Score +2***
VC[a]		Material released or daughter product dichloroethenes.	2
Site results:	***Vinyl chloride is present in MW-2 in significant quantities.***		***Score +2***
Chloroethane[a]		Daughter product of VC under reducing conditions.	2
1,1,1-Trichloroethane		Material released.	
1,1-Dichloroethane		Daughter product of TCE or a chemical reaction of 1,1,1-Trichloroethane.	
Site results:	***Chloroethane was not reported above analytical detection limit.***		***Score 0***
Ethene/Ethane	<0.1 mg/L	Daughter product of VC/ethene	>0.01 mg/L = 2 >0.10 mg/L = 3
Site results:	***In MW-3 the ethene concentration was 0.053 mg/L and ethane concentration was 0.008 mg/L.***		***Score +2***
TOTAL POINTS AWARDED			**+ 22**

[a] Required analysis

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

0 to 5	Inadequate evidence for biodegradation of chlorinated solvents.
6 to 14	Limited evidence for biodegradation of chlorinated solvents.
15 to 20	Adequate evidence for biodegradation of chlorinated organic compounds.
> 20	Strong evidence for biodegradation of chlorinated organic compounds.

The total screening score of 22 points provides strong evidence of chlorinated biodegradation by reductive dechlorination within the source area. Not all of the potential screening tests were run, so the score could have potentially been much higher. Also note that the presence of chlorides, sulfates, and other inorganic compounds associated with the formulation of detergent and surfactant products has caused analytical matrix interference that did not allow us to evaluate many of the factors which would have added to the total points awarded.

6.4 Biodegradation Rate Evaluation

The previous section indicates that the geochemical indicators of biodegradation provide strong evidence of anaerobic biodegradation of the chlorinated VOCs. The determination of the attenuation rates attributable to these biodegradation processes and other abiotic processes is carried out along the three-dimensional flow path from the source area. These attenuation rates can then be compared to literature values to assess their reasonableness.

6.4.1 Determination of Three-Dimensional Flow Path

The horizontal flux can be directly estimated from the slug test results and the calculated horizontal head gradient. The average horizontal hydraulic conductivity value from the slug tests for MW-102, MW-105 and MW-201 in Appendix D is 5 x 10^{-4} cm/sec, and the calculated horizontal hydraulic gradient calculated in Appendix C is 0.056. Accordingly, the horizontal flux is

$$\begin{aligned} q_x &= k_h \bullet +h / +x \\ &= (5 \times 10^{-4})(0.056) = 2.8 \times 10^{-5} \text{ cm/sec} \\ &= 0.079 \text{ ft/day} \end{aligned}$$

The vertical flux needs to be estimated, since there is no direct determination of the vertical hydraulic conductivity. The slug test for MW-202 is obtained for a screened interval described as silty clay and silty sand, with a hydraulic conductivity of 4.7 x 10^{-5} cm/sec. Because the soils between the screened intervals in monitoring well nests MW-101/MW-201 and MW-102/MW-202 contain fine-grained soils which are variously described as silty or clayey, this an appropriate number to apply to the calculation of a vertical flux.

However, these fine-grained soils are typically very anisotropic with k_h:k_v values ranging from 100 to 10,000. The slug test value measured would consequently be considered a horizontal value. Accordingly, the estimated value of the vertical hydraulic conductivity for the site's well nests would be a maximum of 4.7 x 10^{-7} cm/sec. This maximum estimated value will be used for the calculation.

The vertical hydraulic gradients determined in monitoring well nests MW-101/MW-201 and MW-102/MW-202 is 0.4 and 0.5, respectively. Accordingly, the maximum vertical flux is

$$
\begin{aligned}
q_z &= k_v \bullet +h / +z \\
&= (4.7 \text{ x } 10^{-7})(0.4) = 2.6 \text{ x } 10^{-7} \text{ cm/sec} \\
&= 6.7 \text{ x } 10^{-4} \text{ ft/day}
\end{aligned}
$$

These fluxes are used to determine flow times. Assuming a porosity of 0.5, the horizontal flow time from MW-102 to the stream, a distance of 130 feet, is

$$
\begin{aligned}
t_h &= (L_h \bullet n)/q_x \\
&= (130)(0.5)/0.079 = 823 \text{ days} \\
&= 2.3 \text{ years}
\end{aligned}
$$

The corresponding minimum flow time from upper to lower monitoring well in the monitoring well nests is:

$$
\begin{aligned}
t_v &= (L_v \bullet n)/q_z \\
&= (8)(0.5)/6.7 \text{ x } 10^{-4} = 5{,}970 \text{ days} \\
&= 16 \text{ years}
\end{aligned}
$$

Consequently, the migrating dissolved plume constituents will have moved vertically a minor amount (approximately one foot) before the horizontal migration of the groundwater arrives in the vicinity of the stream. Because groundwater flow in the vicinity of the stream is likely converging on the stream, the vertical flow direction likely reverses in the immediate vicinity of the stream, and the stream is the receptor of all of the migrating dissolved plume constituents. This conclusion in not influenced by retardation since the same retardation factor would be applied to both the horizontal and vertical flow components. Consequently, the evaluation of attenuation rates need only consider the horizontal flow path information.

6.4.2 Calculation Of Apparent Attenuation Rates

By comparing the concentrations of the contaminant constituents at well in the source area (*e.g.* MW-102) to the wells downgradient (*e.g.* MW-111) over the period of monitoring can indicate that a persistent pattern of concentration distribution has been established (*e.g.* a stable or shrinking plume). In addition the trends established can indicate the rate of attenuation of the contaminant constituents.

Monitoring well MW-102 has exhibited the persistent presence of PCE, TCE, 1,1,1-TCA and their dehalogenated breakdown products, namely, DCE, DCA and VC. Unfortunately, the main downgradient monitoring well, MW-

111, has only been sampled once for these constituents. However, the area's main receptor, the stream, has had both *cis*-1,2-DCE and 1,1-DCA detected in two of its three sampling events, indicating that only breakdown constituents are migrating to that receptor and indicating some stability to the plume dimensions.

The range in concentrations at MW-102 and the concentrations at MW-111 are used to calculate a range in apparent attenuation rates for these chlorinated constituents. While these rates are primarily due to biodegradation processes, they also include the effects of abiotic retardation, volatilization, dispersion and diffusion. In addition, for the breakdown products, their concentrations reflect the net effect of increases from the breakdown of parent constituents and decreases from their further breakdown to less-chlorinated constituents. Furthermore, some of the parent constituents are not found downgradient; the apparent attenuation rates calculated can only be expressed as some rate greater than indicated by the detection limits downgradient.

The apparent attenuation rate is calculated using the first-order decay equation which has typically been found to be the most applicable for calculating degradation rates in anaerobic environments such as is prevailing in the site vicinity. This equation is

$$C = C_0 \cdot \exp(-kt)$$

where

C_0 = initial concentration (at MW-102)

t = time elapsed in travel (between MW-102 and MW-111)
= 495 days

k = apparent attenuation rate

By this equation, ranges in apparent attenuation rates have been calculated for the seven chlorinated constituents found at MW-102, and are summarized in Table 8. Included in the table is a summary of attenuation rates for these constituents in anaerobic dissolved plumes from other contaminated groundwater sites, as reported in the literature.

As can be seen, the apparent attenuation rates all are all within an order of magnitude from 1E-3 to 1E-2 (*i.e.* from 0.001 to 0.01). As the literature values indicate these values are all within the ranges reported for each constituent in the literature. Accordingly, these rates are within reason. For several of these constituents they represent minimum rates, since they were not detected at MW-111 during the monitoring period.

The two breakdown constituents found in the stream are *cis*-1,2-DCE and 1,1-DCA. The former is often seen as relatively recalcitrant to further breakdown at other sites. Further monitoring of MW-111 might well indicate that the long-term apparent attenuation rate for *cis*-1,2-DCE is lower than the range in the table. The latter constituent, 1,1-DCA, has a concentration at MW-111 that is within the range of concentrations detected at MW-102, so that further monitoring may also indicate a lower apparent attenuation rate than in the table.

7.0 CONCLUSIONS OF THE REMEDIAL INVESTIGATION

Based on the results of the RI, previous activities at the facility have impacted the soil and ground water. A summary of the conclusions obtained from this investigation is presented below:

- The facility has been occupied by various industrial manufacturers since approximately 1910. Chlorinated solvents, MBAS and other surfactants were used in a variety of capacities as part of the various manufacturing activities. These compounds were identified during a Phase II Environmental Assessment in May 1996.
- Laterally, ground water flow direction at the water table is toward a drainage ditch located approximately 75 feet east of the site. This drainage ditch is the major potential receptor of ground water from the site. Surface water elevations in the drainage ditch respond directly to precipitation and are consistently lower than the water table elevations at monitoring wells MW-103, MW-105 and MW-108.
- Vertically, water level readings obtained from the three nested wells indicate a consistent downward vertical gradient. Ground water flow within the deep portion of the surficial aquifer is in an easterly direction. Ground water flow in the lower portion of the surficial aquifer is not affected by the drainage ditch located immediately east of the railroad tracks.
- Horizontal flow rates greatly exceed vertical flow rates so that there is minimal downward migration of the dissolved plume as it migrates eastward toward the drainage ditch.
- The water table elevations at monitoring well MW-104 are consistently 5 to 10 feet higher than the elevations at monitoring wells MW-103 and MW-105. Fluctuations in the water table elevation at monitoring well MW-104 do not vary with response to precipitation data or water usage. Based on information obtained from subsurface investigation, the water table elevation reported at monitoring well MW-104 is believed to be present under semi-confined conditions due to the overlying silt.
- The elevated presence of chlorinated VOCs in the ground water at monitoring well MW-102 is attributed to historical operational activities that occurred within the northern portion of the site.
- The presence of elevated chlorinated VOCs in the ground water at monitoring well MW-109 is attributed to former storage activities that were reported in the Phase I Environmental Assessment.
- Based on the low levels of residual phase chlorinated VOCs beneath the site, the soil does not contain a large mass of chlorinated VOCs.
- Based on the low levels of chlorinated VOCs, dense non-aqueous phase liquid are not present in the subsurface.

- The lateral and vertical extent of PCE, TCE and TCA (materials that are believed to have been used at the facility) have been determined with the exception of the northern and eastern extents beyond monitoring well MW-109.
- The dissolved phase VOCs discharge to the drainage ditch. This is consistent with the distribution of VOCs as mapped in this investigation.
- The drainage ditch located east of the site is classified as a Class D surface water body. Surface water quality standards have not been established for chlorinated VOCs in Class D surface water bodies.
- Dissolved chlorinated VOCs are the chemicals of concern present at the site.
- The distribution of polar solvents beneath the building is attributed to historical operational activities.
- The distribution of relatively low concentrations of MBAS beneath the building is attributed to leakage through the wastewater sump, or the factory floor prior to repair and sealing.
- The presence of MBAS is restricted to the ground water in the vicinity of monitoring wells MW-101 through MW-103. Based on the presence of low levels of MBAS (maximum of 0.280 mg/l in the ground water at monitoring well MW-102 in February 1998), the enhanced biodegradation rate and the absence of MBAS in the surface water, MBAS is considered to present minimal health risks.
- Drinking water for all residences, businesses and industries within the city boundaries of Geneva is obtained from Seneca Lake. A city ordinance prohibits the consumptive use of ground water.
- The presence of breakdown products (DCE, DCA and VC) within the source areas of monitoring well MW-102 and MW-109 indicate that biodegradation by reductive dechlorination is occurring.
- The time of travel from the center of the source area to the drainage ditch is approximately 2.3 years, without accounting for retardation effects.
- The 3+ chlorinated aliphatics (*i.e.* PCE, TCE, 1,1,1-TCA) appear to be completely attenuated before migrating to the downgradient monitoring wells (MW-101, MW-111) or the drainage ditch.
- The monochlorinated aliphatics (*i.e.* VC, chloroethane) also appear to be completely attenuated before migrating to the downgradient monitoring wells (MW-101, MW-111) or the drainage ditch.
- Two of the dichlorinated aliphatics (*i.e.* 1,1-DCA and *cis*-1,2-DCE) appear to be recalcitrant and persist in detectable concentrations at the downgradient monitoring well (MW-111) and the drainage ditch.
- Based on the results of the initial NA screening, strong evidence is present that chlorinated biodegradation is occurring by reductive dechlorination within the source area.
- Natural attenuation is the preferred remedial alternative.

8.0 RECOMMENDATIONS

Based upon the conclusions above, the following recommendations are made:

1. Two additional water table monitoring wells should be installed north of MW-111 and immediately west of the drainage ditch (designated MW-112 and MW-113 on Figure 20). Because of the uninterrupted, steep slope between the railroad track and the drainage ditch, these wells will need to be hand-installed. The well screens will be installed as deep as possible so that they intersect the water table throughout the year and overcome the logistical limitations of MW-111 (water present only during seasonal high water table).

2. During the installation of monitoring wells MW-112 and MW-113, representative soil samples from below the water table should be obtained and analyzed for soil organic carbon content. These analyses would allow for the estimation of the retardation factor for the portion of the site downgradient of the plume.

3. Water levels should be measured triannually in all active monitoring wells for a period of two years. This will allow the continued assessment of seasonal fluctuations and groundwater flow patterns. The further need for such monitoring can be assessed at the end of this period.

4. Triannual water quality sampling and analysis should be performed for a period of one year. The sampling is proposed for the months of March, July and October 1999 in order to obtain samples during the seasonal high and low ground water elevations. The proposed water quality parameters and frequency are summarized in Table 9. This monitoring will allow the further definition of plume geometry and the on-going attenuation processes. At the completion of each triannual monitoring event, a letter report will be prepared and submitted to you for review. This report will include the analytical results and our conclusions and recommendations regarding plume geometry and the on-going attenuation process. At the completion of the first year of monitoring, recommendations (frequency, duration and protocol) will be provided for continued monitoring.

9.0 REFERENCES

Alvaro J. DeCarvelho, Personal Communication, The Soap and Detergent Association (SDA)

Barbee, Gary C. (1994) Fate of chlorinated aliphatic hydrocarbons in the vadose zone and ground water: Ground Water Monitoring and Remediation, v. 9, no. 1, p. 129-140.

Barrio-Lage, Gladys, Frances Z. Parsons, and Raja S. Nassar (1987) Kinetics of the depletion of trichloroethene: Environmental Science & Technology, v. 21, no. 4, p. 386-370.

Buscheck, Tim and Kirk O'Reilly (1996) Intrinsic anaerobic biodegradation of chlorinated solvents at a manufacturing plant: Abstracts, Conference on Intrinsic Remediation of Chlorinated Solvents, April 2, 1996, Salt Lake City, Utah, p. 11-12.

The Finger Lakes Region: Its Origin and Nature; O.D. von Engeln, Cornell University Press.

Gorder, K. A., R. R. Dupont, D. L. Sorenson, and M. W. Kemblowski (1996) Intrinsic remediation of TCE in cold regions: Abstracts, Conference on Intrinsic Remediation of Chlorinated Solvents, April 2, 1996, Salt Lake City, Utah, p. 23.

The Ground-Water Resources of Ontario County, New York; 1962; Frederick K. Mack and Ralph E. Digman, U.S Geological Survey.

Harkness, Mark R., Angelo A. Bracco, Thomas Franz, Constantine Tsentas, Mark Becker, William A. Huber, Jeffrey P. Orient, Corey A. Rich, and Michael Figura (1998) Natural attenuation of chlorinated aliphatics at the Naval Air Engineering Station, Lakehurst, NJ: in Godage B. Wickramanayake and Robert E. Hinchee, eds.; Natural Attenuation: Chlorinated and Recalcitrant Compounds; The First International Conference on Remediation of Chlorinated and Recalcitrant Compounds, Monterey, California, May 18-21, 1998; p. 231-236.

Holder, Anthony W., Philip B. Bedient, and Joseph B. Hughes (1998) TCE and 1,2-DCE biotransformation inside a biologically active zone; *in* Godage B. Wickramanayake and Robert E. Hinchee, eds., *Natural Attenuation: Chlorinated and Recalcitrant Compounds*, The First International Conference on Remediation of Chlorinated and Recalcitrant Compounds, Monterey, California, May 18-21, 1998, p. 219-224.

Lela Jovanovich, Personal Communication, Stepan Corporation.

Mahoney, John, Houmao Liu, James Warner, and Robert Sterrett (1996) In-situ measurement of the rate of vinyl chloride degradation in a gravel aquifer: Abstracts, Conference on Intrinsic Remediation of Chlorinated Solvents, April 2, 1996, Salt Lake City, Utah, p. 29.

Mechaber, Richard A., Benjamin Y. Su, and Evan Cox (1998) Intrinsic bioremediation of chlorinated and non-chlorinated VOCs at a RCRA landfill: "in• Godage B. Wickramanayake and Robert E. Hinchee, eds.; Natural Attenuation: Chlorinated and Recalcitrant Compounds; The First International Conference on Remediation of Chlorinated and Recalcitrant Compounds, Monterey, California, May 18-21, 1998; p. 275-280.

NTIS PB91-212167, "Environmental and Human Safety of Major Surfactants - Volume I. Anionic Surfactants - Part I. Linear Alylbenzene Sulfonates"

NTIS PB91-212167, "Environmental and Human Safety of Major Surfactants - Volume I. Anionic Surfactants - Part II. Alcohol Ethoxy Sulfates"

NTIS PB91-212167, "Environmental and Human Safety of Major Surfactants - Volume I. Anionic Surfactants - Part III. Alykyl Sulfates"

NTIS PB91-212167, "Environmental and Human Safety of Major Surfactants - Volume I. Anionic Surfactants - Part IV. Alpha Olefin Sulfonates"

Overview of the Technical Protocol for Natural Attenuation of Chlorinated VOCs in Ground Water Under Development for the U.S. Air Force Center for Environmental Excellence (Wiedemeier et al 1996).

Phase I Environmental Assessment of Project Butterfly (Monarch Division) Geneva, New York; May 29, 1996; Environmental Strategies Corporation; 21 text pages.

Phase II Environmental Assessment, H.B. Fuller Company, Monarch Chemical Division, Geneva, New York; July 1996; Leggette, Brashears & Graham, Inc.; two volumes; 10 text pages.

Ravi, Varadhan, Jin-Song Chen, and William Gierke (1998) Evaluating the natural attenuation of transient-source compounds in groundwater; from Godage B. Wickramanayake and Robert E. Hinchee, eds., *Natural Attenuation: Chlorinated and Recalcitrant Compounds*, The First International Conference on Remediation of Chlorinated and Recalcitrant Compounds, Monterey, California, May 18-21, 1998, p. 205-211.

Wiedemeier, Todd H., Leigh Alvarado Benson, John T. Wilson, Donald H. Kampbell, Jerry E. Hansen, and Robert Miknis (1996) Patterns of natural attenuation of chlorinated aliphatic hydrocarbons at Plattsburgh Air Force Base, New York: Abstracts, Conference on Intrinsic Remediation of Chlorinated Solvents, April 2, 1996, Salt Lake City, Utah, p. 7-8.

10.0 LIMITATIONS TO THE REMEDIAL INVESTIGATION

The statements contained in this report represent our professional judgment and opinions. Currently accepted industry practices and hydrological and engineering practices were followed at this time and location, and are subject to the current industry standard.

This report was prepared by Delta Environmental Consultants, Inc.

Ronald W. Jenkins
Staff Geologist

Stephen A. Zbur, P.G.
Project Manager

Reviewed by:

Kelton Barr
Senior Consultant

TABLES

TABLES

TABLE 1

WELL CONSTRUCTION DATA
FORMER MONARCH CHEMICAL FACILITY
GENEVA, NEW YORK

DELTA PROJECT NO. S096-015

SITE	WELL DEPTH (feet bgs)	TOTAL DEPTH (feet bgs)	GROUND SURFACE ELEVATION (feet)	MP ELEVATION (feet)	CASING DIAMETER (inches)	SCREENS (feet bgs)		ANNULAR FILLS (feet bgs)	
						INTERVAL	DESCRIPTION	INTERVAL	TYPE
MW-101	16.00	16.00	462.90	466.54	2.00	5.0-15.0	Slotted	0.0-1.5	Backfill
							PVC	1.5-3.0	Seal
								3.0-15.0	Filter
MW-102	16.00	16.00	463.08	462.72	2.00	5.0-15.0	Slotted	0.4-1.5	Backfill
							PVC	1.5-3.0	Seal
								3.0-15.0	Filter
MW-103	16.00	16.00	463.04	462.69	2.00	5.0-15.0	Slotted	0.4-1.5	Backfill
							PVC	1.5-3.0	Seal
								3.0-16.0	Filter
MW-104	16.00	16.00	462.73	462.43	2.00	5.0-15.0	Slotted	0.3-1.5	Backfill
							PVC	1.5-3.0	Seal
								3.0-16.0	Filter
MW-105	16.00	16.00	457.92	457.61	2.00	5.0-15.0	Slotted	0.1-1.5	Backfill
							PVC	1.5-3.0	Seal
								3.0-15.0	Filter
MW-106	16.00	16.00	451.99	451.50	2.00	5.5-15.5	Slotted	1.0-1.5	Backfill
							PVC	1.5-3.5	Seal
								3.5-16.0	Filter
MW-107	16.00	16.00	463.02	465.76	2.00	6.0-16.0	Slotted	0.0-2.0	Backfill
							PVC	2.0-4.0	Seal
								4.0-16.0	Filter

TABLE 1

WELL CONSTRUCTION DATA
FORMER MONARCH CHEMICAL FACILITY
GENEVA, NEW YORK

Date: 12/10/98

DELTA PROJECT NO. S096-015

SITE	WELL DEPTH (feet bgs)	TOTAL DEPTH (feet bgs)	GROUND SURFACE ELEVATION (feet)	MP ELEVATION (feet)	CASING DIAMETER (inches)	SCREENS (feet bgs)		ANNULAR FILLS (feet bgs)	
						INTERVAL	DESCRIPTION	INTERVAL	TYPE
MW-108	14.00	14.00	451.29	453.92	2.00	4.0-14.0	Slotted	0.0-1.0	Backfill
							PVC	1.0-3.0	Seal
								3.0-14.0	Filter
MW-109	15.00	15.00	462.78	462.46	1.25	5.0-15.0	Slotted	0.0-1.0	Backfill
							PVC	1.0-3.0	Seal
								3.0-15.0	Filter
MW-110	12.00	12.00	454.74	458.00	1.25	7.0-12.0	Slotted	0.0-5.0	Backfill
							PVC	5.0-7.0	Seal
								7.0-12.0	Filter
MW-111	10.00	10.00	450.05	453.19	1.25	5.0-10.0	Slotted	0.0-1.0	Backfill
							PVC	1.0-3.0	Seal
								3.0-10.0	Filter
MW-201	26.00	26.00	463.58	465.75	2.00	21.0-26.0	Slotted	0.0-17.8	Backfill
							PVC	17.8-20.0	Seal
								20.0-26.0	Filter
MW-202	25.00	25.00	462.98	462.76	2.00	20.3-23.3	Slotted	0.2-17.3	Backfill
							PVC	17.3-19.8	Seal
								19.8-25.0	Filter
MW-203	21.50	21.50	451.16	453.54	2.00	18.5-21.5	Slotted	0.0-16.0	Backfill
							PVC	16.0-18.0	Seal
								18.0-21.5	Filter

TABLE 1

WELL CONSTRUCTION DATA
FORMER MONARCH CHEMICAL FACILITY
GENEVA, NEW YORK

DELTA PROJECT NO. S096-015

SITE	WELL DEPTH (feet bgs)	TOTAL DEPTH (feet bgs)	GROUND SURFACE ELEVATION (feet)	MP ELEVATION (feet)	CASING DIAMETER (inches)	SCREENS (feet bgs)		ANNULAR FILLS (feet bgs)	
						INTERVAL	DESCRIPTION	INTERVAL	TYPE
P-01	25.00	25.00	462.79	462.16	1.00	23.0-25.0	Slotted PVC	0.0-20.0	Backfill
								20.0-21.0	Seal
								21.0-25.0	Filter

TABLE 2

GROUND WATER ELEVATION DATA
FORMER MONARCH CHEMICAL FACILITY
GENEVA, NEW YORK

Date: 12/10/98

DELTA PROJECT NO. S096-015

SITE	DATE	MP ELEVATION(2) (feet)	TIME	DEPTH TO WATER (feet)	△ WATER ELEV.(1) (feet)	WATER ELEV.(2) (feet)
MW-101	10/22/96	466.540	00:00	7.20	NA	459.34
MW-101	08/15/97	466.540	13:01	12.61	-5.41	453.93
MW-101	08/22/97	466.540	11:50	13.57	-0.96	452.97
MW-101	08/29/97	466.540	14:58	12.78	0.79	453.76
MW-101	09/05/97	466.540	12:16	12.59	0.19	453.95
MW-101	09/12/97	466.540	12:22	12.76	-0.17	453.78
MW-101	09/18/97	466.540	11:40	12.95	-0.19	453.59
MW-101	09/26/97	466.540	11:12	13.04	-0.09	453.50
MW-101	02/18/98	466.540	09:54	7.80	5.24	458.74
MW-101	05/28/98	466.540	00:00	8.90	-1.10	457.64
MW-101	07/16/98	466.540	00:00	8.75	0.15	457.79
MW-102	10/22/96	462.720	00:00	5.95	NA	456.77
MW-102	08/15/97	462.720	12:58	9.63	-3.68	453.09
MW-102	08/22/97	462.720	11:37	9.84	-0.21	452.88
MW-102	08/29/97	462.720	14:51	10.03	-0.19	452.69
MW-102	09/05/97	462.720	12:05	9.23	0.80	453.49
MW-102	09/12/97	462.720	12:13	9.65	-0.42	453.07
MW-102	09/18/97	462.720	11:31	10.06	-0.41	452.66
MW-102	09/26/97	462.720	11:08	10.59	-0.53	452.13
MW-102	02/18/98	462.720	08:26	3.90	6.69	458.82
MW-102	05/28/98	462.720	00:00	6.99	-3.09	455.73
MW-102	07/16/98	462.720	00:00	6.04	0.95	456.68
MW-103	10/22/96	462.690	00:00	5.18	NA	457.51
MW-103	08/15/97	462.690	12:50	11.68	-6.50	451.01
MW-103	08/22/97	462.690	11:30	10.41	1.27	452.28
MW-103	08/29/97	462.690	14:46	12.02	-1.61	450.67
MW-103	09/05/97	462.690	12:01	10.41	1.61	452.28
MW-103	09/12/97	462.690	12:09	9.95	0.46	452.74
MW-103	09/18/97	462.690	11:27	12.11	-2.16	450.58
MW-103	09/26/97	462.690	11:00	13.27	-1.16	449.42
MW-103	02/18/98	462.690	11:13	4.94	8.33	457.75
MW-103	05/28/98	462.690	00:00	7.80	-2.86	454.89
MW-103	07/16/98	462.690	00:00	6.77	1.03	455.92

(1) Change in Water Elevation since last reported measurement

(2) Measurements Based on Mean Sea Level

D = Dry NA = Not Available

TABLE 2

GROUND WATER ELEVATION DATA
FORMER MONARCH CHEMICAL FACILITY
GENEVA, NEW YORK

DELTA PROJECT NO. S096-015

SITE	DATE	MP ELEVATION(2) (feet)	TIME	DEPTH TO WATER (feet)	△ WATER ELEV.(1) (feet)	WATER ELEV.(2) (feet)
MW-104	10/22/96	462.430	00:00	3.70	NA	458.73
MW-104	08/15/97	462.430	12:35	4.22	-0.52	458.21
MW-104	08/22/97	462.430	11:25	3.83	0.39	458.60
MW-104	08/29/97	462.430	14:43	4.49	-0.66	457.94
MW-104	09/05/97	462.430	11:56	4.03	0.46	458.40
MW-104	09/12/97	462.430	12:05	3.82	0.21	458.61
MW-104	09/18/97	462.430	11:24	4.01	-0.19	458.42
MW-104	09/26/97	462.430	10:57	3.71	0.30	458.72
MW-104	02/18/98	462.430	11:32	3.80	-0.09	458.63
MW-104	05/28/98	462.430	00:00	4.24	-0.44	458.19
MW-104	07/16/98	462.430	00:00	4.15	0.09	458.28
MW-105	10/22/96	457.610	00:00	4.63	NA	452.98
MW-105	08/15/97	457.610	12:20	9.03	-4.40	448.58
MW-105	08/22/97	457.610	11:22	8.86	0.17	448.75
MW-105	08/29/97	457.610	14:41	9.16	-0.30	448.45
MW-105	09/05/97	457.610	11:54	8.72	0.44	448.89
MW-105	09/12/97	457.610	12:02	8.33	0.39	449.28
MW-105	09/18/97	457.610	11:21	9.06	-0.73	448.55
MW-105	09/26/97	457.610	10:54	8.67	0.39	448.94
MW-105	02/18/98	457.610	12:53	6.00	2.67	451.61
MW-105	05/28/98	457.610	00:00	8.51	-2.51	449.10
MW-105	07/16/98	457.610	00:00	7.79	0.72	449.82
MW-106	08/15/97	451.500	12:00	5.62	NA	445.88
MW-106	08/22/97	451.500	11:18	5.48	0.14	446.02
MW-106	08/29/97	451.500	14:39	5.64	-0.16	445.86
MW-106	09/05/97	451.500	11:50	5.55	0.09	445.95
MW-106	09/12/97	451.500	11:59	5.39	0.16	446.11
MW-106	09/18/97	451.500	11:17	5.62	-0.23	445.88
MW-106	09/26/97	451.500	10:50	5.25	0.37	446.25
MW-106	02/18/98	451.500	14:20	1.82	3.43	449.68
MW-106	05/28/98	451.500	00:00	4.61	-2.79	446.89
MW-107	08/15/97	465.760	13:05	13.79	NA	451.97
MW-107	08/22/97	465.760	11:50	12.57	1.22	453.19

(1) Change in Water Elevation since last reported measurement D = Dry NA = Not Available

(2) Measurements Based on Mean Sea Level

TABLE 2

GROUND WATER ELEVATION DATA
FORMER MONARCH CHEMICAL FACILITY
GENEVA, NEW YORK

DELTA PROJECT NO. S096-015

SITE	DATE	MP ELEVATION(2) (feet)	TIME	DEPTH TO WATER (feet)	△ WATER ELEV.(1) (feet)	WATER ELEV.(2) (feet)
MW-107	08/29/97	465.760	15:00	13.59	-1.02	452.17
MW-107	09/05/97	465.760	12:18	12.62	0.97	453.14
MW-107	09/12/97	465.760	12:25	12.04	0.58	453.72
MW-107	09/18/97	465.760	11:41	13.22	-1.18	452.54
MW-107	09/26/97	465.760	11:14	12.56	0.66	453.20
MW-107	02/18/98	465.760	10:37	8.67	3.89	457.09
MW-107	05/28/98	465.760	00:00	11.39	-2.72	454.37
MW-107	07/16/98	465.760	00:00	10.50	0.89	455.26
MW-108	08/15/97	453.920	11:50	10.82	NA	443.10
MW-108	08/22/97	453.920	11:59	10.90	-0.08	443.02
MW-108	08/29/97	453.920	14:28	11.01	-0.11	442.91
MW-108	09/05/97	453.920	11:33	11.09	-0.08	442.83
MW-108	09/12/97	453.920	11:47	11.20	-0.11	442.72
MW-108	09/18/97	453.920	11:07	11.20	0.00	442.72
MW-108	09/26/97	453.920	10:41	11.24	-0.04	442.68
MW-108	02/18/98	453.920	14:30	3.20	8.04	450.72
MW-108	05/28/98	453.920	00:00	8.31	-5.11	445.61
MW-108	07/16/98	453.920	00:00	8.15	0.16	445.77
MW-109	02/18/98	462.460	08:47	7.30	NA	455.16
MW-109	05/28/98	462.460	00:00	6.31	0.99	456.15
MW-109	07/16/98	462.460	00:00	8.02	-1.71	454.44
MW-110	02/18/98	458.000	13:16	9.20	NA	448.80
MW-110	05/28/98	458.000	00:00	10.40	-1.20	447.60
MW-110	07/16/98	458.000	00:00	D	NA	NA
MW-111	02/18/98	453.190	13:40	5.40	NA	447.79
MW-111	05/28/98	453.190	00:00	6.60	-1.20	446.59
MW-111	07/16/98	453.190	00:00	6.30	0.30	446.89
MW-201	08/15/97	465.750	13:03	16.06	NA	449.69
MW-201	08/22/97	465.750	11:45	15.89	0.17	449.86
MW-201	08/29/97	465.750	14:56	16.25	-0.36	449.50
MW-201	09/05/97	465.750	12:15	16.00	0.25	449.75

(1) Change in Water Elevation since last reported measurement D = Dry NA = Not Available

(2) Measurements Based on Mean Sea Level

TABLE 2

GROUND WATER ELEVATION DATA
FORMER MONARCH CHEMICAL FACILITY
GENEVA, NEW YORK

DELTA PROJECT NO. S096-015

SITE	DATE	MP ELEVATION (2) (feet)	TIME	DEPTH TO WATER (feet)	△ WATER ELEV. (1) (feet)	WATER ELEV. (2) (feet)
MW-201	09/12/97	465.750	12:21	15.91	0.09	449.84
MW-201	09/18/97	465.750	11:39	16.24	-0.33	449.51
MW-201	09/26/97	465.750	11:11	16.09	0.15	449.66
MW-201	02/18/98	465.750	10:12	13.90	2.19	451.85
MW-201	05/28/98	465.750	00:00	15.23	-1.33	450.52
MW-201	07/16/98	465.750	00:00	14.89	0.34	450.86
MW-202	08/15/97	462.760	12:56	14.43	NA	448.33
MW-202	08/22/97	462.760	11:39	14.27	0.16	448.49
MW-202	08/29/97	462.760	14:49	14.46	-0.19	448.30
MW-202	09/05/97	462.760	12:04	14.30	0.16	448.46
MW-202	09/12/97	462.760	12:11	14.29	0.01	448.47
MW-202	09/18/97	462.760	11:30	14.53	-0.24	448.23
MW-202	09/26/97	462.760	11:02	14.39	0.14	448.37
MW-202	02/18/98	462.760	08:18	12.30	2.09	450.46
MW-202	05/28/98	462.760	00:00	13.41	-1.11	449.35
MW-202	07/16/98	462.760	00:00	13.09	0.32	449.67
MW-203	08/15/97	453.540	11:52	21.54	NA	432.00
MW-203	08/22/97	453.540	12:01	21.03	0.51	432.51
MW-203	08/29/97	453.540	14:18	20.29	0.74	433.25
MW-203	09/05/97	453.540	11:34	19.63	0.66	433.91
MW-203	09/12/97	453.540	11:48	19.06	0.57	434.48
MW-203	09/18/97	453.540	11:06	18.51	0.55	435.03
MW-203	09/26/97	453.540	10:40	18.01	0.50	435.53
MW-203	02/18/98	453.540	14:30	8.40	9.61	445.14
MW-203	05/28/98	453.540	00:00	10.00	-1.60	443.54
MW-203	07/16/98	453.540	00:00	8.62	1.38	444.92
P-01	08/15/97	462.160	13:10	13.22	NA	448.94
P-01	08/22/97	462.160	11:42	13.11	0.11	449.05
P-01	08/29/97	462.160	14:53	13.49	-0.38	448.67
P-01	09/05/97	462.160	12:11	13.22	0.27	448.94
P-01	09/12/97	462.160	12:16	13.16	0.06	449.00
P-01	09/18/97	462.160	11:34	13.48	-0.32	448.68
P-01	09/26/97	462.160	11:07	13.26	0.22	448.90

(1) Change in Water Elevation since last reported measurement D = Dry NA = Not Available

(2) Measurements Based on Mean Sea Level

TABLE 2

GROUND WATER ELEVATION DATA
FORMER MONARCH CHEMICAL FACILITY
GENEVA, NEW YORK

Date: 12/10/98

DELTA PROJECT NO. S096-015

SITE	DATE	MP ELEVATION (2) (feet)	TIME	DEPTH TO WATER (feet)	△ WATER ELEV. (1) (feet)	WATER ELEV. (2) (feet)
P-01	07/16/98	462.160	00:00	O	NA	NA
STREAM-A	08/15/97	447.390	11:55	2.24	NA	445.15
STREAM-A	08/22/97	447.390	12:06	2.12	0.12	445.27
STREAM-A	08/29/97	447.390	14:32	2.19	-0.07	445.20
STREAM-A	09/05/97	447.390	11:41	2.20	-0.01	445.19
STREAM-A	09/12/97	447.390	11:54	2.10	0.10	445.29
STREAM-A	09/18/97	447.390	11:12	2.19	-0.09	445.20
STREAM-A	09/26/97	447.390	10:47	1.96	0.23	445.43
STREAM-A	02/18/98	447.390	15:15	1.30	0.66	446.09
STREAM-A	05/28/98	447.390	00:00	2.00	-0.70	445.39
STREAM-A	07/16/98	447.390	00:00	1.98	0.02	445.41
STREAM-B	08/15/97	447.970	13:25	2.74	NA	445.23
STREAM-B	08/22/97	447.970	12:08	2.63	0.11	445.34
STREAM-B	08/29/97	447.970	14:31	2.74	-0.11	445.23
STREAM-B	09/05/97	447.970	11:39	2.49	0.25	445.48
STREAM-B	09/12/97	447.970	11:52	2.61	-0.12	445.36
STREAM-B	09/18/97	447.970	11:10	2.71	-0.10	445.26
STREAM-B	09/26/97	447.970	10:45	2.48	0.23	445.49
STREAM-B	02/18/98	447.970	15:20	1.28	1.20	446.69
STREAM-B	05/28/98	447.970	00:00	2.56	-1.28	445.41
STREAM-B	07/16/98	447.970	00:00	2.45	0.11	445.52
STREAM-C	05/28/98	450.320	00:00	1.77	NA	448.55
STREAM-C	07/16/98	450.320	00:00	1.45	0.32	448.87

(1) Change in Water Elevation since last reported measurement

(2) Measurements Based on Mean Sea Level

D = Dry   NA = Not Available

TABLE 3
SOIL, GROUND WATER AND SURFACE WATER ANALYTICAL PROTOCOL
FORMER MONARCH CHEMICAL FACILITY
Geneva, NY

LOCATION	SAMPLE TYPE	SAMPLE ID	SAMPLE DATE	DEPTH (ft- bgs)	ANALYTICAL PROTOCOL								
					A	B	C	D	E	F	G	H	I
MONITORING WELL MW-101	GROUND WATER	MW-101	05/29/96	5-15	X								
			10/22/96		X	X	X	X	X	X	X		
			07/18/97		X	X	X			X			
			02/18/98		X	X				X			
			05/28/98		X		X	X	X	X	X		
			07/16/98		X					X			
MONITORING WELL MW-102	GROUND WATER	MW-102	05/29/96	5-15	X								
			10/22/96		X	X	X	X	X	X	X		
			07/18/97		X	X	X			X			
			02/18/98		X	X				X			
			05/28/98		X		X	X	X	X	X		
			07/16/98		X					X			
MONITORING WELL MW-103	GROUND WATER	MW-103	05/29/96	5-15	X								
			10/22/96		X	X	X	X	X	X	X		
			02/18/98		X	X				X			
			05/28/98		X		X	X	X	X	X		
			07/16/98		X					X			
MONITORING WELL MW-104	GROUND WATER	MW-104	05/29/96	5-15	X								
			10/22/96		X	X	X	X	X	X	X		
			02/18/98		X	X				X			
MONITORING WELL MW-105	GROUND WATER	MW-105	05/29/96	5-15	X								
			10/22/96		X	X	X	X	X	X	X		
			02/18/98		X	X				X			
MONITORING WELL MW-106	GROUND WATER	MW-106	07/18/97	5.5-15.5	X	X	X			X			
			02/18/98		X	X				X			
MONITORING WELL MW-107	GROUND WATER	MW-107	07/18/97	6-16	X	X	X			X			
			02/18/98		X	X				X			
MONITORING WELL MW-108	GROUND WATER	MW-108	07/18/97	4-14	X	X	X			X			
			02/18/98		X	X				X			
MONITORING WELL MW-109	GROUND WATER	MW-109	02/18/98	5-15	X	X				X			
			05/28/98		X		X	X	X	X	X		
			07/16/98		X					X			
MONITORING WELL MW-110	GROUND WATER	MW-110	02/18/98	7-12	X	X				X			
MONITORING WELL MW-111	GROUND WATER	MW-111	02/18/98	5-10	X	X				X			
MONITORING WELL MW-201	GROUND WATER	MW-201	07/18/97	21-26	X	X	X			X			
			02/18/98		X	X				X			
MONITORING WELL MW-202	GROUND WATER	MW-202	07/18/97	15.5-21.5	X	X	X			X			
			02/18/98		X	X				X			
MONITORING WELL MW-203	GROUND WATER	MW-203	07/18/97	23-25	X	X				X			
			02/18/98		X	X				X			
GEOPROBE GP-02	GROUND WATER	GP-2	10/23/96	10-15	X	X	X	X	X	X	X		
GEOPROBE GP-04	GROUND WATER	GP-4	10/23/96	5-10	X	X	X	X	X	X	X		
GEOPROBE GP-06	GROUND WATER	GP-6	10/23/96	5-10	X	X	X	X	X	X	X		
GEOPROBE GP-08	GROUND WATER	GP-8	10/23/96	5-10	X	X	X	X	X	X	X		
GEOPROBE GP-09	GROUND WATER	GP-9	10/23/96	5-10	X	X	X	X	X	X	X		

ANALYTICAL PROTOCOL KEY:
A: Volatile Organic Compounds (8240)
B: Methyl Blue Activated Substances (MBAS)
C: Bio-Parameters includes:(alkalinity, nitrate/nitrite, ammonia, sulfate, sulfide, sodium, chlorine, chloride, iron, ORP, TDS, COD, BOD5)
D: Volatile Fatty Acids (Lactate)
E: Light Hydrocarbons (methane, ethane and ethylene)
F: Field Indicator Parameters (pH, dissolved oxygen, conductivity, temperature)
G: Total Organic Carbon
H: Bulk Density
I: Porosity

TABLE 3
SOIL, GROUND WATER AND SURFACE WATER ANALYTICAL PROTOCOL
FORMER MONARCH CHEMICAL FACILITY
Geneva, NY

LOCATION	SAMPLE TYPE	SAMPLE ID	SAMPLE DATE	DEPTH (ft- bgs)	ANALYTICAL PROTOCOL								
Surface Water -1, 2, 3	SURFACE WATE	W-1, SW-2, SW-	02/18/98	WATER SURFACE	X					X			
			05/19/98	WATER SURFACE	X								
			07/16/98	WATER SURFACE	X								
MONITORING WELL MW-101	SOIL	MW-101	05/23/96	0.5	X								
MONITORING WELL MW-101	SOIL	MW-101	05/23/96	6.0	X								
MONITORING WELL MW-102	SOIL	MW-102	05/23/96	5.0	X								
MONITORING WELL MW-103	SOIL	MW-103	05/23/96	4.0	X								
MONITORING WELL MW-103	SOIL	MW-103	05/23/96	6.0	X								
MONITORING WELL MW-104	SOIL	MW-104	05/23/96	0.5	X								
MONITORING WELL MW-104	SOIL	MW-104	05/23/96	4.0	X								
MONITORING WELL MW-105	SOIL	MW-105	05/24/96	6.0	X								
GEOPROBE GP-01	SOIL	GP-1 (4-5)	10/22/96	4-5							X	X	
	SOIL	GP-1 (5-6)	10/22/96	5-6									X
	SOIL	GP-1 (9-10)	10/22/96	9-10							X	X	
GEOPROBE GP-02	SOIL	GP-2 (1-2)	10/22/96	1-2	X								
	SOIL	GP-2 (9-10)	10/22/96	9-10	X								
	SOIL	GP-2 (8-10)	10/22/96	8-10		X							
	SOIL	GP-2 (14-15.5)	10/23/96	14-15.5	X								
GEOPROBE GP-03	SOIL	GP-3 (3-5)	10/23/96	3-5		X							
	SOIL	GP-3 (4-5)	10/23/96	4-5	X								
GEOPROBE GP-04	SOIL	GP-4 (2-3)	10/22/96	2-3	X								
	SOIL	GP-4 (8-10)	10/22/96	8-10		X							
	SOIL	GP-4 (9-10)	10/22/96	9-10	X								
GEOPROBE GP-05	SOIL	GP-5 (2-3)	10/23/96	2-.3	X								
	SOIL	GP-5 (2-4)	10/23/96	2-4		X							
GEOPROBE GP-06	SOIL	GP-6 (2-3)	10/23/96	2-3	X								
	SOIL	GP-6 (2-4)	10/23/96	2-4		X							
	SOIL	GP-6 (9-10)	10/23/96	9-10	X								
GEOPROBE GP-08	SOIL	GP-8 (2-3)	10/23/96	2-3	X								
	SOIL	GP-8 (8-10)	10/23/96	8-10		X							
	SOIL	GP-8 (9-10)	10/23/96	9-10	X								
GEOPROBE GP-09	SOIL	GP-9 (2-3)	10/23/96	2-3	X								
	SOIL	GP-9 (2-4)	10/23/96	2-4		X							
	SOIL	GP-9 (9-10)	10/23/96	9-10	X								
GEOPROBE GP-10	SOIL	GP-10 (8-9)	10/23/96	8-9	X	X							

ANALYTICAL PROTOCOL KEY:
A: Volatile Organic Compounds (8240)
B: Methyl Blue Activated Substances (MBAS)
C: Bio-Parameters includes:(alkalinity, nitrate/nitrite, ammonia, sulfate, sulfide, sodium, chlorine, chloride, iron, ORP, TDS, COD, BOD5)
D: Volatile Fatty Acids (Lactate)
E: Light Hydrocarbons (methane, ethane and ethylene)
F: Field Indicator Parameters (pH, dissolved oxygen, conductivity, temperature)
G: Total Organic Carbon
H: Bulk Density
I: Porosity

Date: 12/10/98

TABLE 4

HISTORICAL SOIL ANALYTICAL RESULTS
FORMER MONARCH CHEMICAL FACILITY
GENEVA, NEW YORK

DELTA PROJECT NO. S096-015

SITE	DATE	DEPTH (ft)	Chloroform (mg/kg)	1,1,1-trichloro ethane (mg/kg)	1,1-Dichloro ethane (mg/kg)	Trichloroethene (mg/kg)	Ethylbenzene (mg/kg)	Toluene (mg/kg)	Tetrachloro ethene (mg/kg)
NYDEC-TAGM			0.30	0.760	0.200	0.700	5.500	1.500	1.400
GP-01	10/22/96	4.00	---	---	---	---	---	---	---
GP-01	10/22/96	9.00	---	---	---	---	---	---	---
GP-02	10/22/96	1.00	<0.064	<0.064	<0.064	0.14	<0.064	<0.064	0.50
GP-02	10/22/96	8.00	---	---	---	---	---	---	---
GP-02	10/22/96	9.00	<0.061	<0.061	<0.061	<0.061	<0.061	<0.061	<0.061
GP-02	10/23/96	14.00	<0.060	<0.060	0.11	0.06	<0.060	<0.060	[6.7]
GP-03	10/23/96	3.00	---	---	---	---	---	---	---
GP-03	10/23/96	4.00	<0.060	<0.060	<0.060	<0.060	<0.060	<0.060	<0.060
GP-04	10/22/96	2.00	<0.060	<0.060	<0.060	<0.060	<0.060	<0.060	<0.060
GP-04	10/22/96	9.00	<0.060	<0.060	<0.060	<0.060	<0.060	<0.060	0.25
GP-05	10/23/96	2.00	<0.11	<0.11	<0.11	<0.11	<0.11	<0.11	<0.11
GP-05	10/23/96	3.00	---	---	---	---	---	---	---
GP-06	10/23/96	2.00	<0.060	<0.060	<0.060	<0.060	<0.060	<0.060	<0.060
GP-06	10/23/96	3.00	---	---	---	---	---	---	---
GP-06	10/23/96	9.00	<0.061	<0.061	<0.061	<0.061	<0.061	<0.061	<0.061
GP-08	10/23/96	2.00	<0.057	<0.057	<0.057	<0.057	<0.057	<0.057	<0.057
GP-08	10/23/96	8.00	---	---	---	---	---	---	---
GP-08	10/23/96	9.00	<0.062	<0.062	<0.062	<0.062	<0.062	<0.062	<0.062
GP-09	10/23/96	2.00	<0.062	<0.062	<0.062	<0.062	<0.062	<0.062	<0.062
GP-09	10/23/96	3.00	---	---	---	---	---	---	---
GP-09	10/23/96	9.00	<0.061	<0.061	<0.061	<0.061	<0.061	<0.061	<0.061
GP-10	10/23/96	8.00	<0.060	<0.060	<0.060	<0.060	<0.060	<0.060	<0.060
MW-101	05/23/96	0.00	<0.00099	<0.00068	<0.00093	<0.00057	<0.0008	<0.0004	<0.001
MW-101	05/23/96	6.00	<0.0012	<0.00082	<0.0011	<0.00068	0.028	0.0072	<0.0012
MW-102	05/23/96	5.00	0.0022	0.0337	0.0691	0.349	<0.00097	<0.00049	0.253
MW-103	05/23/96	4.00	0.0124	0.0028	<0.001	0.0861	<0.0009	<0.00045	0.0596

Values represent total concentrations unless noted   < = Not detected at indicated reporting limit   --- = Not analyzed

[] = Greater than Action Level

For RCL 0998_SOILS

NYDEC-TAGM = Soil Clean-up Objective to protect ground water

TABLE 4

HISTORICAL SOIL ANALYTICAL RESULTS
FORMER MONARCH CHEMICAL FACILITY
GENEVA, NEW YORK

DELTA PROJECT NO. S096-015

SITE	DATE	DEPTH (ft)	cis-1,2-Dichloroethene (mg/kg)	MBAS Colorimetric (mg/kg)	Total organic carbon (mg/kg)
NYDEC-TAGM			0.300	99.99	
GP-01	10/22/96	4.00	---	---	1200
GP-01	10/22/96	9.00	---	---	9100
GP-02	10/22/96	1.00	<0.064	---	---
GP-02	10/22/96	8.00	---	<1.2	---
GP-02	10/22/96	9.00	<0.061	---	---
GP-02	10/23/96	14.00	<0.060	---	---
GP-03	10/23/96	3.00	---	<1.3	---
GP-03	10/23/96	4.00	<0.060	---	---
GP-04	10/22/96	2.00	<0.060	---	---
GP-04	10/22/96	9.00	<0.060	---	---
GP-05	10/23/96	2.00	<0.11	---	---
GP-05	10/23/96	3.00	---	<1.2	---
GP-06	10/23/96	2.00	<0.060	---	---
GP-06	10/23/96	3.00	---	<1.3	---
GP-06	10/23/96	9.00	<0.061	---	---
GP-08	10/23/96	2.00	<0.057	---	---
GP-08	10/23/96	8.00	---	<1.3	---
GP-08	10/23/96	9.00	<0.062	---	---
GP-09	10/23/96	2.00	<0.062	---	---
GP-09	10/23/96	3.00	---	<1.2	---
GP-09	10/23/96	9.00	<0.061	---	---
GP-10	10/23/96	8.00	<0.060	<1.2	---
MW-101	05/23/96	0.00	<0.00097	---	---
MW-101	05/23/96	6.00	0.0063	---	---
MW-102	05/23/96	5.00	0.211	---	---
MW-103	05/23/96	4.00	0.0076	---	---

Values represent total concentrations unless noted   < = Not detected at indicated reporting limit   --- = Not analyzed

For RCL 0998_SOILS

NYDEC-TAGM = Soil Clean-up Objective to protect ground water

TABLE 4

HISTORICAL SOIL ANALYTICAL RESULTS
FORMER MONARCH CHEMICAL FACILITY
GENEVA, NEW YORK

DELTA PROJECT NO. S096-015

SITE	DATE	DEPTH (ft)	Chloroform (mg/kg)	1,1,1-trichloro ethane (mg/kg)	1,1-Dichloro ethane (mg/kg)	Trichloroethene (mg/kg)	Ethylbenzene (mg/kg)	Toluene (mg/kg)	Tetrachloro ethene (mg/kg)
NYDEC-TAGM			0.30	0.760	0.200	0.700	5.500	1.500	1.400
MW-103	05/23/96	6.00	0.0053	<0.00077	<0.001	<0.00064	<0.0009	<0.00045	<0.0011
MW-104	05/23/96	0.00	<0.001	0.00095	<0.00095	<0.00058	<0.00081	<0.00041	0.0029
MW-104	05/23/96	4.00	<0.0011	<0.00079	<0.0011	<0.00066	<0.00093	<0.00046	<0.0012
MW-105	05/24/96	6.00	<0.0011	<0.00079	<0.0011	<0.00066	<0.00093	<0.00046	<0.0012

Values represent total concentrations unless noted   < = Not detected at indicated reporting limit   --- = Not analyzed

For RCL 0998_SOILS

NYDEC-TAGM = Soil Clean-up Objective to protect ground water

TABLE 4

HISTORICAL SOIL ANALYTICAL RESULTS
FORMER MONARCH CHEMICAL FACILITY
GENEVA, NEW YORK

DELTA PROJECT NO. S096-015

SITE	DATE	DEPTH (ft)	cis-1,2-Dichloroethene (mg/kg)	MBAS Colorimetric (mg/kg)	Total organic carbon (mg/kg)
NYDEC-TAGM			0.300	99.99	
MW-103	05/23/96	6.00	<0.0011	---	---
MW-104	05/23/96	0.00	<0.00098	---	---
MW-104	05/23/96	4.00	<0.0011	---	---
MW-105	05/24/96	6.00	<0.0011	---	---

Values represent total concentrations unless noted   < = Not detected at indicated reporting limit   --- = Not analyzed

For RCL 0998_SOILS   NYDEC-TAGM = Soil Clean-up Objective to protect ground water

TABLE 5

HISTORICAL GROUND WATER RESULTS
VOLATILE ORGANIC COMPOUNDS
FORMER MONARCH CHEMICAL FACILITY
GENEVA, NEW YORK
DELTA PROJECT NO. S096-015

Date: 12/11/98

SITE	DATE	Acetone (mg/l)	Chloroform (mg/l)	1,1,1-trichloro ethane (mg/l)	Chloromethane (mg/l)	Vinyl chloride (mg/l)	Methylene chloride (mg/l)	1,1-Dichloro ethane (mg/l)	Methyl ethyl ketone (mg/l)
DEC-GW-STD		0.050	0.007	0.005	NS	0.002	0.005	0.005	0.050
GP-02	10/23/96	[0.06]	<0.01	<0.01	<0.05	<0.01	<0.01	<0.01	<0.05
GP-04	10/23/96	[0.06]	<0.01	<0.01	<0.05	<0.01	<0.01	<0.01	<0.05
GP-06	10/24/96	[0.75]	<0.1	<0.1	<0.5	<0.1	<0.1	<0.1	<0.5
GP-08	10/23/96	[0.13]	0.003	<0.003	<0.005	<0.003	0.003	[0.005]	<0.005
GP-09	10/23/96	[0.56]	<0.02	<0.02	<0.1	<0.02	<0.02	<0.02	<0.1
MW-101	05/29/96	---	<0.00094	0.00074	<0.001	<0.0016	<0.00064	<0.00089	---
MW-101	10/22/96	<0.005	<0.003	<0.003	<0.005	<0.003	<0.003	<0.003	<0.005
MW-101	07/18/97	<0.01	<0.003	<0.003	<0.003	<0.002	<0.003	<0.003	<0.01
MW-101	02/18/98	<0.01	<0.003	<0.003	<0.003	<0.002	<0.003	<0.003	<0.01
MW-101	05/28/98	<0.01	<0.003	<0.003	0.007	<0.002	0.003	<0.003	<0.01
MW-101	07/16/98	<0.01	<0.003	<0.003	<0.003	<0.002	<0.003	<0.003	<0.01
MW-102	05/29/96	---	[0.0167]	[0.0063]	<0.001	[0.162]	[0.0062]	[0.0661]	---
MW-102	10/22/96	[0.31]	[0.012]	<0.01	<0.01	[0.13]	<0.01	[0.056]	0.031
MW-102	07/21/97	<0.01	<0.003	<0.003	<0.003	[0.011]	<0.003	[0.008]	<0.01
MW-102	02/18/98	[0.05]	<0.0060	[0.006]	<0.0060	[0.25]	<0.0060	[0.14]	<0.0200
MW-102	05/28/98	[0.05]	<0.015	[0.023]	<0.015	[0.24]	<0.015	[0.13]	<0.05
MW-102	07/16/98	[0.076]	[0.008]	[0.016]	<0.003	[0.26]	0.003	[0.13]	<0.01
MW-103	05/29/96	---	[0.0187]	[0.0074]	<0.001	[0.0058]	[0.0113]	[0.0141]	---
MW-103	10/22/96	[0.86]	[0.011]	<0.01	<0.01	<0.01	[0.011]	[0.011]	0.049
MW-103	02/18/98	[0.11]	0.005	<0.003	<0.003	[0.005]	[0.006]	[0.01]	<0.01
MW-103	05/28/98	[0.18]	<0.015	<0.015	<0.015	<0.01	<0.015	<0.015	<0.05
MW-103	07/16/98	[0.3]	<0.003	<0.003	<0.003	[0.004]	[0.006]	[0.011]	0.01
MW-104	05/29/96	---	[0.0231]	0.0012	<0.001	<0.0016	0.0027	<0.00089	---
MW-104	10/22/96	[0.05]	0.004	<0.003	<0.005	<0.003	<0.003	<0.003	0.011
MW-104	02/18/98	<0.01	<0.003	<0.003	<0.003	<0.002	<0.003	<0.003	<0.01
MW-105	05/29/96	---	<0.00094	0.0034	<0.001	<0.0016	<0.00064	0.0018	---

Values represent total concentrations unless noted < = Not detected at indicated reporting limit --- = Not analyzed
[] = Greater than Action Level

For RCL HIST_VOC NS = NO STANDARD

DEC-GW-STD = NY DEC GROUND WATER STANDARDS (1998)

TABLE 5

HISTORICAL GROUND WATER RESULTS
VOLATILE ORGANIC COMPOUNDS
FORMER MONARCH CHEMICAL FACILITY
GENEVA, NEW YORK
DELTA PROJECT NO. S096-015

SITE	DATE	1,1-Dichloro ethylene (mg/l)	1,1,2-Trichloro ethane (mg/l)	Trichloro ethylene (mg/l)	Methyl isobutyl ketone (MIBK) (mg/l)	Chlorobenzene (mg/l)	Tetrachloro ethylene (mg/l)	cis-1,2-Dichloro ethylene (mg/l)	trans-1,2-Di-chloroethylene (mg/l)
DEC-GW-STD		0.005	0.0006	0.005	0.050	0.005	0.005	0.010	0.005
GP-02	10/23/96	<0.01	<0.01	<0.01	[0.25]	<0.01	<0.01	<0.01	<0.01
GP-04	10/23/96	<0.01	<0.01	<0.01	[0.07]	<0.01	<0.01	<0.01	<0.01
GP-06	10/24/96	<0.1	<0.1	<0.1	<0.5	<0.1	<0.1	<0.1	<0.1
GP-08	10/23/96	<0.003	<0.003	<0.003	<0.005	<0.003	<0.003	<0.003	<0.003
GP-09	10/23/96	<0.02	<0.02	<0.02	<0.1	<0.02	<0.02	<0.02	<0.02
MW-101	05/29/96	<0.00097	<0.00059	<0.00054	---	<0.00067	[0.011]	0.002	<0.00092
MW-101	10/22/96	<0.003	<0.003	<0.003	<0.005	<0.003	0.004	[0.014]	<0.003
MW-101	07/18/97	<0.003	<0.003	<0.003	<0.01	<0.003	0.003	0.009	<0.003
MW-101	02/18/98	<0.003	<0.003	<0.003	<0.01	<0.003	[0.012]	<0.003	<0.003
MW-101	05/28/98	<0.003	<0.003	0.004	<0.01	<0.003	[0.011]	<0.003	<0.003
MW-101	07/16/98	<0.003	<0.003	[0.009]	<0.01	<0.003	[0.013]	0.005	<0.003
MW-102	05/29/96	[0.0091]	[0.0023]	[0.242]	---	0.0019	[0.11]	[0.283]	0.0021
MW-102	10/22/96	<0.01	<0.01	[0.069]	[0.057]	<0.01	<0.01	[0.26]	<0.01
MW-102	07/21/97	<0.003	<0.003	[0.016]	<0.01	<0.003	<0.003	[0.015]	<0.003
MW-102	02/18/98	<0.0060	<0.0060	[0.24]	<0.02	<0.0060	[0.051]	[0.21]	<0.0060
MW-102	05/28/98	<0.015	<0.015	[0.28]	<0.05	<0.015	[0.053]	[0.26]	<0.015
MW-102	07/16/98	[0.009]	[0.003]	[0.46]	<0.01	<0.003	[0.033]	[0.51]	[0.006]
MW-103	05/29/96	<0.00097	<0.00059	[0.0327]	---	[0.0062]	[0.0401]	[0.0119]	<0.00092
MW-103	10/22/96	<0.01	<0.01	<0.01	0.033	<0.01	<0.01	<0.01	<0.01
MW-103	02/18/98	<0.003	<0.003	[0.014]	<0.01	<0.003	[0.015]	[0.013]	<0.003
MW-103	05/28/98	<0.015	<0.015	<0.015	<0.05	<0.015	<0.015	<0.015	<0.015
MW-103	07/16/98	<0.003	<0.003	[0.015]	<0.01	<0.003	[0.007]	0.009	<0.003
MW-104	05/29/96	<0.00097	<0.00059	<0.00054	---	<0.00067	<0.00095	<0.00092	<0.00092
MW-104	10/22/96	<0.003	<0.003	<0.003	[0.057]	<0.003	<0.003	<0.003	<0.003
MW-104	02/18/98	<0.003	<0.003	<0.003	<0.01	<0.003	<0.003	<0.003	<0.003
MW-105	05/29/96	<0.00097	<0.00059	<0.00054	---	<0.00067	0.0018	<0.00092	<0.00092

Values represent total concentrations unless noted < = Not detected at indicated reporting limit --- = Not analyzed
[] = Greater than Action Level
For RCL HIST_VOC NS = NO STANDARD

DEC-GW-STD = NY DEC GROUND WATER STANDARDS (1998)

TABLE 5

HISTORICAL GROUND WATER RESULTS
VOLATILE ORGANIC COMPOUNDS
FORMER MONARCH CHEMICAL FACILITY
GENEVA, NEW YORK
DELTA PROJECT NO. S096-015

Date: 12/11/98

SITE	DATE	Acetone (mg/l)	Chloroform (mg/l)	1,1,1-trichloro ethane (mg/l)	Chloromethane (mg/l)	Vinyl chloride (mg/l)	Methylene chloride (mg/l)	1,1-Dichloro ethane (mg/l)	Methyl ethyl ketone (mg/l)
DEC-GW-STD		0.050	0.007	0.005	NS	0.002	0.005	0.005	0.050
MW-105	10/22/96	<0.005	<0.003	[0.006]	<0.005	<0.003	<0.003	<0.003	<0.005
MW-105	02/18/98	<0.01	<0.003	<0.003	<0.003	<0.002	<0.003	<0.003	<0.01
MW-106	07/18/97	<0.01	<0.003	<0.003	<0.003	<0.002	<0.003	<0.003	<0.01
MW-106	02/18/98	<0.01	<0.003	<0.003	<0.003	<0.002	<0.003	<0.003	<0.01
MW-107	07/18/97	<0.01	<0.003	<0.003	<0.003	<0.002	<0.003	<0.003	<0.01
MW-107	02/18/98	<0.01	<0.003	<0.003	<0.003	<0.002	<0.003	<0.003	<0.01
MW-108	07/21/97	<0.01	<0.003	<0.003	0.004	<0.002	<0.003	<0.003	<0.01
MW-108	02/18/98	<0.01	<0.003	<0.003	<0.003	<0.002	<0.003	<0.003	<0.01
MW-109	02/18/98	<0.1	<0.03	[0.4]	<0.03	[0.05]	<0.03	[0.081]	<0.1
MW-109	05/28/98	[0.056]	<0.015	[0.23]	<0.015	[0.025]	<0.015	[0.056]	[0.074]
MW-109	07/16/98	<0.01	[0.009]	[0.22]	<0.003	[0.038]	<0.003	[0.061]	<0.01
MW-110	02/18/98	<0.01	<0.003	<0.003	<0.003	<0.002	<0.003	<0.003	<0.01
MW-111	02/18/98	<0.01	<0.003	<0.003	<0.003	<0.002	<0.003	[0.033]	<0.01
MW-201	07/18/97	<0.01	<0.003	<0.003	<0.003	<0.002	<0.003	<0.003	<0.01
MW-201	02/18/98	<0.01	<0.003	<0.003	<0.003	<0.002	<0.003	<0.003	<0.01
MW-202	07/21/97	<0.01	<0.003	<0.003	<0.003	<0.002	<0.003	<0.003	<0.01
MW-202	02/18/98	<0.01	<0.003	<0.003	<0.003	<0.002	<0.003	<0.003	<0.01
MW-203	07/21/97	0.011	<0.003	<0.003	<0.003	<0.002	<0.003	<0.003	<0.01
MW-203	02/18/98	0.012	<0.003	<0.003	<0.003	<0.002	<0.003	<0.003	<0.01

Values represent total concentrations unless noted < = Not detected at indicated reporting limit --- = Not analyzed
[] = Greater than Action Level

For RCL HIST_VOC NS = NO STANDARD

DEC-GW-STD = NY DEC GROUND WATER STANDARDS (1998)

TABLE 5

HISTORICAL GROUND WATER RESULTS
VOLATILE ORGANIC COMPOUNDS
FORMER MONARCH CHEMICAL FACILITY
GENEVA, NEW YORK
DELTA PROJECT NO. S096-015

SITE	DATE	1,1-Dichloro ethylene (mg/l)	1,1,2-Trichloro ethane (mg/l)	Trichloro ethylene (mg/l)	Methyl isobutyl ketone (MIBK) (mg/l)	Chlorobenzene (mg/l)	Tetrachloro ethylene (mg/l)	cis-1,2-Dichloro ethylene (mg/l)	trans-1,2-Di-chloroethylene (mg/l)
DEC-GW-STD		0.005	0.0006	0.005	0.050	0.005	0.005	0.010	0.005
MW-105	10/22/96	<0.003	<0.003	<0.003	0.013	<0.003	<0.003	<0.003	<0.003
MW-105	02/18/98	<0.003	<0.003	<0.003	<0.01	<0.003	<0.003	<0.003	<0.003
MW-106	07/18/97	<0.003	<0.003	<0.003	<0.01	<0.003	<0.003	<0.003	<0.003
MW-106	02/18/98	<0.003	<0.003	<0.003	<0.01	<0.003	<0.003	<0.003	<0.003
MW-107	07/18/97	<0.003	<0.003	<0.003	<0.01	<0.003	[0.007]	<0.003	<0.003
MW-107	02/18/98	<0.003	<0.003	<0.003	<0.01	<0.003	[0.006]	<0.003	<0.003
MW-108	07/21/97	<0.003	<0.003	<0.003	<0.01	<0.003	<0.003	<0.003	<0.003
MW-108	02/18/98	<0.003	<0.003	<0.003	<0.01	<0.003	<0.003	<0.003	<0.003
MW-109	02/18/98	[0.064]	<0.03	[0.28]	<0.1	<0.03	[0.52]	[0.22]	<0.03
MW-109	05/28/98	[0.047]	<0.015	[0.21]	<0.05	<0.015	[0.31]	[0.15]	<0.015
MW-109	07/16/98	[0.039]	<0.003	[0.23]	<0.01	<0.003	[0.35]	[0.2]	<0.003
MW-110	02/18/98	<0.003	<0.003	<0.003	<0.01	<0.003	<0.003	<0.003	<0.003
MW-111	02/18/98	[0.016]	<0.003	0.004	<0.01	<0.003	<0.003	0.006	<0.003
MW-201	07/18/97	<0.003	<0.003	<0.003	<0.01	<0.003	<0.003	<0.003	<0.003
MW-201	02/18/98	<0.003	<0.003	<0.003	<0.01	<0.003	0.004	<0.003	<0.003
MW-202	07/21/97	<0.003	<0.003	<0.003	<0.01	<0.003	<0.003	<0.003	<0.003
MW-202	02/18/98	<0.003	<0.003	<0.003	<0.01	<0.003	<0.003	<0.003	<0.003
MW-203	07/21/97	<0.003	<0.003	<0.003	<0.01	<0.003	<0.003	<0.003	<0.003
MW-203	02/18/98	<0.003	<0.003	<0.003	<0.01	<0.003	<0.003	<0.003	<0.003

Values represent total concentrations unless noted < = Not detected at indicated reporting limit --- = Not analyzed
[] = Greater than Action Level

For RCL HIST_VOC NS = NO STANDARD

DEC-GW-STD = NY DEC GROUND WATER STANDARDS (1998)

TABLE 6

HISTORICAL GROUND WATER RESULTS
FIELD INDICATORS/BIO PARAMETERS
FORMER MONARCH CHEMICAL FACILITY
GENEVA, NEW YORK
DELTA PROJECT NO. S096-015

SITE	DATE	Methane (mg/l)	Ethane (mg/l)	Ethylene (mg/l)	Alkalinity (as CaCO3) (mg/l)	Ammonia (as N) (mg/l)	Lactate (mg/l)	Sulfate (mg/l)	Chloride (mg/l)
GP-02	10/23/96	0.014746	0.000628	0.000282	1700#	5.5	<1	160	89
GP-04	10/23/96	0.024236	0.000047	0.000159	3300#	7.7	<1	250	400
GP-06	10/24/96	0.009361	0.000249	0.000684	9200	51	320	1500	1100
GP-08	10/23/96	0.063045	0.00011	0.000155	2300#	8.3	18	310	630
GP-09	10/23/96	---	---	---	2400#	17	49	9	270
GP-09	10/25/96	0.042979	0.000111	0.00008	---	---	---	---	---
MW-101	05/29/96	---	---	---	---	---	---	---	---
MW-101	10/22/96	>0.3	<0.000005	0.000019	450#	1.9	<1	95	10
MW-101	07/18/97	---	---	---	384	---	---	---	---
MW-101	02/18/98	---	---	---	---	---	---	---	---
MW-101	05/28/98	<1	<1	<1	300	0.7	---	38	2
MW-102	05/29/96	---	---	---	---	---	---	---	---
MW-102	10/22/96	0.268626	0.000766	0.053322	2500#	1.7	<1	280	430
MW-102	07/21/97	---	---	---	1020	---	---	---	---
MW-102	02/18/98	---	---	---	---	---	---	---	---
MW-102	05/28/98	<1	<1	<1	2000	1.0	---	210	350
MW-103	05/29/96	---	---	---	---	---	---	---	---
MW-103	10/22/96	0.134313	0.00031	0.005095	3000#	8.3	11	200	350
MW-103	02/18/98	---	---	---	---	---	---	---	---
MW-103	05/28/98	<1	<1	<1	2400	7.8	---	200	210
MW-104	05/29/96	---	---	---	---	---	---	---	---
MW-104	10/22/96	0.002203	0.000013	0.000055	330#	0.8	<1	63	10
MW-104	02/18/98	---	---	---	---	---	---	---	---
MW-105	05/29/96	---	---	---	---	---	---	---	---
MW-105	10/22/96	0.058933	0.000019	0.000018	560#	<0.5	<1	150	290
MW-105	02/18/98	---	---	---	---	---	---	---	---
MW-106	07/18/97	---	---	---	370	---	---	---	---

Values represent total concentrations unless noted <=Not detected at indicated reporting limit ---=Not analyzed
#=Constituent in more than one test method, highest result reported.

For RCL AQUA-COMPO

TABLE 6

HISTORICAL GROUND WATER RESULTS
FIELD INDICATORS/BIO PARAMETERS
FORMER MONARCH CHEMICAL FACILITY
GENEVA, NEW YORK
DELTA PROJECT NO. S096-015

SITE	DATE	Soluble Iron (mg/l)	Oxidation-Reduction Potential (mV)	BOD (mg/l)	COD (mg/l)	TOC (mg/l)	Specific Conductivity (umho)	MBAS Colorimetric (mg/l)	Nitrate plus Nitrite (as N) (mg/l)
GP-02	10/23/96	1.0	-147	71	320	91	3390	4.5	2.5
GP-04	10/23/96	1.0	-134	52	74	140	3120	4.0	0.3
GP-06	10/24/96	0.4	-141	1400	6800	1600	3190	3.3	12
GP-08	10/23/96	0.3	-200	42	240	90	4420	0.96	<0.2
GP-09	10/23/96	2.0	-180	160	470	190	3460	5.0	<0.2
GP-09	10/25/96	---	---	---	---	---	---	---	---
MW-101	05/29/96	---	---	---	---	---	---	---	---
MW-101	10/22/96	10	-67	<12	95	26	870	0.17	<0.2
MW-101	07/18/97	1.8	0.12	---	---	---	784	<0.05	---
MW-101	02/18/98	---	9.5	---	---	---	620	0.09	---
MW-101	05/28/98	---	---	<8	<20	7	---	---	---
MW-102	05/29/96	---	---	---	---	---	---	---	---
MW-102	10/22/96	0.3	-170	40	410	160	4010	5.0	<0.2
MW-102	07/21/97	3.2	230	---	---	---	480	0.62	---
MW-102	02/18/98	---	-40.2	---	---	---	4200	0.28	---
MW-102	05/28/98	---	---	<24	210	3	---	---	---
MW-103	05/29/96	---	---	---	---	---	---	---	---
MW-103	10/22/96	1.0	-276	170	600	280	5030	5.0	<0.2
MW-103	02/18/98	---	-118.6	---	---	---	3000	0.60	---
MW-103	05/28/98	---	---	140	500	220	---	---	---
MW-104	05/29/96	---	---	---	---	---	---	---	---
MW-104	10/22/96	0.2	109	<8	46	11	625	4.4	0.4
MW-104	02/18/98	---	-83.4	---	---	---	400	<0.05	---
MW-105	05/29/96	---	---	---	---	---	---	---	---
MW-105	10/22/96	0.1	160	<4	<20	5	1530	<0.05	<0.2
MW-105	02/18/98	---	12.9	---	---	---	1200	<0.05	---
MW-106	07/18/97	<0.1	107.0	---	---	---	728	<0.05	---

Values represent total concentrations unless noted < =Not detected at indicated reporting limit --- =Not analyzed

For RCL AQUA-COMPO

TABLE 6

HISTORICAL GROUND WATER RESULTS
FIELD INDICATORS/BIO PARAMETERS
FORMER MONARCH CHEMICAL FACILITY
GENEVA, NEW YORK
DELTA PROJECT NO. S096-015

SITE	DATE	Surfactants (mg/l)	Temp era ture (C)	Chlorine Residual, Total (mg/l)	Chlorine Residual, Free (mg/l)	Oxygen, dissolved (mg/l)	pH	TDS (mg/l)	Sodium (mg/l)
GP-02	10/23/96	---	15.1	<0.1#	<0.1#	0.1	8.71	2100	920
GP-04	10/23/96	---	15.1	0.04#	0.02#	0.1	8.52	4600	1600
GP-06	10/24/96	---	15.1	<0.1#	<0.1#	0.1	8.64	19000	5700
GP-08	10/23/96	---	15.0	0.02#	<0.1#	0.1	8.37	4200	1200
GP-09	10/23/96	---	15.0	0.04#	0.03#	0.1	8.62	5300	1000
GP-09	10/25/96	---	---	---	---	---	---	---	---
MW-101	05/29/96	7.2	---	---	---	---	---	---	---
MW-101	10/22/96	---	13.9	0.04#	0.05#	0.2	6.68	670	29
MW-101	07/18/97	---	15.9	<0.1	---	6.26	6.96	---	---
MW-101	02/18/98	---	8.0	---	---	5.6	6.74	---	---
MW-101	05/28/98	---	---	---	---	---	---	330	17
MW-102	05/29/96	20.1	---	---	---	---	---	---	---
MW-102	10/22/96	---	13.8	0.03#	0.02#	0.1	7.08	4200	1300
MW-102	07/21/97	---	14.0#	<0.1	---	3.86	8.2	---	---
MW-102	02/18/98	---	9.6	---	---	5.8	7.66	---	---
MW-102	05/28/98	---	---	---	---	---	---	3000	910
MW-103	05/29/96	.83	---	---	---	---	---	---	---
MW-103	10/22/96	---	15.3	0.02#	<0.1#	0.1	8.96	4800	1400
MW-103	02/18/98	---	9.7	---	---	4.0	8.85	---	---
MW-103	05/28/98	---	---	---	---	---	---	3800	1200
MW-104	05/29/96	525	---	---	---	---	---	---	---
MW-104	10/22/96	---	13.1	0.05#	<0.1#	0.8	7.24	580	1500
MW-104	02/18/98	---	9.3	---	---	5.0	8.20	---	---
MW-105	05/29/96	5.1	---	---	---	---	---	---	---
MW-105	10/22/96	---	15.0	0.03#	<0.1#	0.9	6.5	1300	240
MW-105	02/18/98	---	10.1	---	---	3.4	6.48	---	---
MW-106	07/18/97	---	16.5	<0.1	---	2.75	7.03	---	---

Values represent total concentrations unless noted < =Not detected at indicated reporting limit ---=Not analyzed
#=Constituent in more than one test method, highest result reported.

For RCL AQUA-COMPO

TABLE 6

HISTORICAL GROUND WATER RESULTS
FIELD INDICATORS/BIO PARAMETERS
FORMER MONARCH CHEMICAL FACILITY
GENEVA, NEW YORK
DELTA PROJECT NO. S096-015

Date: 12/10/98

SITE	DATE	Methane (mg/l)	Ethane (mg/l)	Ethylene (mg/l)	Alkalinity (as CaCO3) (mg/l)	Ammonia (as N) (mg/l)	Lactate (mg/l)	Sulfate (mg/l)	Chloride (mg/l)
MW-106	02/18/98	---	---	---	---	---	---	---	---
MW-107	07/18/97	---	---	---	2523	---	---	---	---
MW-107	02/18/98	---	---	---	---	---	---	---	---
MW-108	07/21/97	---	---	---	160	---	---	---	---
MW-108	02/18/98	---	---	---	---	---	---	---	---
MW-109	02/18/98	---	---	---	---	---	---	---	---
MW-109	05/28/98	<1	<1	<1	960	<0.5	---	370	210
MW-111	02/18/98	---	---	---	---	---	---	---	---
MW-201	07/18/97	---	---	---	387	---	---	---	---
MW-201	02/18/98	---	---	---	---	---	---	---	---
MW-202	07/21/97	---	---	---	192	---	---	---	---
MW-202	02/18/98	---	---	---	---	---	---	---	---
MW-203	07/21/97	---	---	---	---	---	---	---	---
MW-203	02/18/98	---	---	---	---	---	---	---	---

Values represent total concentrations unless noted   < =Not detected at indicated reporting limit   --- =Not analyzed

For RCL AQUA-COMPO

TABLE 6

HISTORICAL GROUND WATER RESULTS
FIELD INDICATORS/BIO PARAMETERS
FORMER MONARCH CHEMICAL FACILITY
GENEVA, NEW YORK
DELTA PROJECT NO. S096-015

SITE	DATE	Soluble Iron (mg/l)	Oxidation-Reduction Potential (mV)	BOD (mg/l)	COD (mg/l)	TOC (mg/l)	Specific Conductivity (umho)	MBAS Colorimetric (mg/l)	Nitrate plus Nitrite (as N) (mg/l)
MW-106	02/18/98	---	2.2	---	---	---	860	<0.05	---
MW-107	07/18/97	0.2	118	---	---	---	335	<0.05	---
MW-107	02/18/98	---	2.2	---	---	---	440	<0.05	---
MW-108	07/21/97	<0.1	410	---	---	---	520	<0.05	---
MW-108	02/18/98	---	-4.2	---	---	---	960	<0.05	---
MW-109	02/18/98	---	8.2	---	---	---	2200	0.62	---
MW-109	05/28/98	---	---	<8	53	20	---	---	---
MW-111	02/18/98	---	-17.9	---	---	---	900	<0.05	---
MW-201	07/18/97	1.4	30	---	---	---	953	0.12	---
MW-201	02/18/98	---	-7.2	---	---	---	1000	<0.05	---
MW-202	07/21/97	0.3	125	---	---	---	620	<0.05	---
MW-202	02/18/98	---	-41.9	---	---	---	800	<0.05	---
MW-203	07/21/97	---	---	---	---	---	---	<0.05	---
MW-203	02/18/98	---	-68.8	---	---	---	760	<0.05	---

Values represent total concentrations unless noted < =Not detected at indicated reporting limit ---=Not analyzed

For RCL AQUA-COMPO

TABLE 6

HISTORICAL GROUND WATER RESULTS
FIELD INDICATORS/BIO PARAMETERS
FORMER MONARCH CHEMICAL FACILITY
GENEVA, NEW YORK
DELTA PROJECT NO. S096-015

SITE	DATE	Surfactants (mg/l)	Temp era ture (C)	Chlorine Residual, Total (mg/l)	Chlorine Residual, Free (mg/l)	Oxygen, dissolved (mg/l)	pH	TDS (mg/l)	Sodium (mg/l)
MW-106	02/18/98	---	8.5	---	---	2.8	6.65	---	---
MW-107	07/18/97	---	13.6	<0.1	---	8.25	6.37	---	---
MW-107	02/18/98	---	8.2	---	---	6.6	6.87	---	---
MW-108	07/21/97	---	13.0#	<0.1	---	6.59	7.3	---	---
MW-108	02/18/98	---	6.2	---	---	5.8	6.77	---	---
MW-109	02/18/98	---	8.8	---	---	4.0	6.72	---	---
MW-109	05/28/98	---	---	---	---	---	---	1700	420
MW-111	02/18/98	---	7.7	---	---	2.2	7.04	---	---
MW-201	07/18/97	---	16.1	<0.1	---	1.30	6.75	---	---
MW-201	02/18/98	---	10.7	---	---	5.2	7.05	---	---
MW-202	07/21/97	---	15.0#	<0.1	---	3.72	8.00	---	---
MW-202	02/18/98	---	11.7	---	---	6.8	7.7	---	---
MW-203	07/21/97	---	---	---	---	---	---	---	---
MW-203	02/18/98	---	8.3	---	---	5.1	7.8	---	---

Values represent total concentrations unless noted   < = Not detected at indicated reporting limit   --- = Not analyzed
= Constituent in more than one test method, highest result reported.

For RCL AQUA-COMPO

TABLE 7

SURFACE WATER ANALYTICAL RESULTS
VOLATILE ORGANIC COMPOUNDS
FORMER MONARCH CHEMICAL FACILITY
GENEVA, NEW YORK
DELTA PROJECT NO. S096-015

Date: 12/10/98

SITE	DATE	Chloromethane (mg/l)	Bromomethane (mg/l)	Vinyl chloride (mg/l)	Chloroethane (mg/l)	Methylene chloride (mg/l)	Acetone (mg/l)	Carbon disulfide (mg/l)	1,1-Dichloro ethene (mg/l)
SW-1	02/18/98	<0.003	<0.003	<0.002	<0.003	<0.003	<0.01	<0.003	<0.003
SW-1	05/28/98	<0.003	<0.003	<0.002	<0.003	<0.003	<0.01	<0.003	<0.003
SW-1	07/16/98	<0.003	<0.003	<0.002	<0.003	<0.003	<0.01	<0.003	<0.003
SW-2	02/18/98	<0.003	<0.003	<0.002	<0.003	<0.003	<0.01	<0.003	<0.003
SW-2	05/28/98	<0.003	<0.003	<0.002	<0.003	<0.003	<0.01	<0.003	<0.003
SW-2	07/16/98	<0.003	<0.003	<0.002	<0.003	<0.003	<0.01	<0.003	<0.003
SW-3	02/18/98	<0.003	<0.003	<0.002	<0.003	<0.003	<0.01	<0.003	<0.003
SW-3	05/28/98	<0.003	<0.003	<0.002	<0.003	0.003	<0.01	<0.003	<0.003
SW-3	07/16/98	<0.003	<0.003	<0.002	<0.003	<0.003	<0.01	<0.003	<0.003

Values represent total concentrations unless noted < = Not detected at indicated reporting limit --- = Not analyzed

For RCL UPST-8260

TABLE 7

SURFACE WATER ANALYTICAL RESULTS
VOLATILE ORGANIC COMPOUNDS
FORMER MONARCH CHEMICAL FACILITY
GENEVA, NEW YORK
DELTA PROJECT NO. S096-015

SITE	DATE	1,1-Dichloro ethane (mg/l)	trans-1,2-Dichloroethene (mg/l)	cis-1,2-Dichloroethene (mg/l)	Chloroform (mg/l)	1,2-Dichloro ethane (mg/l)	2-Butanone (mg/l)	1,1,1-trichloro ethane (mg/l)	Carbon tetrachloride (mg/l)
SW-1	02/18/98	<0.003	<0.003	<0.003	<0.003	<0.003	<0.01	<0.003	<0.003
SW-1	05/28/98	<0.003	<0.003	<0.003	<0.003	<0.003	<0.01	<0.003	<0.003
SW-1	07/16/98	<0.003	<0.003	<0.003	<0.003	<0.003	<0.01	<0.003	<0.003
SW-2	02/18/98	<0.003	<0.003	<0.003	<0.003	<0.003	<0.01	<0.003	<0.003
SW-2	05/28/98	0.006	<0.003	0.005	<0.003	<0.003	<0.01	<0.003	<0.003
SW-2	07/16/98	0.009	<0.003	0.005	<0.003	<0.003	<0.01	<0.003	<0.003
SW-3	02/18/98	<0.003	<0.003	<0.003	<0.003	<0.003	<0.01	<0.003	<0.003
SW-3	05/28/98	0.006	<0.003	0.004	<0.003	<0.003	<0.01	<0.003	<0.003
SW-3	07/16/98	0.008	<0.003	0.005	<0.003	<0.003	<0.01	<0.003	<0.003

Values represent total concentrations unless noted   < = Not detected at indicated reporting limit   --- = Not analyzed

For RCL UPST-8260

TABLE 7

SURFACE WATER ANALYTICAL RESULTS
VOLATILE ORGANIC COMPOUNDS
FORMER MONARCH CHEMICAL FACILITY
GENEVA, NEW YORK
DELTA PROJECT NO. S096-015

SITE	DATE	Bromodichloro methane (mg/l)	1,2-Dichloro propane (mg/l)	cis-1,3-Dichloropropene (mg/l)	Trichloroethene (mg/l)	Dibromochloro methane (mg/l)	1,1,2-Trichloro ethane (mg/l)	Benzene (mg/l)	Trans-1,3-Dichloropropene (mg/l)
SW-1	02/18/98	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
SW-1	05/28/98	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
SW-1	07/16/98	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
SW-2	02/18/98	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
SW-2	05/28/98	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
SW-2	07/16/98	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
SW-3	02/18/98	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
SW-3	05/28/98	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
SW-3	07/16/98	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003

Values represent total concentrations unless noted   < = Not detected at indicated reporting limit   --- = Not analyzed

For RCL UPST-8260

TABLE 7

SURFACE WATER ANALYTICAL RESULTS
VOLATILE ORGANIC COMPOUNDS
FORMER MONARCH CHEMICAL FACILITY
GENEVA, NEW YORK
DELTA PROJECT NO. S096-015

SITE	DATE	Bromoform (mg/l)	4-Methyl-2-pentanone (mg/l)	2-Hexanone (mg/l)	Tetrachloro ethene (mg/l)	1,1,2,2-Tetra chloroethane (mg/l)	Toluene (mg/l)	Chlorobenzene (mg/l)	Ethylbenzene (mg/l)
SW-1	02/18/98	<0.003	<0.01	<0.01	<0.003	<0.003	<0.003	<0.003	<0.003
SW-1	05/28/98	<0.003	<0.01	<0.01	<0.003	<0.003	<0.003	<0.003	<0.003
SW-1	07/16/98	<0.003	<0.01	<0.01	<0.003	<0.003	<0.003	<0.003	<0.003
SW-2	02/18/98	<0.003	<0.01	<0.01	<0.003	<0.003	<0.003	<0.003	<0.003
SW-2	05/28/98	<0.003	<0.01	<0.01	<0.003	<0.003	<0.003	<0.003	<0.003
SW-2	07/16/98	<0.003	<0.01	<0.01	<0.003	<0.003	<0.003	<0.003	<0.003
SW-3	02/18/98	<0.003	<0.01	<0.01	<0.003	<0.003	<0.003	<0.003	<0.003
SW-3	05/28/98	<0.003	<0.01	<0.01	<0.003	<0.003	<0.003	<0.003	<0.003
SW-3	07/16/98	<0.003	<0.01	<0.01	<0.003	<0.003	<0.003	<0.003	<0.003

Values represent total concentrations unless noted < = Not detected at indicated reporting limit --- = Not analyzed

For RCL UPST-8260

TABLE 7

Date: 12/10/98

SURFACE WATER ANALYTICAL RESULTS
VOLATILE ORGANIC COMPOUNDS
FORMER MONARCH CHEMICAL FACILITY
GENEVA, NEW YORK
DELTA PROJECT NO. S096-015

SITE	DATE	Styrene (mg/l)	M/P-xylenes (mg/l)	o-Xylene (mg/l)	MBAS Colorimetric (mg/l)
SW-1	02/18/98	<0.003	<0.003	<0.003	<0.05
SW-1	05/28/98	<0.003	<0.003	<0.003	---
SW-1	07/16/98	<0.003	<0.003	<0.003	---
SW-2	02/18/98	<0.003	<0.003	<0.003	<0.05
SW-2	05/28/98	<0.003	<0.003	<0.003	---
SW-2	07/16/98	<0.003	<0.003	<0.003	---
SW-3	02/18/98	<0.003	<0.003	<0.003	<0.05
SW-3	05/28/98	<0.003	<0.003	<0.003	---
SW-3	07/16/98	<0.003	<0.003	<0.003	---

Values represent total concentrations unless noted <=Not detected at indicated reporting limit ---=Not analyzed

For RCL UPST-8260

TABLE 7

SURFACE WATER ANALYTICAL RESULTS
FIELD INDICATOR PARAMETERS
FORMER MONARCH CHEMICAL FACILITY
GENEVA, NEW YORK
DELTA PROJECT NO. S096-015

SITE	DATE	pH	Conductivity (umho)	Temperature (C)	Oxygen, dissolved (mg/l)
SW-1	02/18/98	7.23	300	3.4	8.8
SW-2	02/18/98	7.22	300	3.3	8.6
SW-3	02/18/98	7.12	320	3.6	9.0

Values represent total concentrations unless noted < =Not detected at indicated reporting limit ---=Not analyzed

For RCL FIELDPARAM

TABLE 8
COMPARISON OF OBSERVED AND LITERATURE ATTENUATION RATES
Former Monarch Chemical Facility

Compound	Range of Site Attenuation Rates (day^{-1})	Attenuation Rates from Literature (day^{-1})	Literature Reference
PCE	>7.3E-3	2.04E-2 to 3.01E-3	Barbee (1994)
		1.2E-3	Buscheck and O'Reilly (1996)
		1.9E-3	Harkness *et al.* (1998)
		1.4E-2	Mechaber *et al.* (1998)
TCE	2.8E-3 to 9.6E-3	2.10E-2 to 3.01E-3	Barbee (1994)
		1.2E-2 to 2.1E-2	Barrio-Lage (1987)
		1.4E-3	Buscheck and O'Reilly (1996)
		2.0E-2 to 6.4E-3	Gorder *et al.* (1996)
		1.1E-3 to 1.9E-3	Harkness *et al.* (1998)
		1E-2	Holder *et al.* (1998)
		1.6E-2	Mechaber *et al.* (1998)
		1.5E-3	Wiedemeier *et al.* (1996)
cis-1,2-DCE	2.7E-3 to 9.0E-3	7.88E-3 to 2.04E-3	Barbee (1994)
		1.1E-3 to 1.9E-3	Harkness *et al.* (1998)
		1E-2	Holder *et al.* (1998)
		5.3E-2 to 9.9E-3	Mahoney *et al.* (1996)
		3.17E-3	Mechaber *et al.* (1998)
		5.2E-2	Wiedemeier *et al.* (1996)
trans-1,2-DCE	>0.0014	1.31E-2 to 4.72E-3	Barbee (1994)
		1E-2	Holder *et al.* (1998)
		5.3E-2 to 9.9E-3	Mahoney *et al.* (1996)
VC	>3.4E-3 to >9.8E-3	<1.16E-2	Barbee (1994)
		6.8E-4	Harkness *et al.* (1998)
		5.0E-2 to 2.2E-2	Mahoney *et al.* (1996)
		6.31E-4	Mechaber *et al.* (1998)
		1.3E-3	Wiedemeier *et al.* (1996)
1,1,1-TCA	>3.3E-3 to >6.2E-3	4.33E-2 to 3.01E-3	Barbee (1994)
1,1-DCA	<0.0029	<1.16E-2	Barbee (1994)
		2.5E-4	Ravi *et al.* (1998)

TABLE 9
PROPOSED GROUND WATER AND SURFACE WATER MONITORING PROGRAM
FORMER MONARCH CHEMICAL FACILITY
Geneva, NY

LOCATION	ANALYTICAL PROTOCOL & FREQUENCY			
	WL	WQ	Field	BioInd
MW-101	Triannually	Annually	Annually	*Once*
MW-102	Triannually	Triannually	Annually	*Once*
MW-103	Triannually	Annually	Annually	*Once*
MW-104	Triannually	Annually	Annually	
MW-105	Triannually		Annually	*Once*
MW-106	Triannually			*Once*
MW-107	Triannually			*Once*
MW-108	Triannually	Annually	Annually	*Once*
MW-109	Triannually	Triannually	Annually	
MW-110	Triannually	Annually	Annually	
MW-111	Triannually	Triannually	Annually	*Once*
MW-112	Triannually	Triannually	Annually	*Once*
MW-113	Triannually	Triannually	Annually	*Once*
MW-201	Triannually	Triannually	Annually	*Once*
MW-202	Triannually	Triannually	Annually	*Once*
MW-203	Triannually	Triannually	Annually	
Stream A	Triannually	Triannually		
Stream B	Triannually	Triannually		
Stream C	Triannually	Triannually		

WL: Water level monitoring

WQ: Volatile Organic Compounds (8240) and Methyl Blue Active Substances

Field: Field Bioindicator Parameters (pH, dissolved oxygen, specific conductance, temperature, ORP)

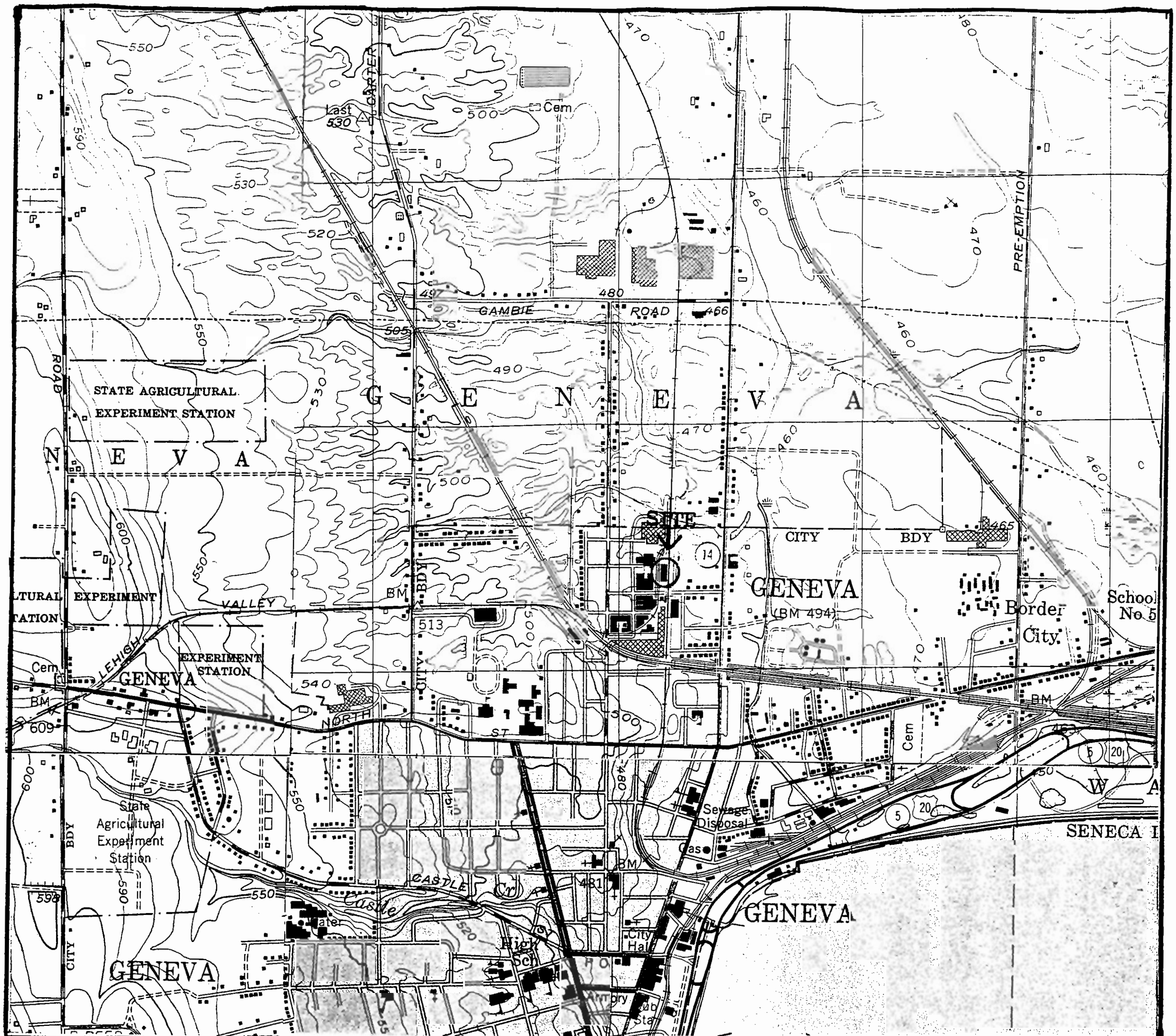
BioInd: Laboratory Bioindicator Parameters (alkalinity, nitrate/nitrite, ammonia, sulfate, sulfide, sodium chlorine, chloride, iron, TDS, COD, BOD5

A blank space indicates that additional analysis is not proposed.

Triannual sampling will be done in March, July, and October.

Annual field and "once" bioindicator parameters will be obtained during the March sampling.

FIGURES



SCALE 1:24000

1 0 1 MILE

0 1000 2000 3000 4000 5000 6000 7000

CONTOUR INTERVAL 10 FT

GENEVA NORTH

N4254.5-W7652.5/7.5

AMS 5669 IV NW-SERIES V821

1953

PHOTOREVISED 1978

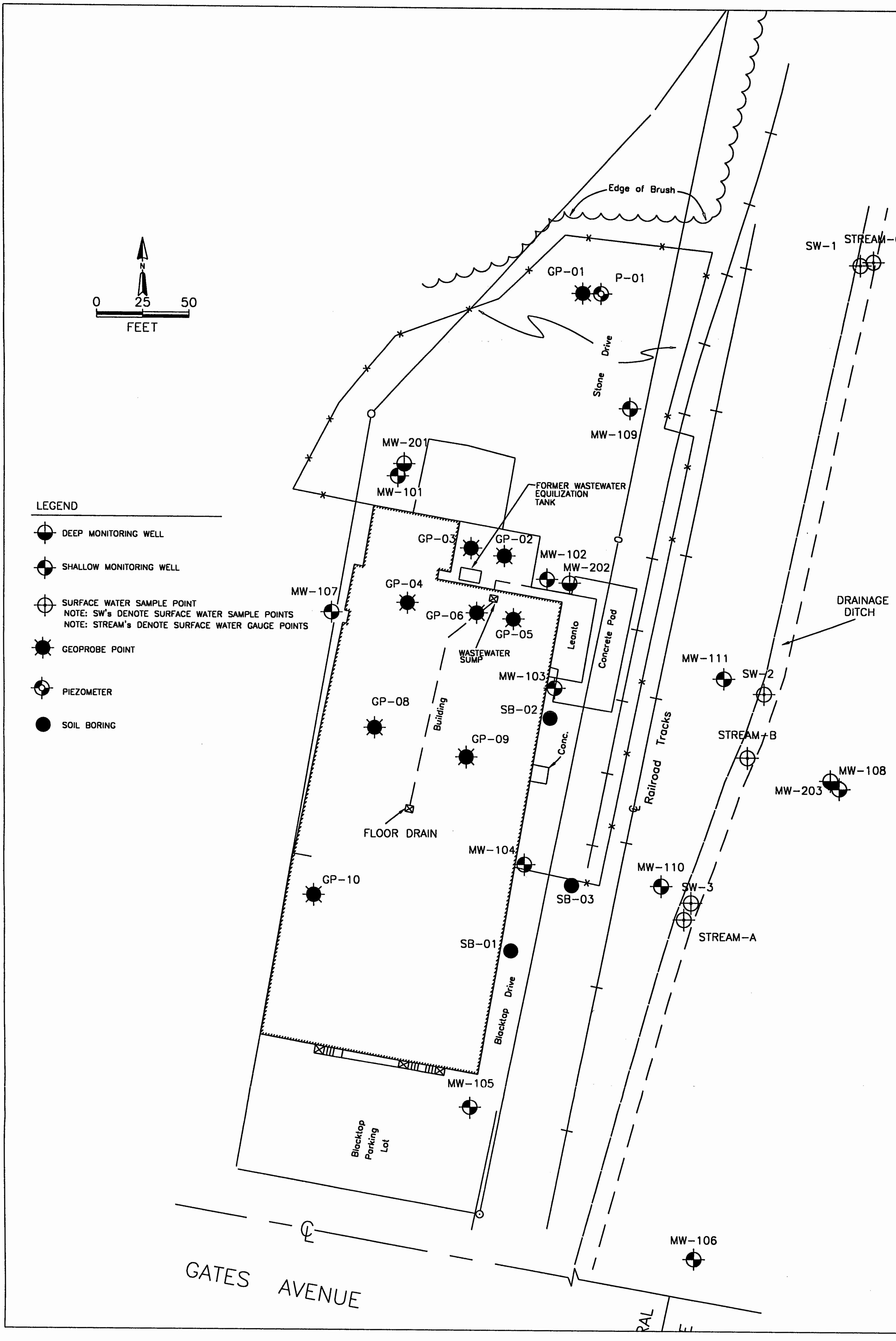
MN GN

10.5 ° 187 MILS

1°19 23 MILS

Delta
Environmental Consultants, Inc.
Pittsburgh, Pennsylvania

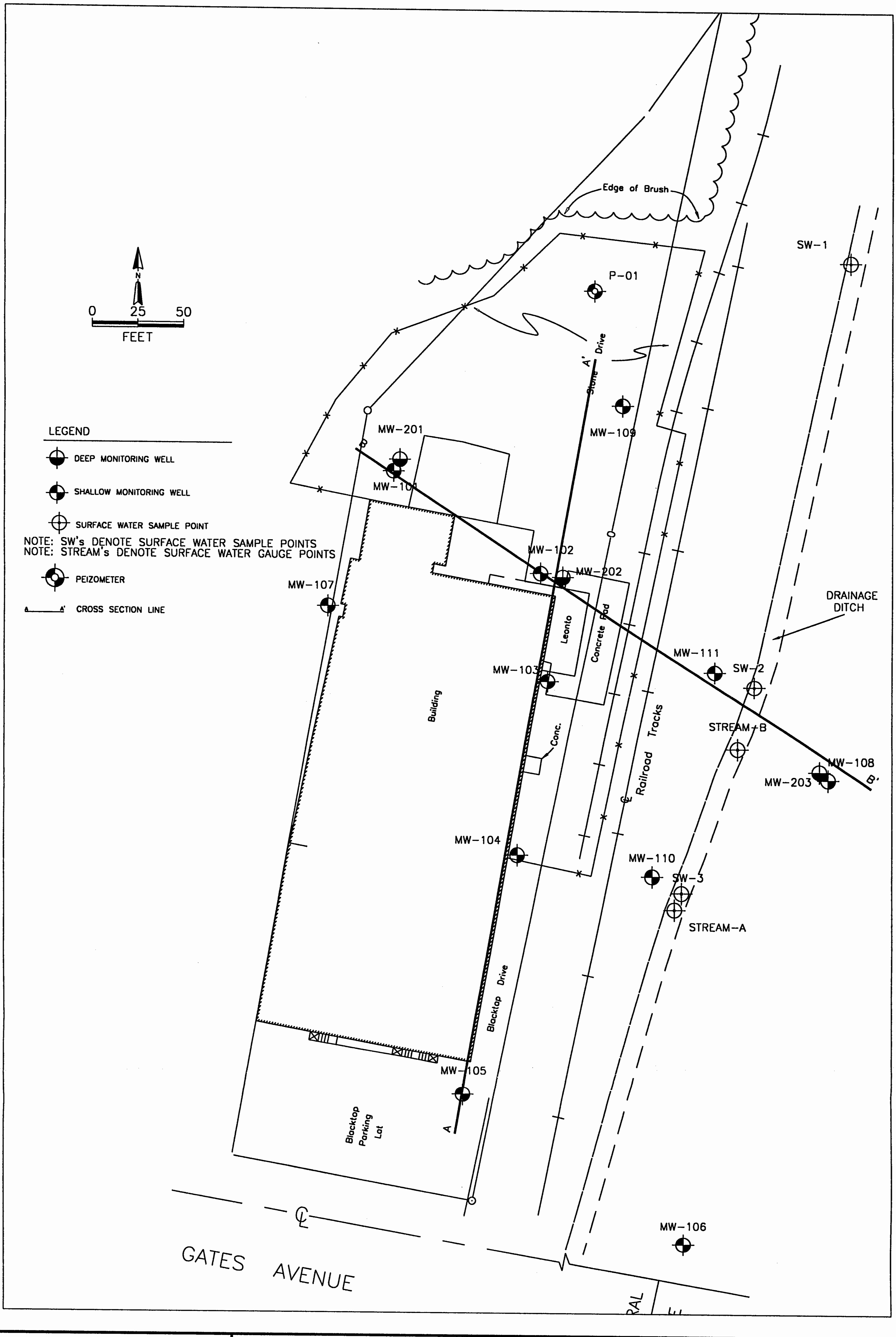
FIGURE NO.	CLIENT/LOCATION		
1	FORMER MONARCH CHEMICAL GENEVA, NEW YORK		
DELTA PROJECT NO. S096-015	DESCRIPTION TOPOGRAPHIC MAP		
DRAWN BY H. WATSON			
REVIEWED BY	DATE 9/24/98	SCALE SHOWN	CAD NO. 001-TOPO



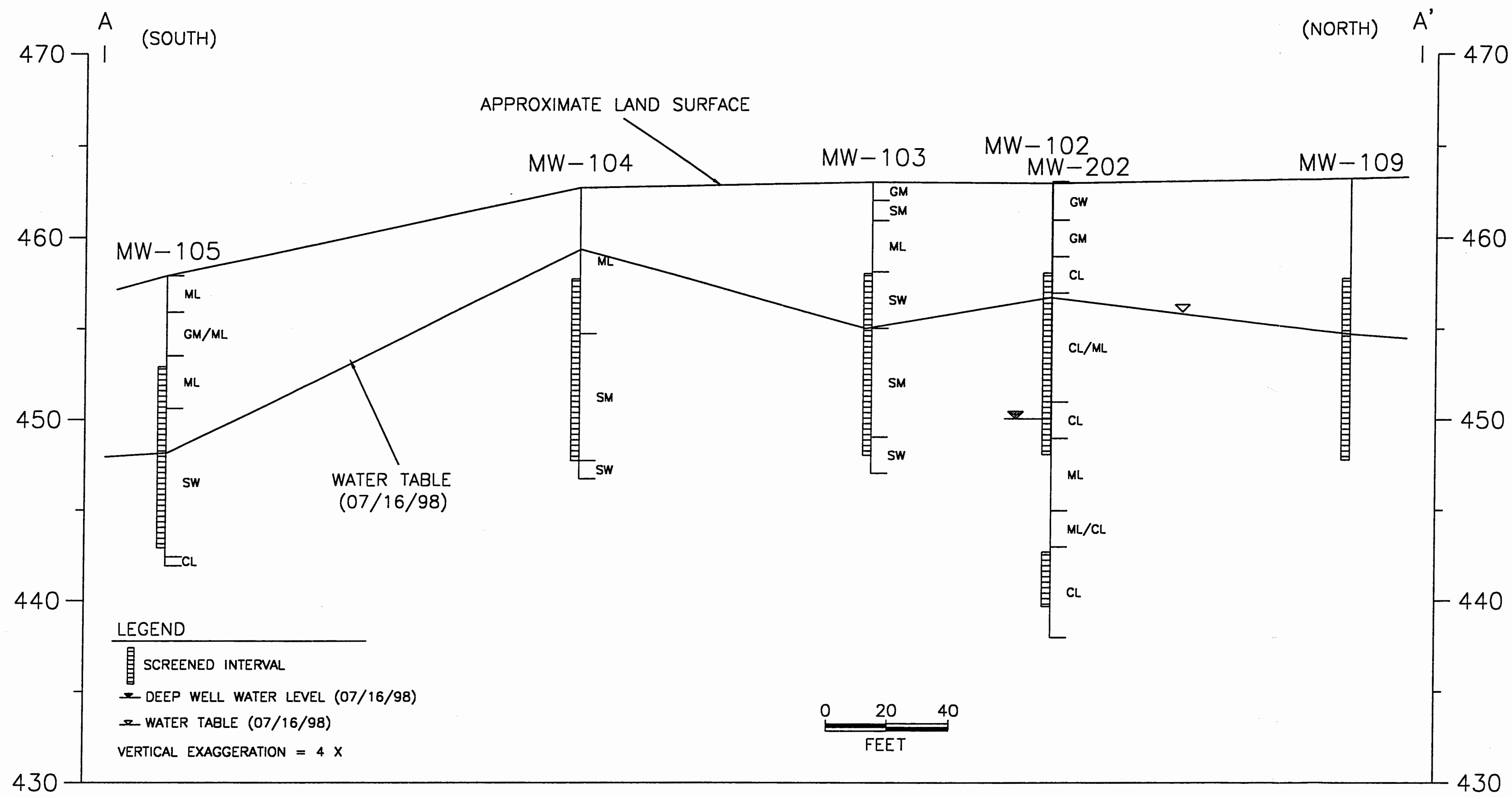
Delta Environmental Consultants, Inc.

TITLE:
SITE MAP
FORMER MONARCH CHEMICAL FACILITY
GENEVA, NEW YORK

DWN: DEK/HLW	DES.:	PROJECT NO.: S096-105
CHKD:	APPD:	FIGURE NO.: 2
DATE: 12-07-98	REV.:	

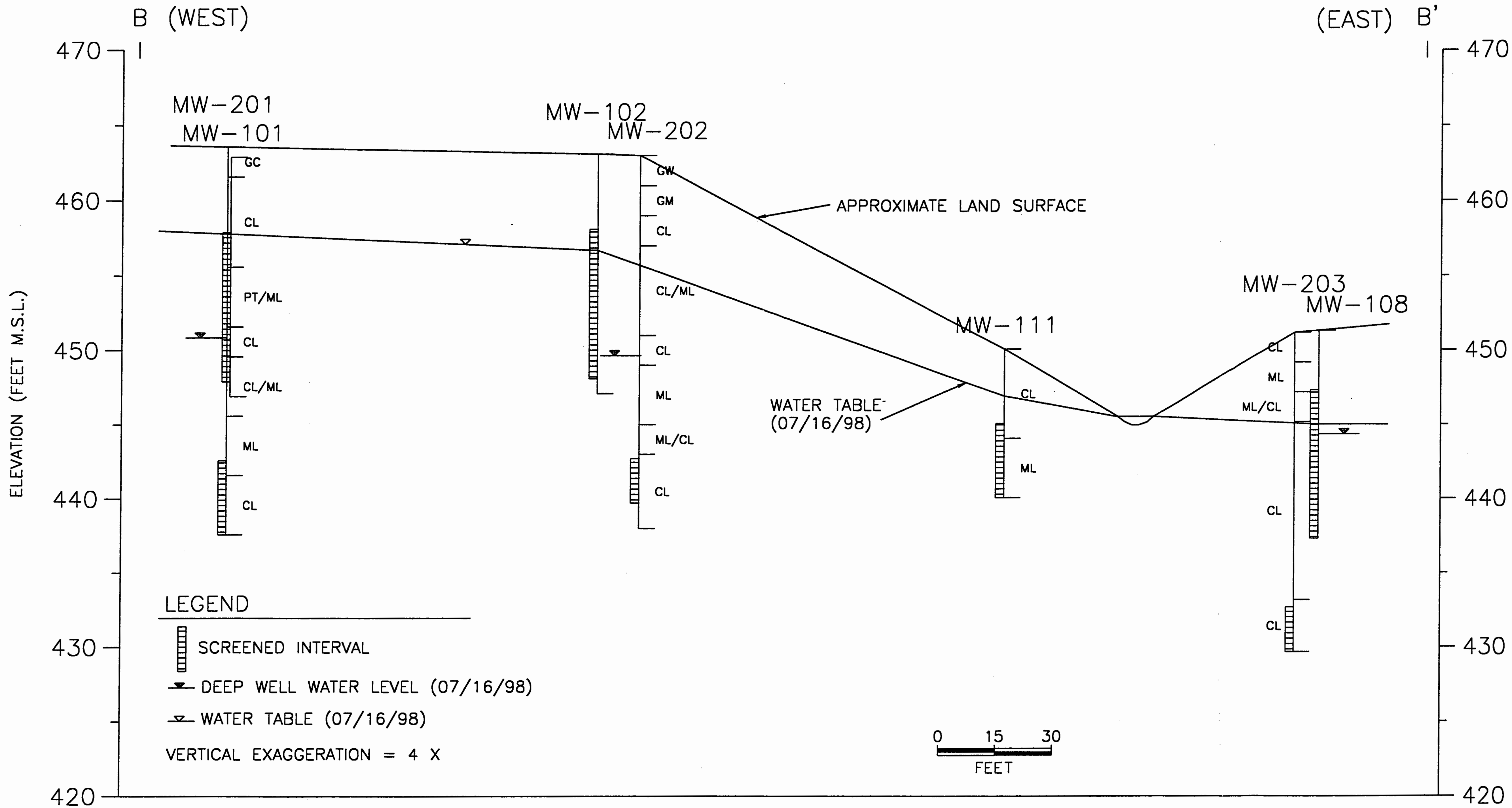


Delta Environmental Consultants, Inc.	TITLE: CROSS SECTION LOCATION MAP FORMER MONARCH CHEMICAL FACILITY GENEVA, NEW YORK	DWN: DEK/HLW DES.: CHKD: APPD: DATE: 11-20-98 REV.:	PROJECT NO.: S096-015 FIGURE NO.: 3



Delta Environmental Consultants, Inc.

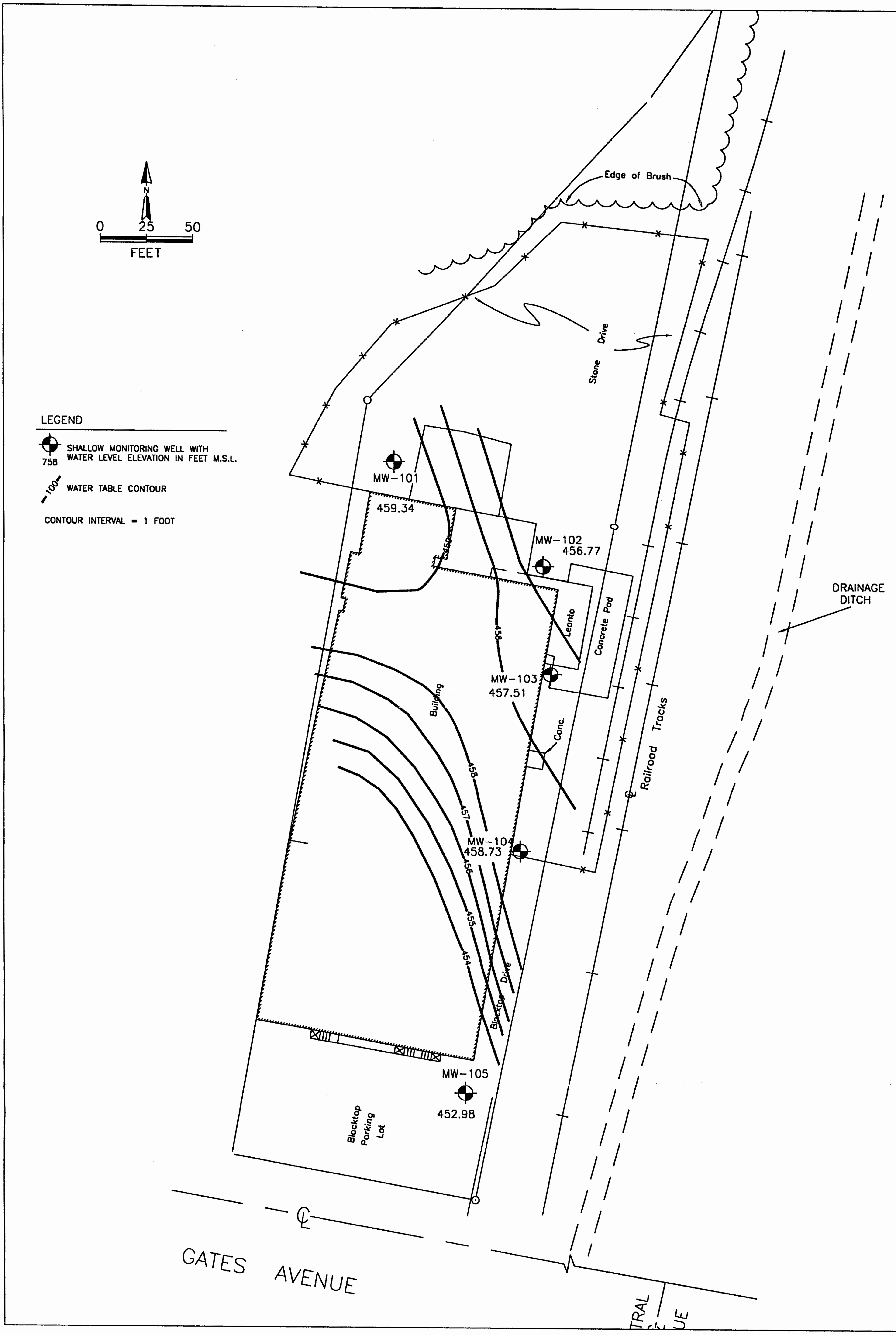
TITLE: CROSS SECTION A – A' FORMER MONARCH CHEMICAL FACILITY GENEVA, NEW YORK	DWN: DEK	DES.:	PROJECT NO.: S096-015
	CHKD:	APPD:	FIGURE NO.: 4
	DATE: 09/17/98	REV.:	



Delta Environmental Consultants, Inc.

TITLE:
CROSS SECTION B – B'
FORMER MONARCH CHEMICAL FACILITY
GENEVA, NEW YORK

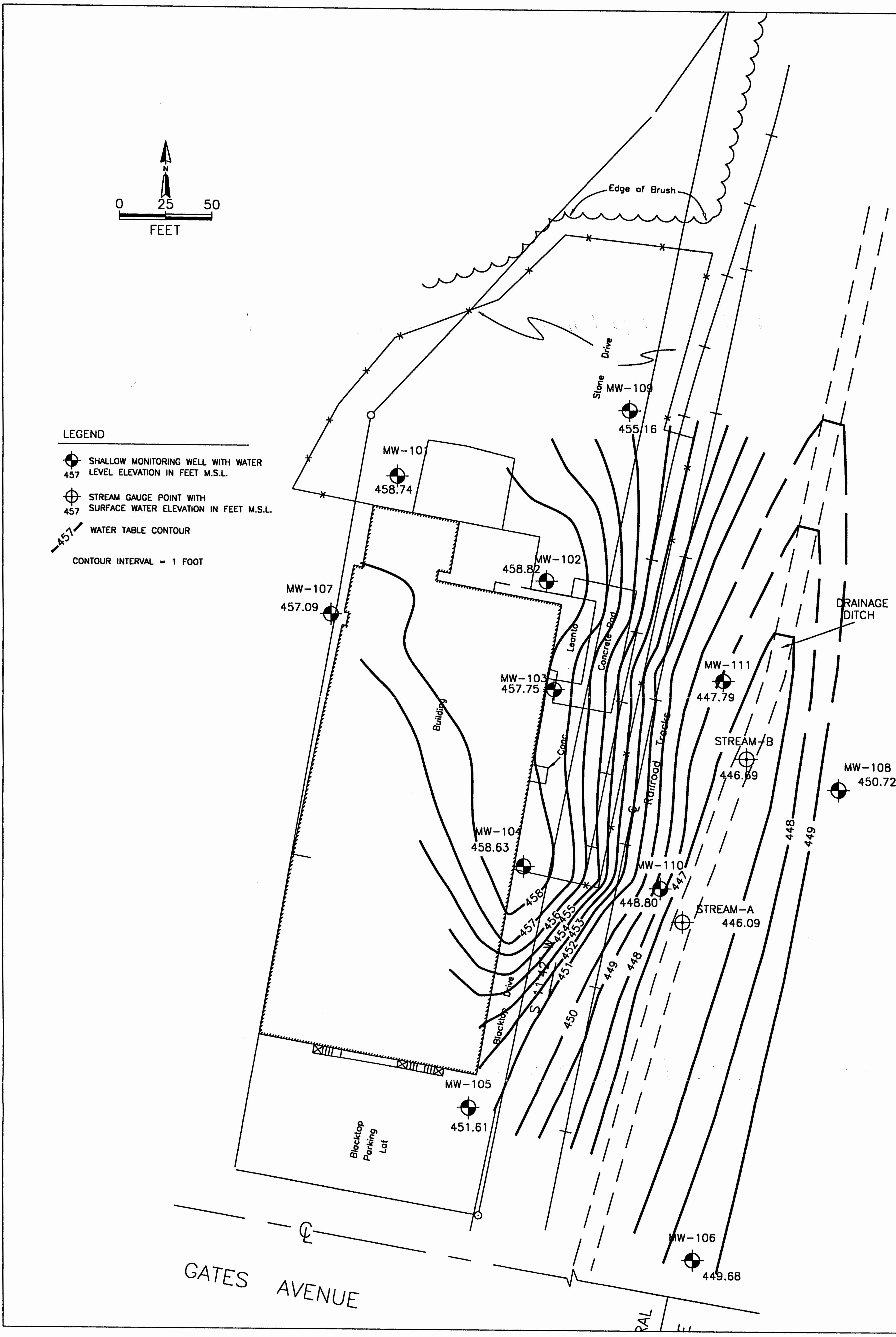
DWN: DEK	DES.:	PROJECT NO.: S096-015
CHKD:	APPD:	FIGURE NO.: 5
DATE: 09/17/98	REV.:	



Delta Environmental Consultants, Inc.

TITLE:
WATER TABLE CONTOUR MAP (10/22/96)
FORMER MONARCH CHEMICAL FACILITY
GENEVA, NEW YORK

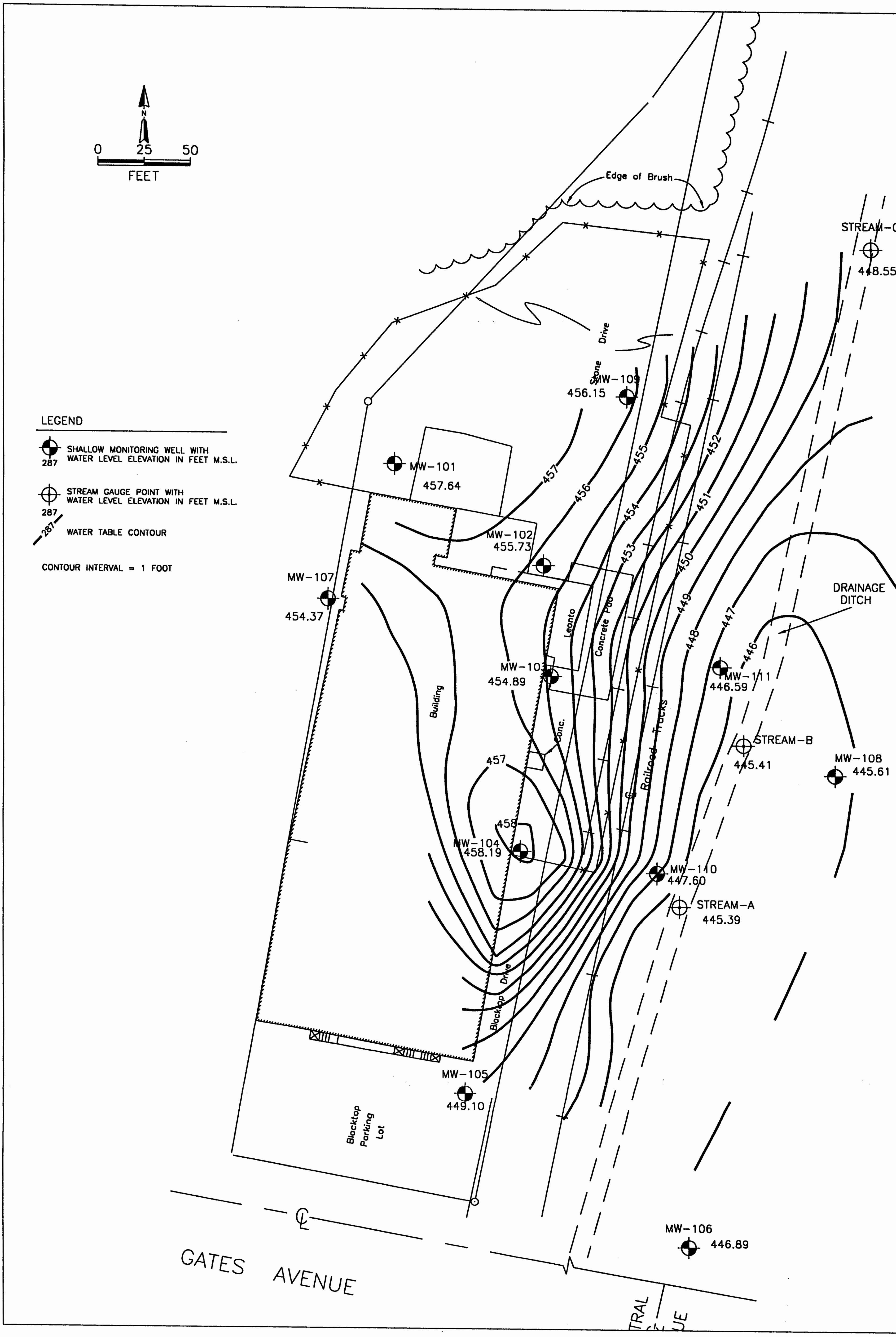
DWN: DEK/HLW	DES.:	PROJECT NO.: S096-015	
CHKD:	APPD:	FIGURE NO.: 6	
DATE: 09/24/98	REV.:		



Delta Environmental Consultants, Inc.

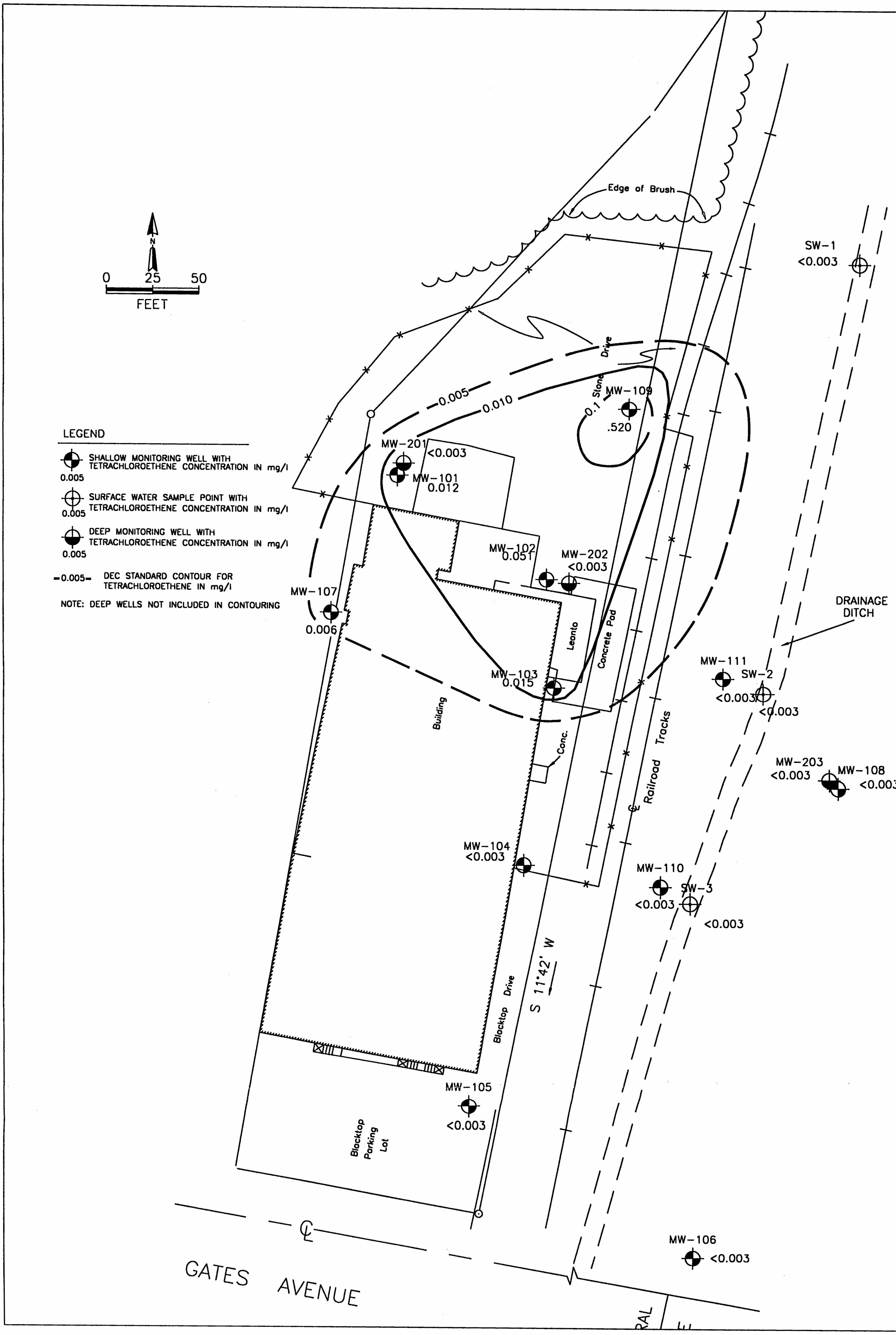
TITLE:
WATER TABLE CONTOUR MAP (02/18/98)
FORMER MONARCH CHEMICAL FACILITY
GENEVA, NEW YORK

DWN: DEK	DES.:	PROJECT NO.: S096-015	
CHKD:	APPD:		
DATE: 03/31/98	REV.:	FIGURE NO.: 7	



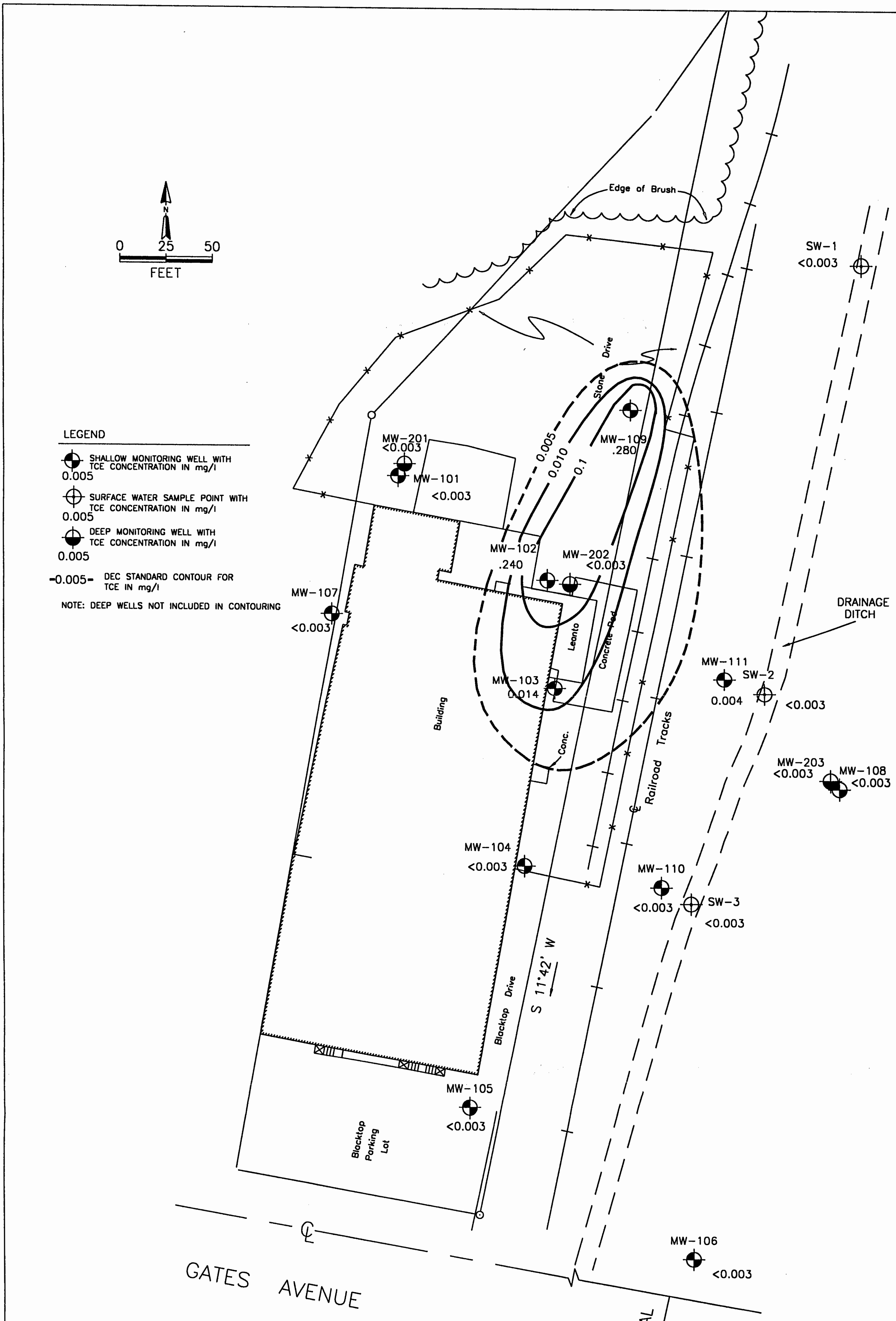
TITLE:	DWN:	DES.:	PROJECT NO.:
WATER TABLE CONTOUR MAP (05/28/98) FORMER MONARCH CHEMICAL FACILITY GENEVA, NEW YORK	DEK		S096-015
	CHKD:	APPD:	FIGURE NO.:
	DATE: 09/21/98	REV.:	8

Delta Environmental Consultants, Inc.

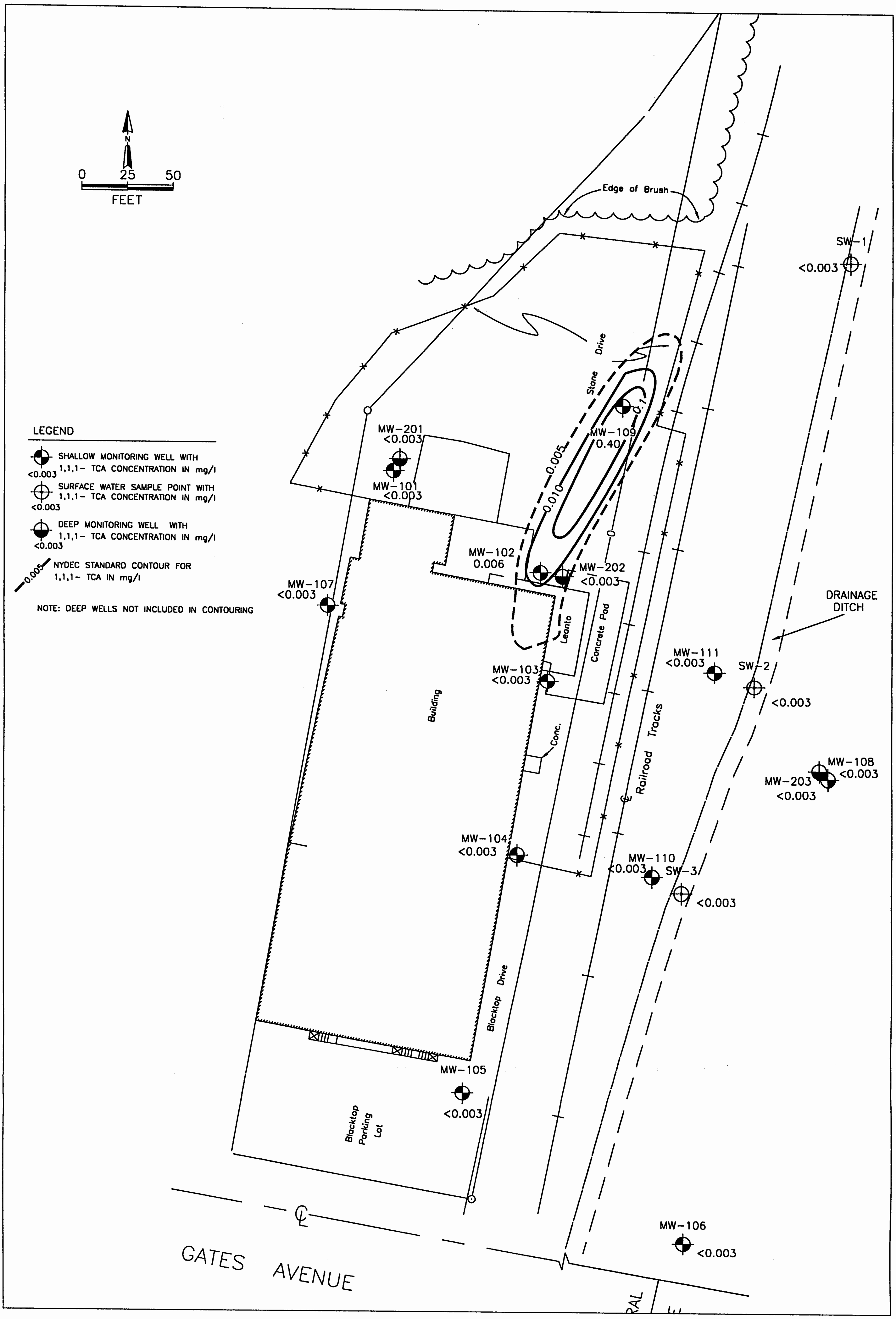


Delta Environmental Consultants, Inc.

TITLE:	DWN: DEK	DES.:	PROJECT NO.: S096-015
TETRACHLOROETHENE IN GROUND WATER (02/18/98)	CHKD:	APPD:	
FORMER MONARCH CHEMICAL FACILITY			FIGURE NO.: 9
GENEVA, NEW YORK	DATE: 03/31/98	REV.:	

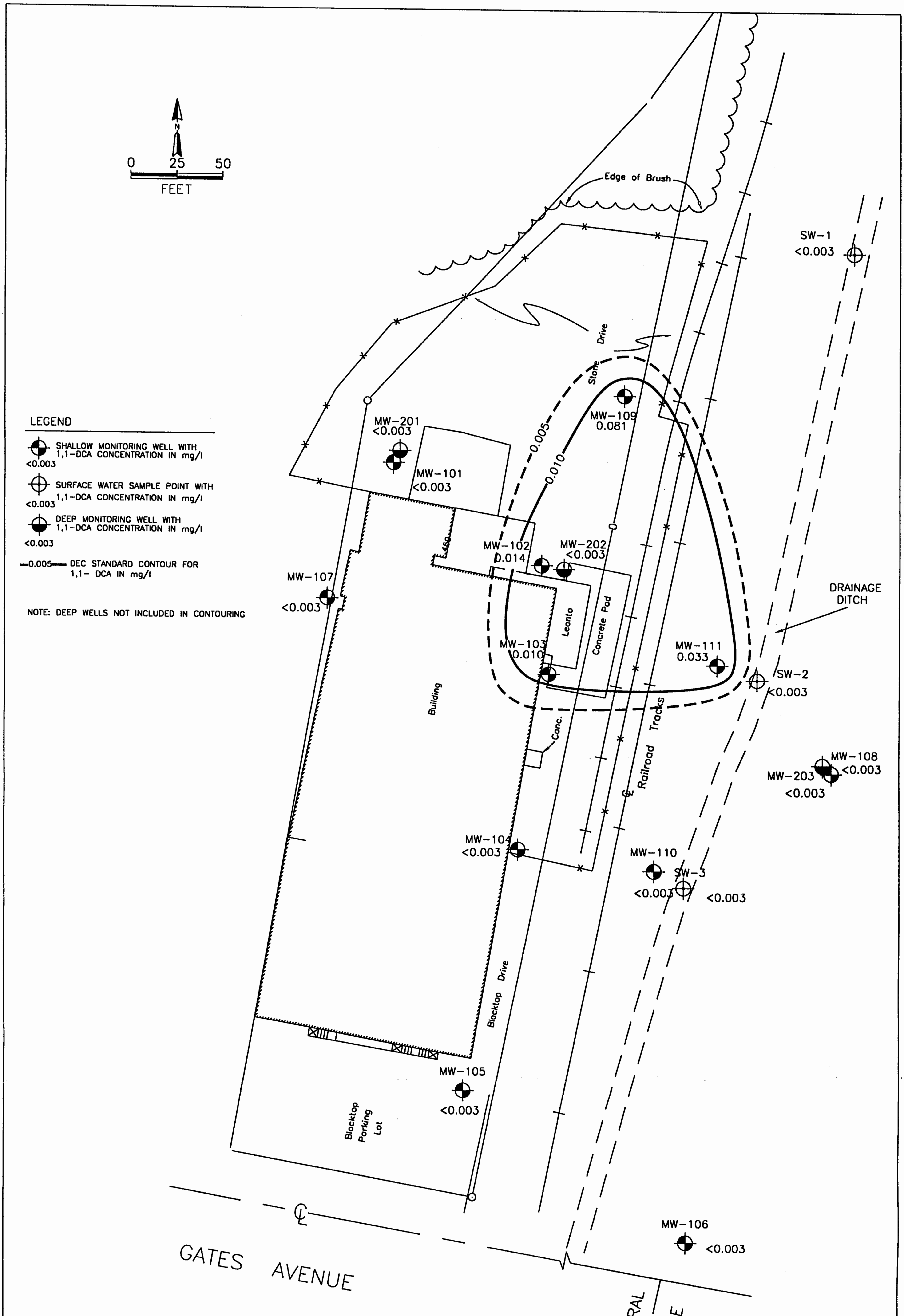


Delta Environmental Consultants, Inc.	TITLE: TRICHLOROETHENE IN GROUND WATER (02/18/98) FORMER MONARCH CHEMICAL FACILITY GENEVA, NEW YORK	DWN: DEK CHKD: DATE: 03/31/98	DES.: APPD: REV.:	PROJECT NO.: S096-015 FIGURE NO.: 10



Delta Environmental Consultants, Inc.

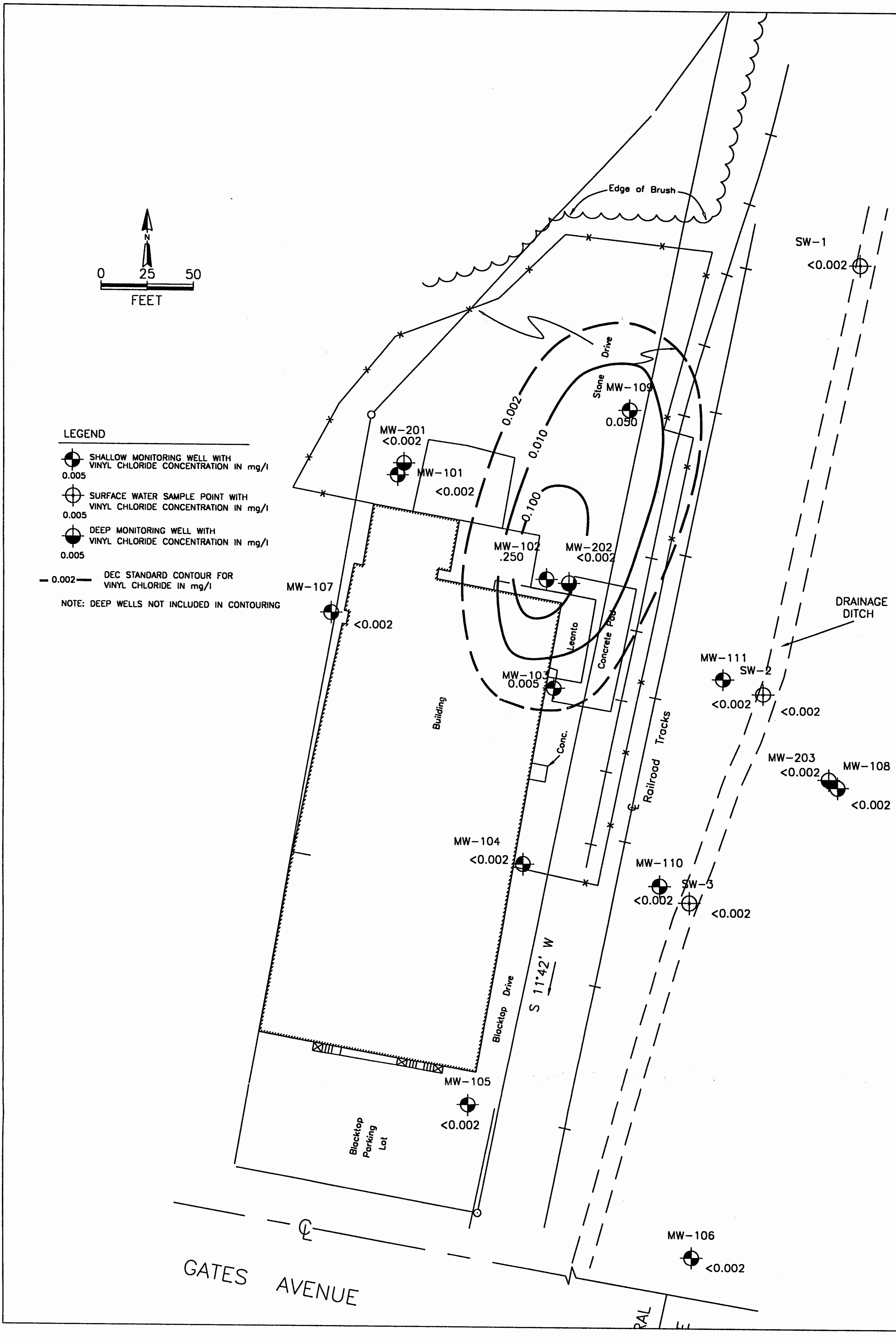
TITLE:	DWN: DEK/HLW	DES.:	PROJECT NO.: S096-015
1,1,1- TCA IN GROUND WATER (2/18/98) FORMER MONARCH CHEMICAL FACILITY GENEVA, NEW YORK	CHKD:	APPD:	FIGURE NO.: 11
	DATE: 11/13/98	REV.:	



Delta Environmental Consultants, Inc.

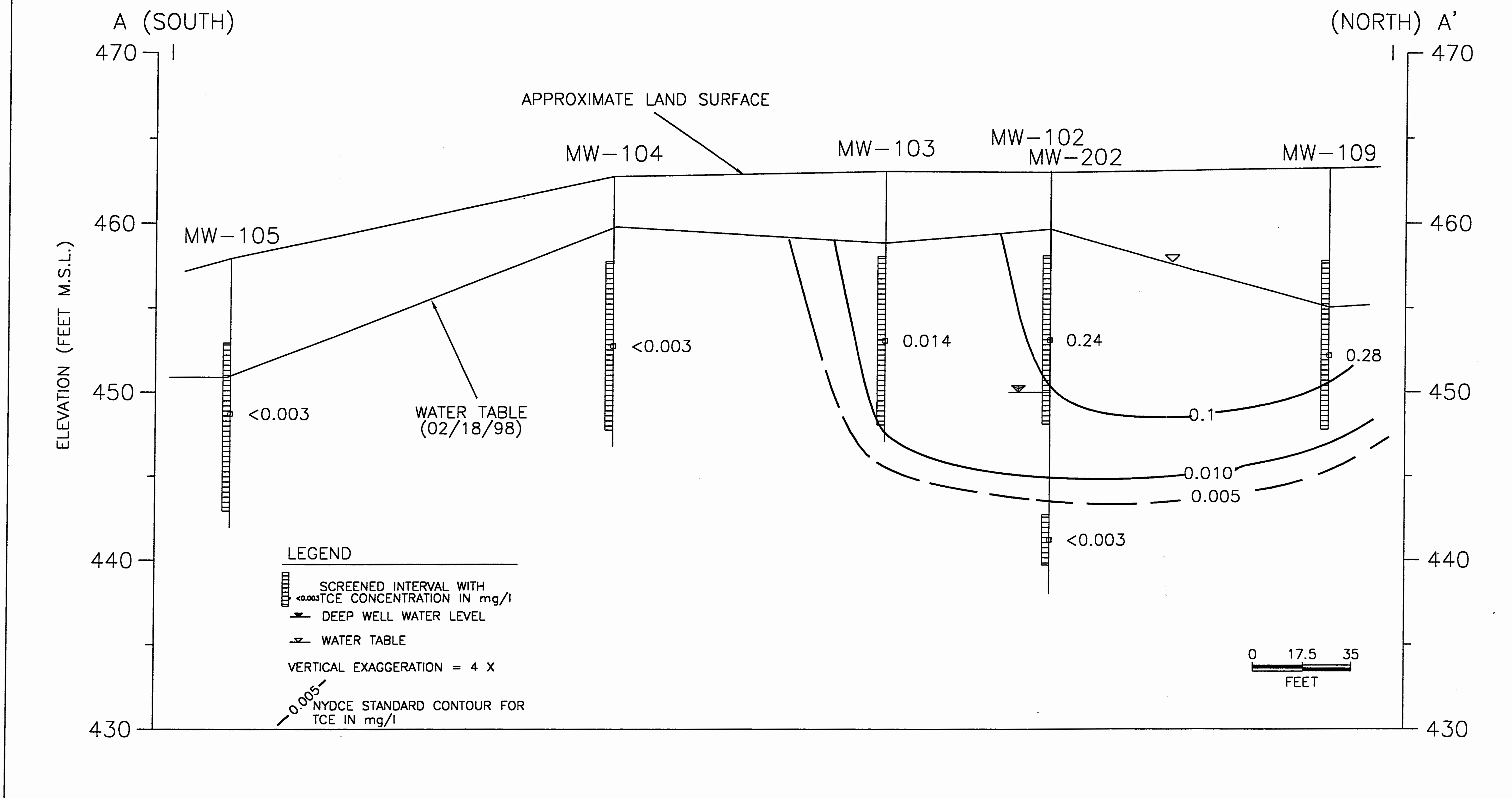
TITLE: 1,1-DCA IN GROUND WATER (02/18/98)
FORMER MONARCH CHEMICAL FACILITY
GENEVA, NEW YORK

DWN: DEK	DES.:	PROJECT NO.: S096-015
CHKD:	APPD:	
DATE: 09/24/98	REV.:	FIGURE NO.: 12

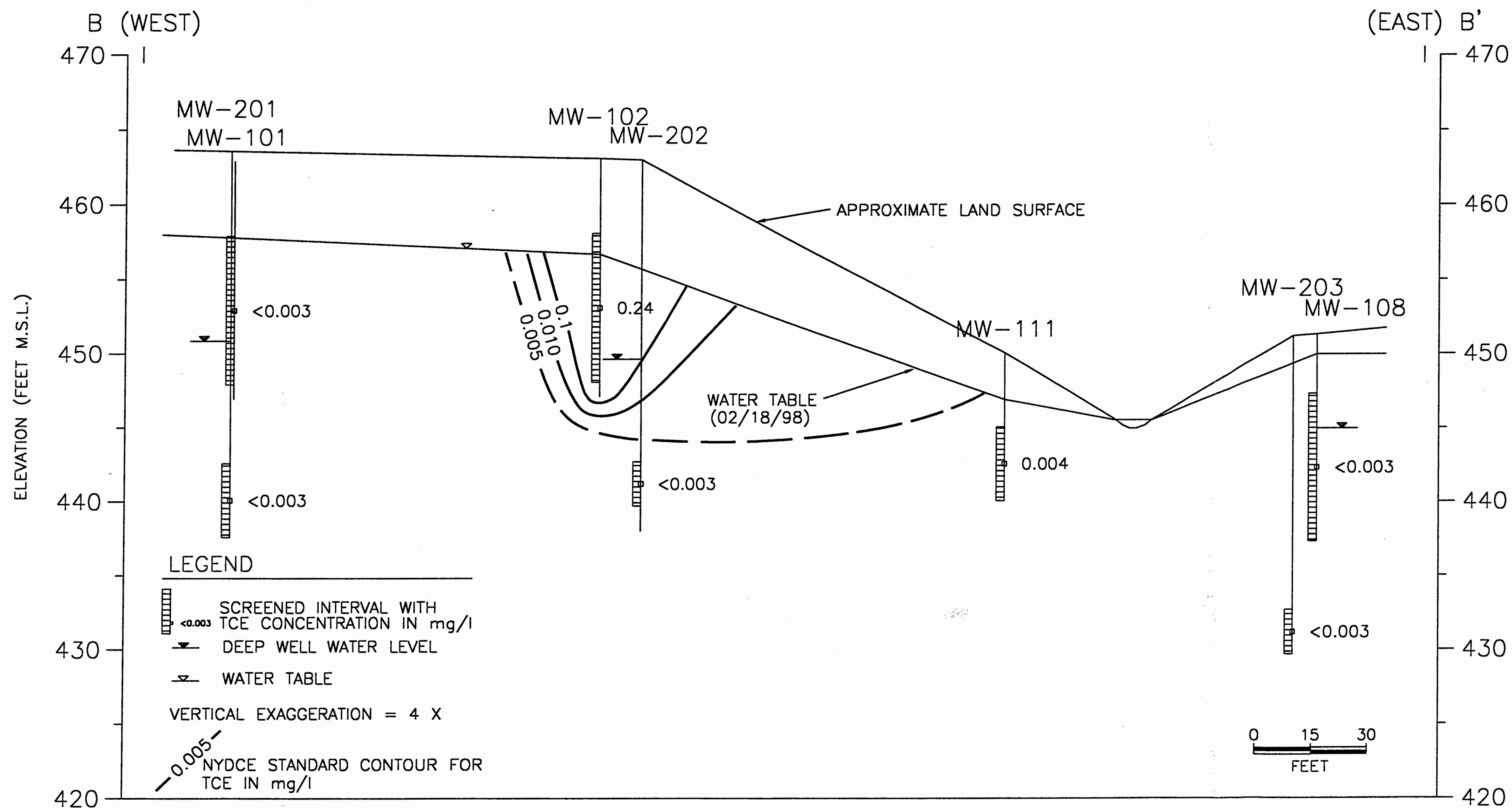


Delta Environmental Consultants, Inc.

TITLE:	DWN: DEK	DES.:	PROJECT NO.: S096-015
VINYL CHLORIDE IN GROUND WATER (02/18/98) FORMER MONARCH CHEMICAL FACILITY GENEVA, NEW YORK	CHKD:	APPD:	
	DATE: 03/31/98	REV.:	FIGURE NO.: 13



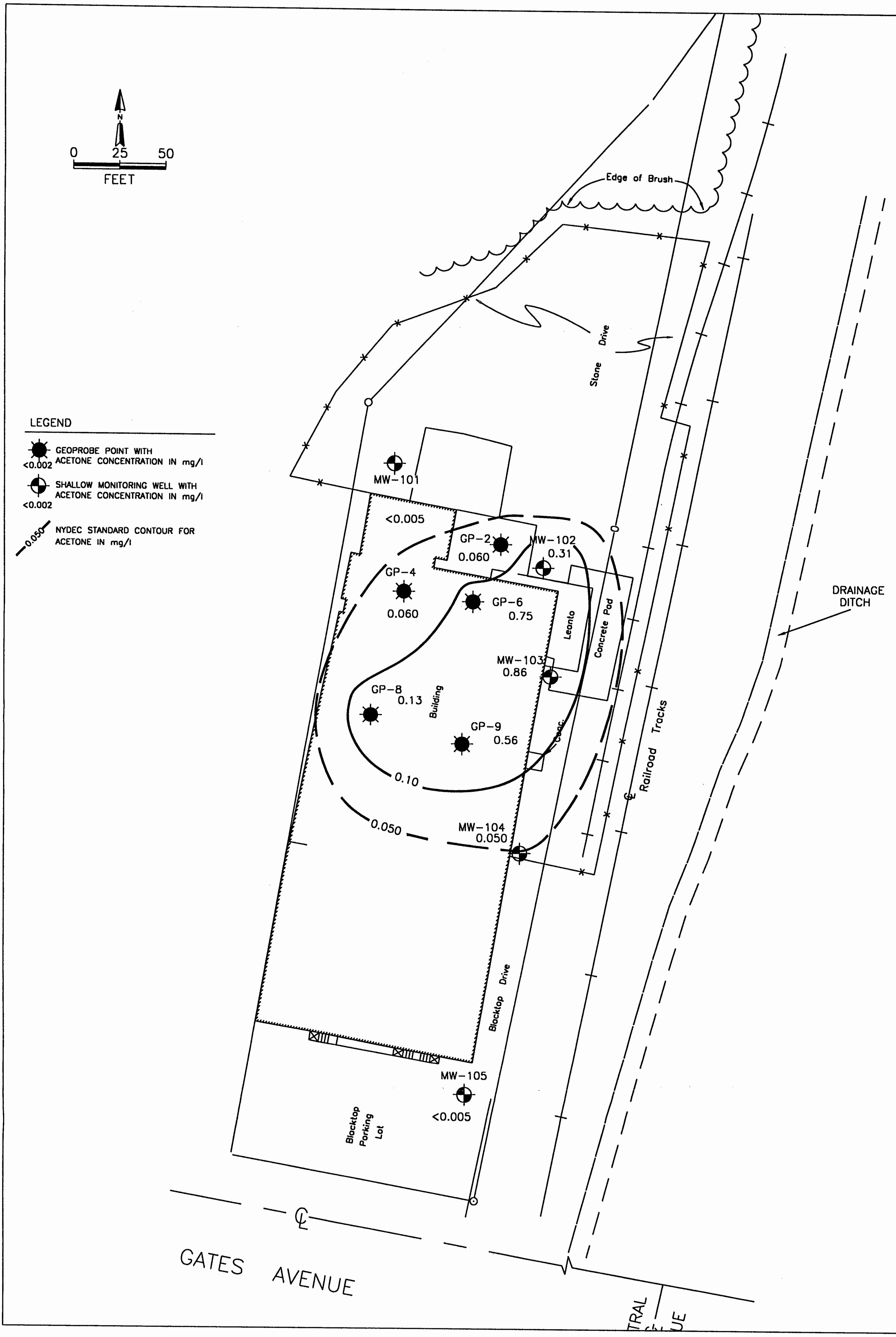
Delta Environmental Consultants, Inc.	TITLE: ISOCONCENTRATION CROSS SECTION A – A': TCE (02/18/98) FORMER MONARCH CHEMICAL FACILITY GENEVA, NEW YORK	DWN: DEK / DES.: / CHKD: / APPD: / DATE: 09/24/98 / REV.:	PROJECT NO.: S096-015 / FIGURE NO.: 14



Delta Environmental Consultants, Inc.

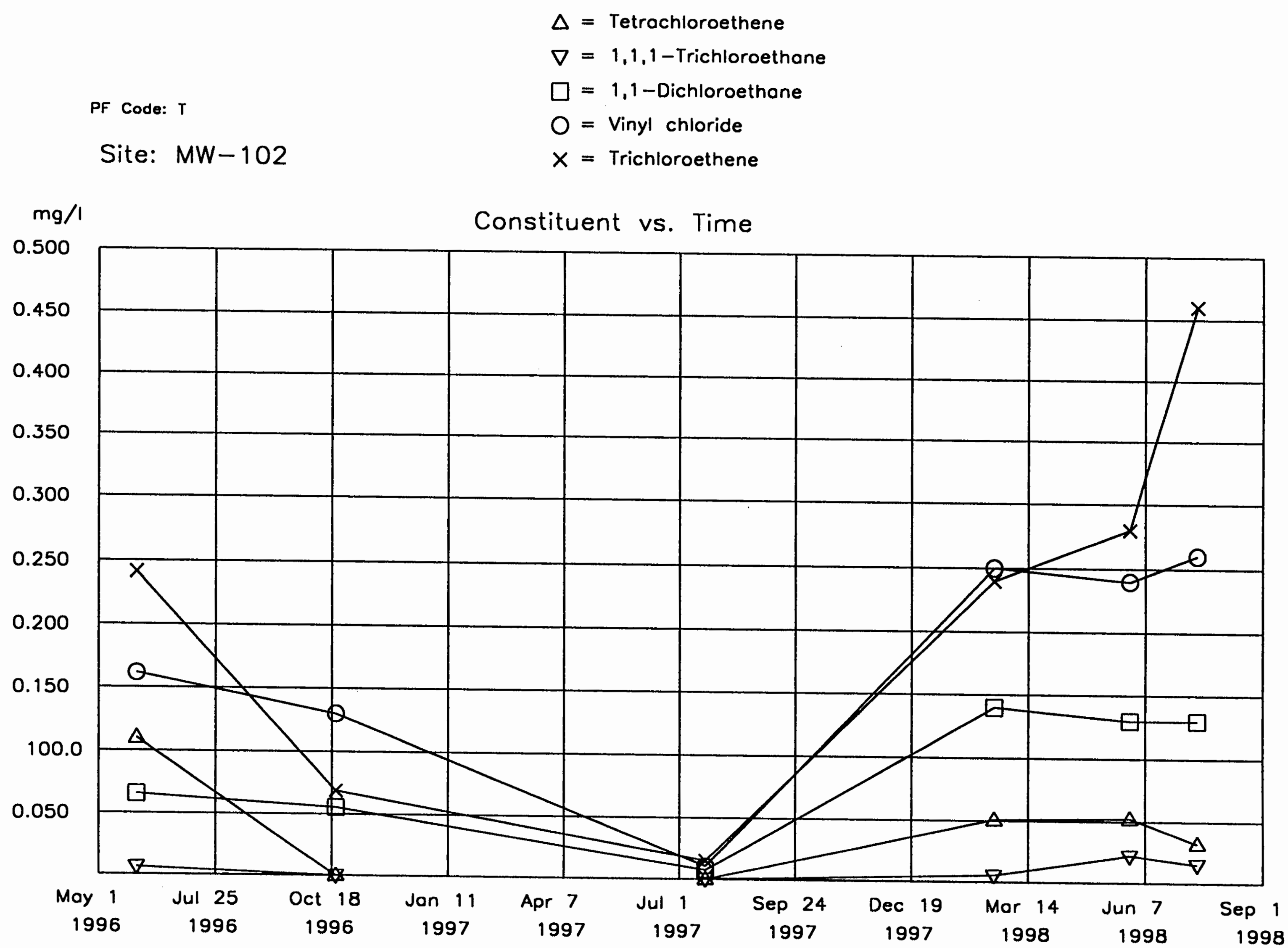
TITLE: ISOCONCENTRATION CROSS SECTION B – B': TCE (02/18/98)
FORMER MONARCH CHEMICAL FACILITY
GENEVA, NEW YORK

DWN: DEK	DES.:	PROJECT NO.: S096-015
CHKD:	APPD:	
DATE: 09/24/98	REV.:	FIGURE NO.: 15



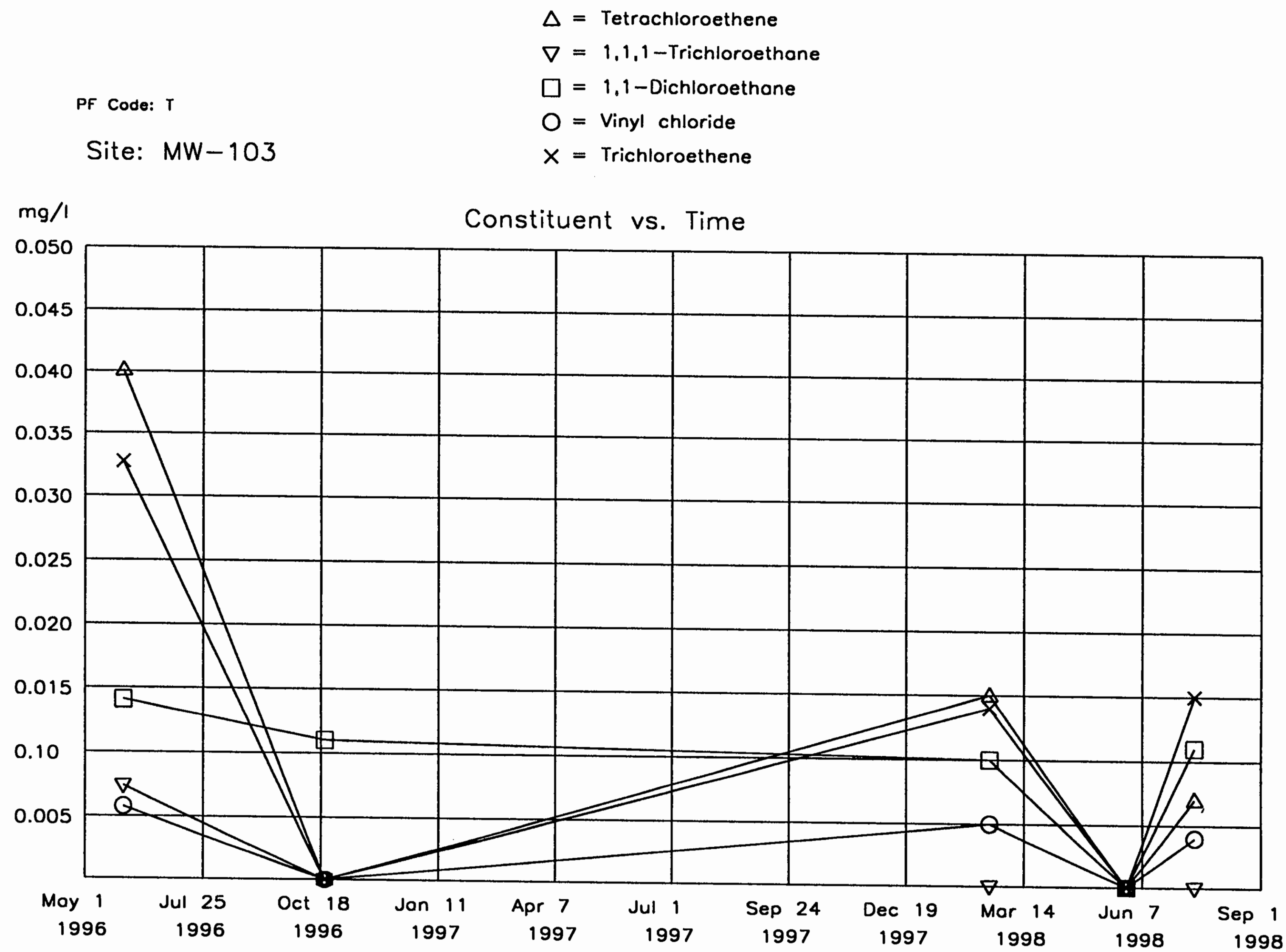
![Delta Environmental Consultants, Inc.]

TITLE:	DWN: DEK	DES.:	PROJECT NO.: S096-015
ACETONE IN GROUND WATER (10/23/96) FORMER MONARCH CHEMICAL FACILITY GENEVA, NEW YORK	CHKD:	APPD:	FIGURE NO.: 16
	DATE: 09/25/98	REV.:	



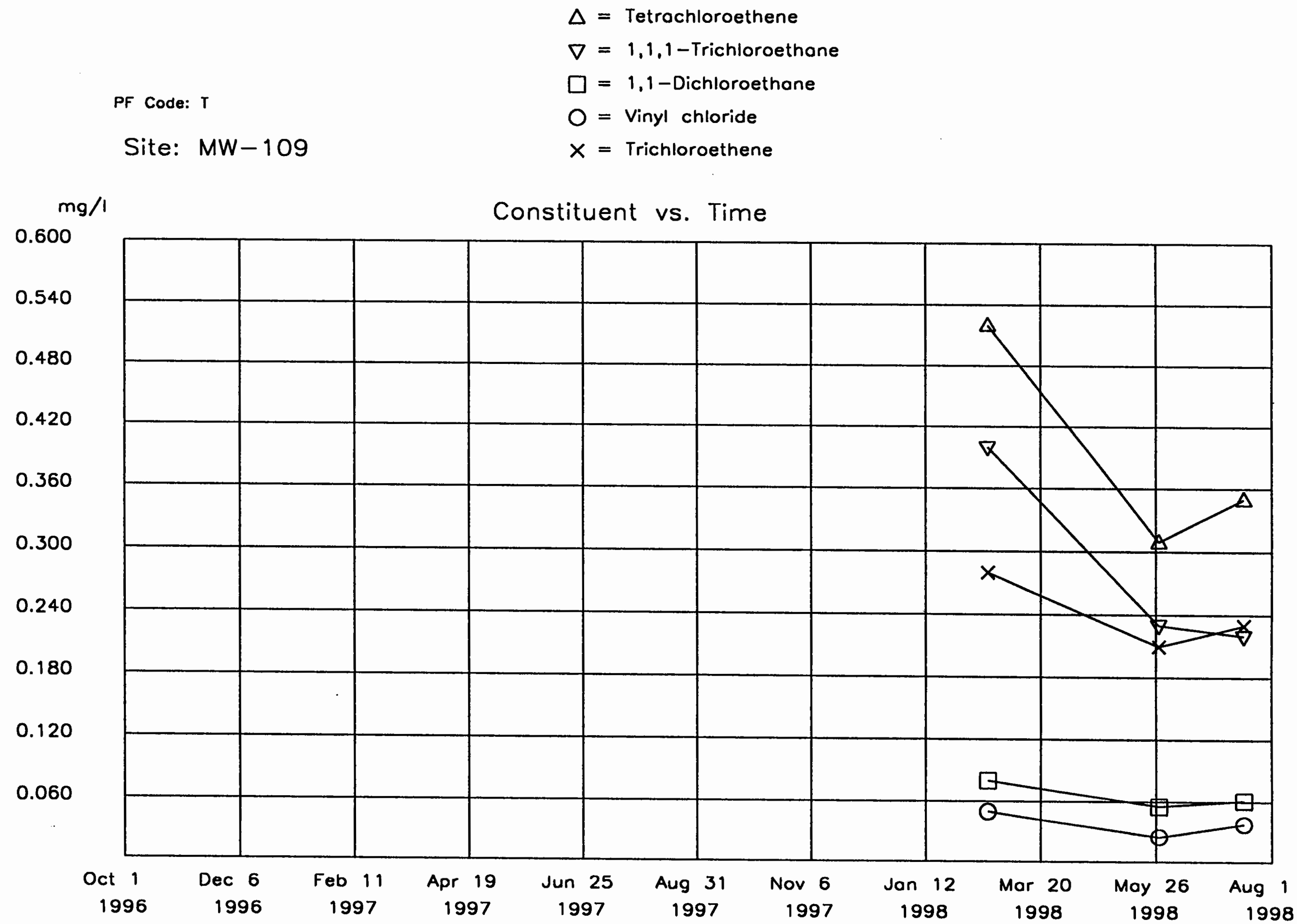
Delta Environmental Consultants, Inc.

TITLE: CONSTITUENT VERSUS TIME GRAPH: MW-102 FORMER MONARCH CHEMICAL FACILITY GENEVA, NEW YORK	DWN: DEK	DES.:	PROJECT NO.: S096-015
	CHKD:	APPD:	
	DATE: 09/28/98	REV.:	FIGURE NO.: 17



Delta Environmental Consultants, Inc.

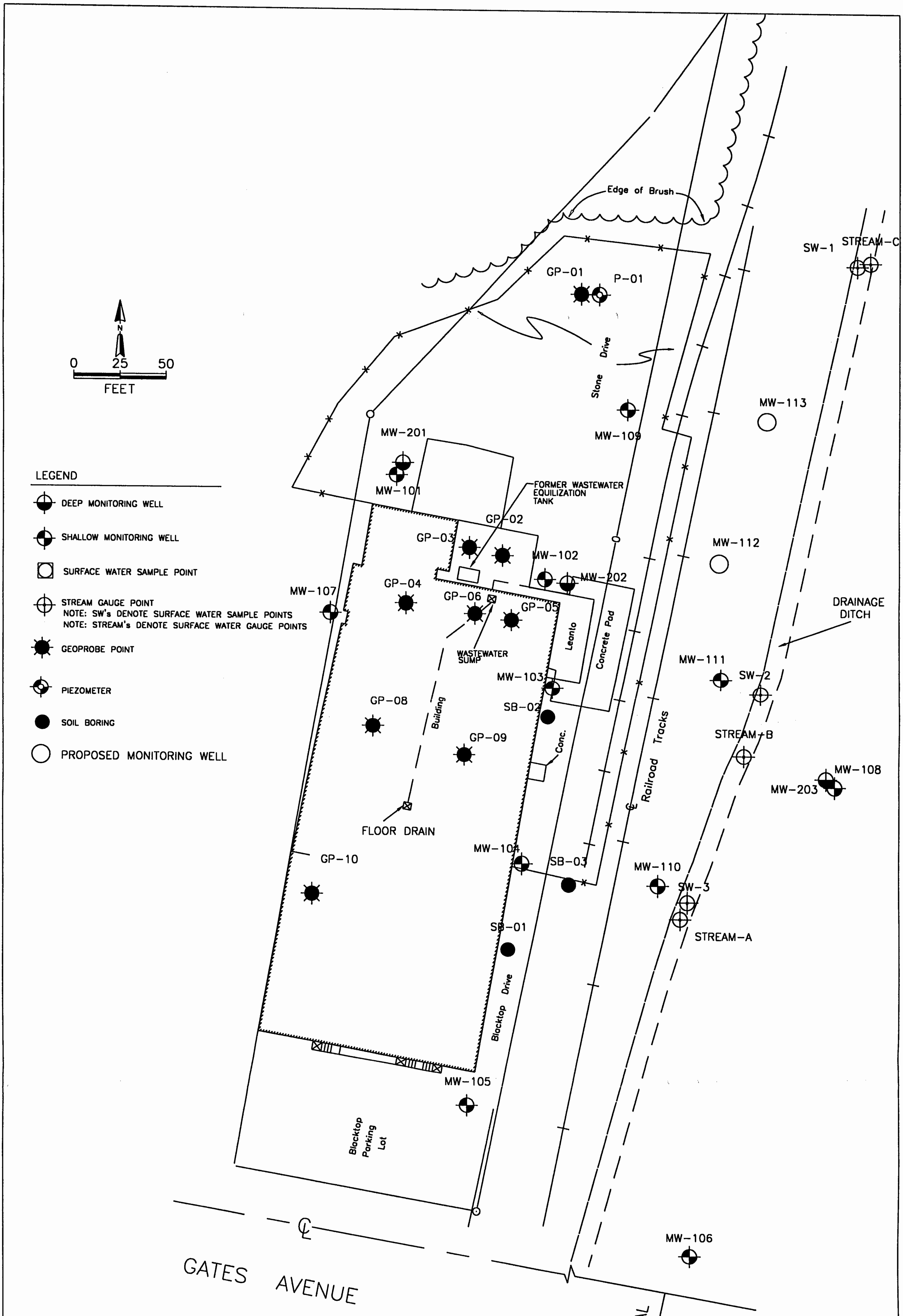
TITLE: CONSTITUENT VERUS TIME GRAPH: MW-103 FORMER MONARCH CHEMICAL FACILITY GENEVA, NEW YORK	DWN: DEK	DES.:	PROJECT NO.: S096-015
	CHKD:	APPD:	FIGURE NO.: 18
	DATE: 09/28/98	REV.:	



Delta Environmental Consultants, Inc.

TITLE:
CONSTITUENT VERSUS TIME GRAPH: MW-109
FORMER MONARCH CHEMICAL FACILITY
GENEVA, NEW YORK

DWN: DEK	DES.:	PROJECT NO.: S096-015
CHKD:	APPD:	
DATE: 09/24/98	REV.:	FIGURE NO.: 19



Delta Environmental Consultants, Inc.	TITLE: PROPOSED MONITORING WELL LOCATIONS FORMER MONARCH CHEMICAL FACILITY GENEVA, NEW YORK	DWN: DEK/HLW DES.: CHKD: APPD: DATE: 12-10-98 REV.:	PROJECT NO.: S096-015 FIGURE NO.: 20

APPENDIX A

SOIL BORING LOGS

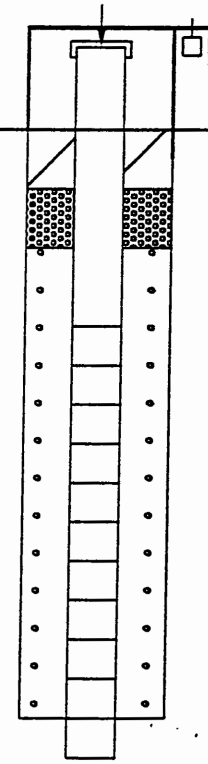
Delta Environmental Consultants, Inc.

Project Number: S096-015	Site Id: MW-101
Project Name: H.B. Fuller	Location: Geneva, New York
Contractor:	Elevation: 462.90'
Consulting Firm: LBG	Datum: Mean Sea Level
Logged By:	Measuring Point: 466.54'
Date(s): 05/23/96 - 05/23/96	Conductor Casing: type: dia: 0.00in fm: 0.00' to: 0.00'
Purpose: Monitoring Well, Shallow	
Drilling Method: Hollow Stem Auger	Blank Casing: type: PVC dia: 2.00in fm: -3.6' to: 5.00'
Remarks:	Screens: type: Slotted size: 0.010in dia: 2.00in fm: 5.00' to: 15.00'
	Annular Fill: type: BENTONITE-CEMENT GROUT fm: 0.00' to: 1.50' type: Bentonite Chips fm: 1.50' to: 3.00' type: SAND PACK #2 fm: 3.00' to: 15.00'

Sample No.	Blow Count	PID	USCS Code	Material Description
1	[illegible]	191 ppm	ML/GM	SILT AND GRASS/GRAVEL FINE AND COARSE, AND SILT AND FINE SAND
2	[illegible]	36 ppm	GW	GRAVEL, FINE AND COARSE, AND SILT AND FINE SAND. SATURATED, BROWN/GRAVEL, MEDIUM TO COARSE. GRAY
3	[illegible]	53.7 ppm	ML ML/CL	SILT; LITTLE FINE GRAVEL; TRACE OF CLAY. BROWN/SILT;LITTLE CLAY. BROWN/SILT AND CLAY. BROWN/RED, MOIST. PHC ODOR
4	[illegible]	62 ppm	SW	SILT AND CLAY; TRACE OF VERY FINE SAND. MOIST. BROWN/RED. SLIGHT PHC ODOR. SAND, VERY FINE AND FINE;LITTLE SILT, BROWN, SATURATED, PHC ODOR.
5	[illegible]	0 ppm		SAND, FINE TO VERY FINE; LITTLE MEDIUM SAND, TRACE SILT. BROWN/GRAY, SATURATED, SLIGHT PHC ODOR
6	[illegible]	12 ppm	ML/CL SM	SAND, FINE TO VERY FINE; LITTLE MEDIUM SAND, TRACE SILT, BROWN/GRAY, SATURATED SLIGHT PHC ODOR/SILT AND CLAY, BROWN/SAND, FINE AND SILT, BROWN
7	[illegible]	10.2 ppm		SAND, VERY FINE; SOME SILT; LITTLE FINE AND MEDIUM SAND, SATURATED, BROWN
8	[illegible]	5.6 ppm		SAND, VERY FINE; SOME SILT; LITTTLE FINE AND MEDIUM SAND, SATURATED, BROWN

Elevation (ft): 460, 450, 440 — Depth (ft): 10, 20

Well Construction
MP. EL. 466.54

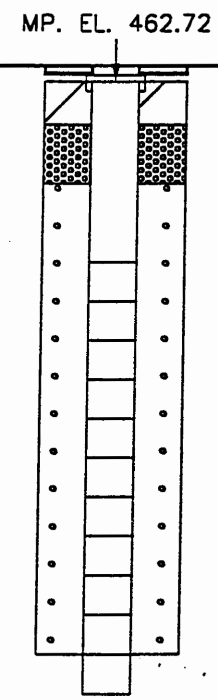


Delta Environmental Consultants, Inc.

Project Number: S096-015	Site Id: MW-102
Project Name: H.B. Fuller	Location: Geneva, New York
Contractor:	Elevation: 463.08'
Consulting Firm: LBG	Datum: Mean Sea Level
Logged By:	Measuring Point: 462.72'
Date(s): 05/23/96 - 05/23/96	Conductor Casing: type: dia: 0.00in fm: 0.00' to: 0.00'
Purpose: Monitoring Well, Deep	Blank Casing: type: PVC dia: 2.00in fm: 0.4' to: 5.00'
Drilling Method: Hollow Stem Auger	Screens: type: Slotted size: 0.010in dia: 2.00in fm: 5.00' to: 15.00'
Remarks:	Annular Fill: type: BENTONITE-CEMENT GROUT fm: 0.40' to: 1.50' type: Bentonite Chips fm: 1.50' to: 3.00' type: SAND PACK #2 fm: 3.00' to: 15.00'

Sample No.	Blow Count	PID	USCS Code	Material Description
1	[illegible]	14.4 ppm	SM	SAND, COARSE TO FINE; LITTLE FINE TO COARSE GRAVEL AND SILT; TRACE OF ASPHALT, DARK BROWN, MOIST
2	[illegible]	23.2 ppm		SAND, COARSE TO FINE AND SILT; LITTLE FINE TO MEDIUM GRAVEL, DARK BROWN, SATURATED, SEWAGE ODOR
3	[illegible]	2.8 ppm	CL/ML	CLAY AND SILT, BROWN/RED, MOIST, SLIGHT ODOR
4	[illegible]	27.7 ppm	SM	SAND, FINE TO COARSE AND SILT; LITTLE MEDIUM GRAVEL. BROWN, SATURATED, SLIGHT SEWAGE ODOR
5	[illegible]	23.9 ppm		SAND, VERY FINE TO FINE; SOME SILT, BROWN, SATURATED, SLIGHT ODOR
6	[illegible]	10.4 ppm		SAND, VERY FINE TO FINE; SOME SILT, BROWN, SATURATED, SLIGHT ODOR
7	[illegible]	5.7 ppm		SAND, FINE TO VERY FINE; LITTLE SILT; TRACE CLAY, BROWN, ODOR
8	[illegible]	11.1 ppm		SAND, FINE TO VERY FINE; LITTLE SILT; TRACE CLAY, BROWN, ODOR

Well Construction



Delta Environmental Consultants, Inc.

Project Number: S096-015	Site Id: MW-103
Project Name: H.B. Fuller	Location: Geneva, New York
Contractor:	Elevation: 463.04'
Consulting Firm: LBG	Datum: Mean Sea Level
Logged By:	Measuring Point: 462.69'
Date(s): 05/23/96 - 05/23/96	Conductor Casing: type: dia: 0.00in fm: 0.00' to: 0.00'
Purpose: Monitoring Well, Shallow	Blank Casing: type: PVC dia: 2.00in fm: 0.4' to: 5.00'
Drilling Method: Hollow Stem Auger	Screens: type: Slotted size: 0.010in dia: 2.00in fm: 5.00' to: 15.00'
Remarks:	Annular Fill: type: BENTONITE-CEMENT GROUT fm: 0.40' to: 1.50'; type: Bentonite Chips fm: 1.50' to: 3.00'; type: SAND PACK #2 fm: 3.00' to: 16.00'

Sample No.	PID	USCS Code
1	15 ppm	GM
		SM
2	6 ppm	ML
3	6 ppm	
		SW
4	6.1 ppm	
5	16.8 ppm	SM
6	9.8 ppm	
7	10.8 ppm	
8	13.9 ppm	SW

Elevation (ft): 460, 450, 440

Depth (ft): 10, 20

Material Description

GRAVEL, MEDIUM TO COARSE; SOME SILT AND FINE SAND, DRIVEWAY FILL, GRAY, DRY

SILT AND FINE SAND; LITTLE FINE TO MEDIUM GRAVEL, GRAY, DRY

SILT AND FINE SAND; LITTLE FINE TO MEDIUM GRAVEL, GRAY, DRY/SILT; LITTLE CLAY; TRACE OF FINE SAND, BROWN/RED, DRY NO ODOR

SILT; LITTLE CLAY; TRACE OF FINE SAND, BROWN/RED, DRY NO ODOR

SAND, FINE TO VERY FINE; LITTLE SILT, BROWN MOIST

SAND, FINE TO VERY FINE; LITTLE SILT, BROWN, SATURATED, SLIGHT ODOR

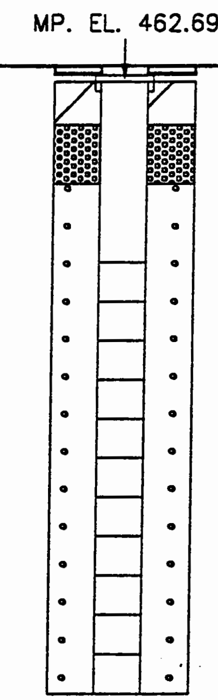
SILT AND SAND, FINE TO VERY FINE; TRACE FINE GRAVEL, BROWN/BLACK, SATURATED SLIGHT ODOR

SAND, FINE TO VERY FINE, AND SILT, BROWN, SATURATED

SILT AND FINE SAND; TRACE OF CLAY, BROWN WITH TRACE OF BLACK, SATURATED, SLIGHT ODOR

SAND, FINE; LITTLE VERY FINE SAND; LITTLE SILT, BROWN, SATURATED, SLIGHT ODOR

Well Construction

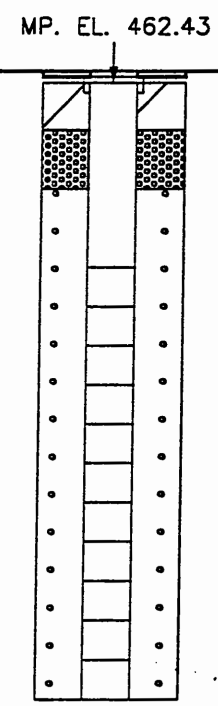


Delta Environmental Consultants, Inc.

Project Number: S096-015	Site Id: MW-104
Project Name: H.B. Fuller	Location: Geneva, New York
Contractor:	Elevation: 462.73'
Consulting Firm: LBG	Datum: Mean Sea Level
Logged By:	Measuring Point: 462.43'
Date(s): 05/23/96 - 05/23/96	Conductor Casing: type: dia: 0.00in fm: 0.00' to: 0.00'
Purpose: Monitoring Well, Shallow	Blank Casing: type: PVC dia: 2.00in fm: 0.3' to: 5.00'
Drilling Method: Hollow Stem Auger	Screens: type: Slotted size: 0.010in dia: 2.00in fm: 5.00' to: 15.00'
Remarks:	Annular Fill: type: BENTONITE-CEMENT GROUT fm: 0.30' to: 1.50'; type: Bentonite Chips fm: 1.50' to: 3.00'; type: SAND PACK #2 fm: 3.00' to: 16.00'

Elevation (ft)	Depth (ft)	Recovery	Sample No.	Blow Count	PID	Graphic Log	USCS Code	Material Description
			1		6.9 ppm		ML	SILT; LITTLE FINE SAND; LITTLE FINE TO COARSE GRAVEL, GRAY/BROWN, DRY COMPACTED ROAD FILL
460			2		3.0 ppm			SILT; LITTLE FINE TO MEDIUM SAND; LITTLE CLAY; LITTLE FINE TO MEDIUM GRAVEL BROWN/GRAY/BLACK, DRY
			3		1.2 ppm			SILT AND VERY FINE TO FINE SAND, CLUMPS, SATURATED, TAN/BROWN
			4		5.7 ppm			SILT AND FINE TO VERY FINE SAND, CLUMPS OF SILT/CLAY, SIZE OF MEDIUM GRAVEL; TRACE OF FINE TO MEDIUM GRAVEL
			5		23.6 ppm		SM	SAND, FFINE TO VERY FINE; SOME SILT; TRACE FINE TO MEDIUM GRAVEL, BROWN/GRAY SATURATED
	10		6		16.8 ppm			SAND, FINE TO VERY FINE; SOME SILT; TRACE FINE TO MEDIUM GRAVE, BROWN/GRAY SATURATED
450			7		4.8 ppm			SILT AND SAND, FINE TO VERY FINE, BROWN, SATURATED
			8		6 ppm		SW	SILT AND SAND, FINE TO VERY FINE, BROWN, SATURATED
	20							
440								

Well Construction



Delta Environmental Consultants, Inc.	Project Number: S096-015	Site Id: MW-105
	Project Name: H.B. Fuller	Location: Geneva, New York
	Contractor:	Elevation: 457.92'
Consulting Firm: LBG		Datum: Mean Sea Level
Logged By:		Measuring Point: 457.61'
Date(s): 05/24/96 - 05/24/96		
Purpose: Monitoring Well, Shallow		
Drilling Method: Hollow Stem Auger		
Remarks:		

Conductor Casing:
type: dia: 0.00in fm: 0.00' to: 0.00'

Blank Casing:
type: PVC dia: 2.00in fm: 0.1' to: 5.00'

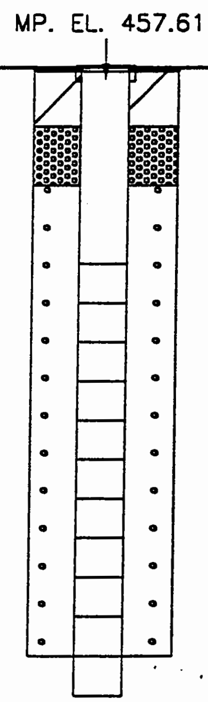
Screens:
type: Slotted size: 0.010in dia: 2.00in fm: 5.00' to: 15.00'

Annular Fill:
type: BENTONITE-CEMENT GROUT fm: 0.10' to: 1.50'
type: Bentonite Chips fm: 1.50' to: 3.00'
type: SAND PACK #2 fm: 3.00' to: 15.00'

Sample No.	Blow Count	PID	USCS Code	Material Description
1	[illegible]	1.2 ppm	ML	ASPHALT, BLACK, DRY/SILT, MEDIUM RAVEL AND MEDIUM SAND, DARK BROWN, DRY
2	[illegible]	0 ppm	GM/ML	SILT AND FINE TO MEDIUM GRAVEL; TRACE OF CLAY (NODULES), BLACK, DRY
3	[illegible]	0 ppm	ML	SILT AND FINE TO MEDIUM GRAVEL; TRACE OF CLAY (NODULES), BLACK, DRY
				SILT; SOME FONE TO VERY FINE SAND; LITTLE CLAY, BROWN, MOIST/SATURATED
4	[illegible]	1 ppm		SILT; SOME FFINE TO VERY FINE SAND; LITTLE CLAY, BROWN, MOIST/SATURATED
			SW	SAND, VERY FINE; LITTLE FINE SAND, LITTLE SILT, BROWN, SATURATED
5	[illegible]	1.6 ppm		SAND, VERY FFINE; LITTLE FINE SAND, LITTLE SILT, BROWN, SATURATED
6	[illegible]	1.3 ppm		SAND, VERY FINE TO FINE; LITTLE SILT, BROWN, SATURATED
7	[illegible]	1.0 ppm		SAND, VERY FINE TO FINE; LITTLE SILT, BROWN, SATURATED
8	[illegible]	1.1 ppm		SAND, VERY FFINE TO FINE, LITTLE SILT, BRROWN SATURATED
			CL	CLAY; LITTLE SILT, GRAY/BROWN

Elevation (ft): 450, 440, 430
Depth (ft): 10, 20

Well Construction

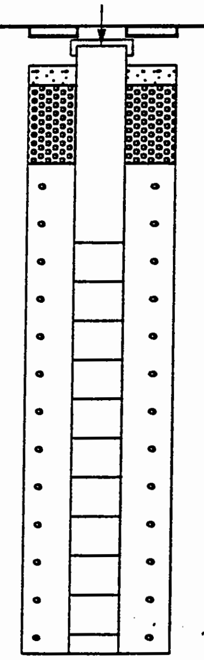


Delta Environmental Consultants, Inc.	Project Number: S096-015	Site Id: MW-106
	Project Name: H.B. Fuller	Location: Geneva, New York
	Contractor:	Elevation: 451.99'
Consulting Firm: Delta Environmental		Datum: Mean Sea Level
Logged By: B.Botterman		Measuring Point: 451.50'
Date(s): 07/16/97 - 07/16/97		Conductor Casing: type: dia: 0.00in fm: 0.00' to: 0.00'
Purpose: Monitoring Well, Shallow		Blank Casing: type: PVC dia: 2.00in fm: 0.5' to: 5.51'
Drilling Method: Hollow Stem Auger		
Remarks:		Screens: type: Slotted size: 0.010in dia: 2.00in fm: 5.51' to: 15.51'
		Annular Fill: type: CONCRETE fm: 1.00' to: 1.50'; type: Bentonite Chips fm: 1.50' to: 3.50'; type: SAND PACK #2 fm: 3.50' to: 16.00'

Elevation (ft)	Depth (ft)	Recovery	Sample No.	Blow Count	HNU	Graphic Log	USCS Code	Material Description
							PT	TOPSOIL AND GRASS, ROOTS, BLACK TOPSOIL FILL, DRY
450							CL	BECOMES MEDIUM BROWN SILTY CLAY GUMBO DAMP
			1	[illegible]	0 ppm			MEDIUM BROWN SILTY CLAY DAMP
			2	[illegible]	0 ppm		SM/CL	SAME AS ABOVE. VERY FINE GRAINED SAND MEDIUM BROWN. VERY FINE GRAINED SAND WITH SOME GRAVEL (FINE) WET MEDIUM BROWN SILTY CLAY, MOIST
			3	[illegible]	0 ppm			SAME AS ABOVE BECOMES MEDIUM GRAY SILTY CLAY VERY PLASTIC
	10		4	[illegible]	0 ppm		CL	CLAY WITH VERY FINE GRAINED SAND STRINGERS, VERY WET
440			5	[illegible]	0 ppm			CLAY, MEDIUM GRAY VERY PLASTIC AND WET AND SOFT, BECOMES FIRMER
			6	[illegible]	0 ppm			SAME AS ABOVE
					0 ppm			
	20							
430								

Well Construction

MP. EL. 451.50

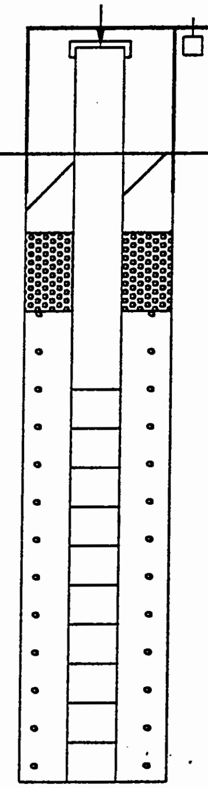


Delta Environmental Consultants, Inc.	Project Number: S096-015	Site Id: MW-107
	Project Name: H.B. Fuller	Location: Geneva, New York
	Contractor:	Elevation: 463.02'
Consulting Firm: Delta Environmental		Datum: Mean Sea Level
Logged By: B. Botterman		Measuring Point: 465.76'
Date(s): 07/16/97 - 07/16/97		Conductor Casing: type: dia: 0.00in fm: 0.00' to: 0.00'
Purpose: Monitoring Well, Shallow		
Drilling Method: Hollow Stem Auger		Blank Casing: type: PVC dia: 2.00in fm: -2.7' to: 6.00'
Remarks:		Screens: type: Slotted size: 0.010in dia: 2.00in fm: 6.00' to: 16.00'
		Annular Fill: type: BENTONITE-CEMENT GROUT fm: 0.00' to: 2.00'; type: Bentonite Chips fm: 2.00' to: 4.00'; type: SAND PACK #2 fm: 4.00' to: 16.00'

Elevation (ft)	Depth (ft)	Recovery	Sample No.	Blow Count	HNU	Graphic Log	USCS Code	Material Description
							PT	TOPSOIL, MEDIUM BROWN, DRY
460			1	[illegible]	0.5 ppm		CL	MEDIUM BROWN SILTY CLAY W/VERY FINE GRAINED SAND DAMP
			2	[illegible]	0 ppm			MEDIUM BROWN SILTY CLAY, DAMP, PLASTIC
								MEDIUM BRONW SILTY CLAY
			3	[illegible]	0 ppm		SM/SC	
								BECOMES FINER VERY FINE GRAINED SAND
			4	[illegible]	0 ppm			VERY FINE GRAINED SAND MEDIUM BROWN ROUNDED GRAINS, SILTY CLAY WET MEDIUM BROWN, VERY FINE GRAINED SAND
	10		5	[illegible]	0 ppm		CL	SILTY CLAY MEDIUM BROWN WET
			6	[illegible]	0.25 ppm			MEDIUM GRAY SILTY CLAY, WET VERY PLASTIC
450								VERY FINE GRAINED SAND STRINGERS WET
			7	[illegible]	0 ppm		SM/SC	MEDIUM BROWN SILTY SAND VERY FINE GRAINED WET, MEDIUM GRAY CLAY PLASTIC WET
								VERY FINED GRAINED MEDIUM SAND WET
					0 ppm			
	20							
440								

Well Construction

MP. EL. 465.76

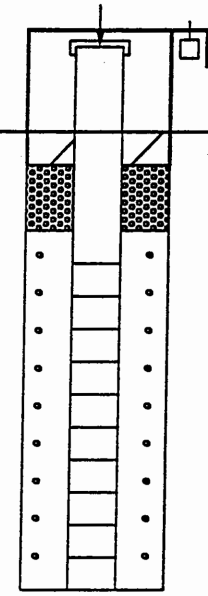


Delta Environmental Consultants, Inc.

Project Number:	Site Id: MW-108
Project Name: H.B. Fuller	Location: Geneva, New York
Contractor:	Elevation: 451.29'
Consulting Firm: Delta Environmental	Datum: Mean Sea Level
Logged By: B. Botterman	Conductor Casing: type: dia: 0.00in fm: 0.00' to: 0.00'
Date(s): 07/16/97 - 07/16/97	
Purpose: Monitoring Well, Shallow	Blank Casing: type: PVC dia: 2.00in fm: -2.6' to: 4.00'
Drilling Method: Hollow Stem Auger	
Annular Fill: type: BENTONITE-CEMENT GROUT fm: 0.00' to: 1.00' type: Bentonite Chips fm: 1.00' to: 3.00' type: SAND PACK #2 fm: 3.00' to: 14.00'	Screens: type: Slotted size: 0.010in dia: 2.00in fm: 4.00' to: 14.00' Remarks: GEOLOGY LOGGED AT MW-203

Elevation (ft)	Depth (ft)	Recovery	Sample No.	Blow Count	HNU	Graphic Log	USCS Code	Material Description
450					0 ppm		CL	TOPSOIL BROWN SILTY CLAY DRY
					0 ppm		ML	SILTY CLAY BECOMES DAMP VERY FINE GRAINED MEDIUM BROWN MOIST BECOMES WET
					0 ppm		ML/CL	MEDIUM GRAY VERY FINE GRAINED SAND WET SOME IRON STAINING WET. MEDIUM GRAY VERY FINE GRAINED SAND. MEDIUM GRAY SILTY CLAY WET PLASTIC
					0 ppm		CL	
					0 ppm			
	10				0 ppm			VERY FINE GRAINED SAND STRINGER MEIUM GRAY WET CLAY SAME AS ABOVE VERY FINE GRAINED SAND STRINGER MEDIUM GRAY WET CLAY SAME AS ABOVE
440					0 ppm			
					0 ppm			
430	20							
420	30							

Well Construction
MP. EL. 453.92



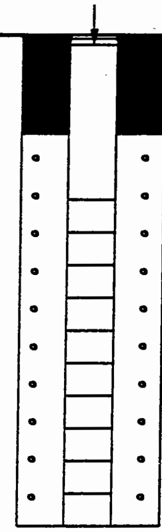
Delta Environmental Consultants, Inc.

Project Number: S096-015	Site Id: MW-109
Project Name: H.B. Fuller	Location: Geneva, New York
Contractor:	Elevation: 462.78'
Consulting Firm: Delta Environmental	Datum: Mean Sea Level
Logged By: R. Jenkins	Conductor Casing: type: dia: 0.00in fm: 0.00' to: 0.00'
Date(s): 02/17/98 - 02/17/98	
Purpose: Monitoring Well, Shallow	Blank Casing: type: PVC dia: 1.25in fm: 0.3' to: 5.00'
Drilling Method: GEOPROBE	
Annular Fill:	Screens: type: Slotted size: 0.010in dia: 1.25in fm: 5.00' to: 15.00'
type: Bentonite Grout fm: 0.00' to: 1.00'	Remarks:
type: Bentonite Pellets fm: 1.00' to: 3.00'	
type: SAND PACK #2 fm: 3.00' to: 15.00'	

Elevation (ft)	Depth (ft)	Recovery	Sample No.	Blow Count	Vapor	Graphic Log	USCS Code	Material Description
								SAND, COARSE TO FINE, TRACE OF ASPHALT
460								
								CLAY AND SILT, BROWN/RED
	10							SAND, FINE TO VERY FINE, SATURATED
450								
	20							
440								
	30							
430								

Well Construction

MP. EL. 462.46



Delta Environmental Consultants, Inc.

Project Number: S096-015	Site Id: MW-110
Project Name: H.B. Fuller	Location: Geneva, New York
Contractor: Zebra	Elevation: 454.74'
Consulting Firm: Delta Environmental	Datum: Mean Sea Level
Logged By: R. Jenkins	Measuring Point: 458.00'
Date(s): 02/17/98 - 02/17/98	Conductor Casing: type: dia: 0.00in fm: 0.00' to: 0.00'
Purpose: Monitoring Well, Shallow	
Drilling Method: GEOPROBE	Blank Casing: type: PVC dia: 1.25in fm: -3.2' to: 7.00'
Remarks:	Screens: type: Slotted size: 0.010in dia: 1.25in fm: 7.00' to: 12.00'
	Annular Fill: type: Bentonite Grout fm: 0.00' to: 5.00' type: Bentonite Pellets fm: 5.00' to: 7.00' type: SAND PACK #2 fm: 7.00' to: 12.00'

Elevation (ft)	Depth (ft)	Recovery	Sample No.	Blow Count	HNU	Graphic Log	USCS Code	Material Description
				NA	0 ppm		CL	CLAY, RED BROWN
450							ML	SILT RED BROWN, TRACE FINE SAND, MOIST
	10				0 ppm			
440								
	20							
430								

Well Construction

MP. EL. 458.00

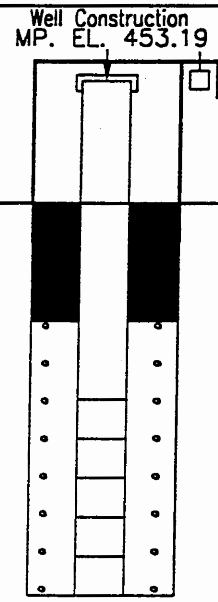
Delta Environmental Consultants, Inc.

	Project Number: S096-015	Site Id: MW-111
	Project Name: H.B. Fuller	Location: Geneva, New York
	Contractor: Zebro	Elevation: 450.05'

Consulting Firm: Delta Environmental	Datum: Mean Sea Level
Logged By: R. Jenkins	Measuring Point: 453.19'
Date(s): 02/18/98 - 02/18/98	Conductor Casing: type: dia: 0.00in fm: 0.00' to: 0.00'
Purpose: Monitoring Well, Shallow	Blank Casing: type: PVC dia: 1.25in fm: -3.1' to: 5.00'
Drilling Method: GEOPROBE	Screens: type: Slotted size: 0.010in dia: 1.25in fm: 5.00' to: 10.00'
Remarks:	Annular Fill: type: Bentonite Grout fm: 0.00' to: 1.00'; type: Bentonite Pellets fm: 1.00' to: 3.00'; type: SAND PACK #2 fm: 3.00' to: 10.00'

Elevation (ft)	Depth (ft)	Recovery	Sample No.	Blow Count	HNU	Graphic Log	USCS Code	Material Description
450					0 ppm		CL	CLAY, RED, BROWN
					0 ppm		ML	SILT RED BROWN, TRACE FINE SAND, MOIST
440	10							
430	20							
420								

Well Construction



Delta Environmental Consultants, Inc.

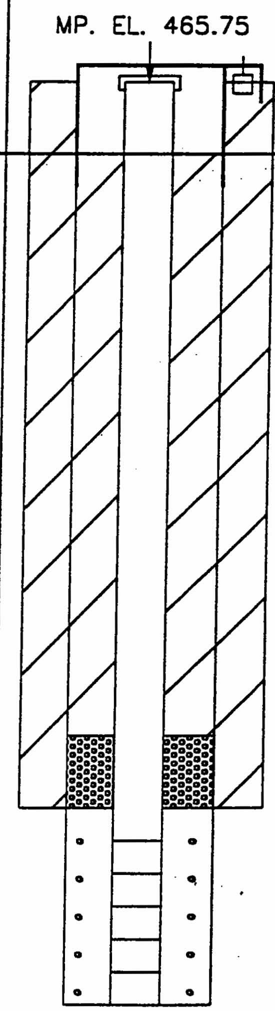
Project Number:	Site Id: MW-201
Project Name: H.B. Fuller	Location: Geneva, New York
Contractor:	Elevation: 463.58'
Consulting Firm: Delta Environmental	Datum: Mean Sea Level
Logged By: B. Botterman	Conductor Casing: type: Carbon Steel dia: 4.00in fm: -2.20' to: 20.00'
Date(s): 07/16/97 - 07/16/97	
Purpose: Monitoring Well, Deep	Blank Casing: type: PVC dia: 2.00in fm: -2.2' to: 21.00'
Drilling Method: Hollow Stem Auger	
Annular Fill: type: BENTONITE-CEMENT GROUT fm: 0.00' to: 17.80'; type: Bentonite Chips fm: 17.80' to: 20.00'; type: SAND PACK #2 fm: 20.00' to: 26.00'	Screens: type: Slotted size: 0.010in dia: 2.00in fm: 21.00' to: 26.00'
	Remarks:

Sample No.	Blow Count	HNU	USCS Code	Material Description
1	7 9 7 7		GC	SOIL FILL, GRAVEL, MEDIUM GRAY DRY, MEDIUM BROWN SAND VERY FINE GRAINED DRY BLUISH SLAG/SAND DAMP
2	4 8 8 9	15 ppm	CL	SILTY CLAY MEDIUM BROWN DAMP
3	4 5 8 8	9 ppm		
4	3 6 7 7	6 ppm		SOME GRAVEL FRAGMENTS IN SILTY CLAY BECOMES WET VERY FINE GRAINED SAND WITH SOME SILT, SOFT
5	2 3 8 13	11 ppm	PT/ML	CLAY CONTENT INCREASING BECOMES DAMP. APPEARS LIKE TOPSOIL, DARK BROWN SILTY LOAM SOME ROCK FRAGMENTS, VERY FINE GRAINED MEDIUM BROWN SAND, WELL SORTED DAMP
6	2 7 6 6	5 ppm		
7	4 4 6 7	7 ppm	CL	SILTY CLAY MEDIUM BROWN DAMP LAYERS OF VERY FINE GRAINED SAND, MEDIUM BROWN WET AND SILTY CLAY
8	2 2 3 4	1 ppm	CL/ML	CLAY BECOMES SOFTER WET AND MEDIUM GRAY VERY FINE GRAINED SAND TO SILTY CLAY WITH SOME VERY FINE GRAINED SAND
9	2 2 3 3	1 ppm		GRAY CLAY WET, MEDIUM BROWN VERY FINE GRAINED SAND GRAY CLAY SAME AS ABOVE VERY WET SOFT PLASTIC
10	2 2 3 3	0 ppm	ML	SAME AS ABOVE BECOMES MEDIUM GRAY VERY FINE GRAINED SAND WITH SOME SILT
11	6 8 8 8	0 ppm		VERY FINE GRAINED MEDIUM BROWN SILTY SAND, WET
12	3 5 6 6	0 ppm	CL	BECOME SILTY CLAY, MEDIUM BROWN
		0 ppm		
		0 ppm		

Elevation (ft): 460, 450, 440, 430

Depth (ft): 10, 20, 30

Well Construction



Delta Environmental Consultants, Inc.	Project Number:	Site Id: MW-202
	Project Name: H.B. Fuller	Location: Geneva, New York
	Contractor:	Elevation: 462.98'

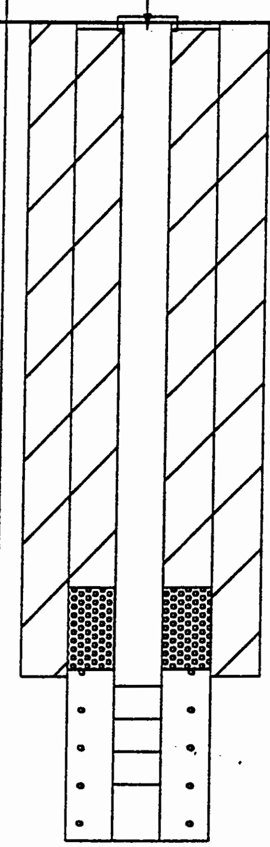
Consulting Firm: Delta Environmental	Datum: Mean Sea Level
Logged By: B. Botterman	Conductor Casing: type: Carbon Steel dia: 4.00in fm: 0.00' to: 20.00'
Date(s): 07/16/97 - 07/16/97	
Purpose: Monitoring Well, Deep	Blank Casing: type: PVC dia: 2.00in fm: 0.0' to: 20.28'
Drilling Method: Hollow Stem Auger	
Annular Fill: type: BENTONITE-CEMENT GROUT fm: 0.20' to: 17.28' type: Bentonite Chips fm: 17.28' to: 19.78' type: SAND PACK #2 fm: 19.78' to: 25.00'	Screens: type: Slotted size: 0.010in dia: 2.00in fm: 20.28' to: 23.28' Remarks:

Sample No.	Blow Count	HNU	USCS Code	Material Description
1	13 17 8 8	0 ppm	GW	GRAVEL AND FILL MEDIUM GRAY DRY
2	6 4 51 R	0 ppm	GM	FILL SAME AS ABOVE, BRICKS FILL BECOMES WET, SILT AND GRAVEL MEDIUM GRAY
3	5 5 10 15	0 ppm	CL	MEDIUM BROWN SILTY CLAY, PLASTIC DAMP
4	6 7 11 8	0 ppm	CL/ML	MEDIUM BROWN SILTY CLAY DAMP DENSE BECOMES MORE PLASTIC. MEDIUM BROWN VERY FINE GRAINED SAND, WET
5	4 5 11 14	0 ppm		SAME AS ABOVE
6	4 4 2 1	1 ppm		SILTY CLAY AND SILTY SAND STRINGERS VERY FINE GRAINED SAND, MEDIUM BROWN
7	2 5 4 4	15 ppm 0 ppm	CL	SILTY CLAY VERY PLASTIC AND WET BECOMES VERY SOFT CLAY WET
8	2 4 10 10	3 ppm	ML	VERY FINE GRAINED SAND MEDIUM BROWN WET
9	12 10 5 5	3 ppm		SAND VERY WET, BECOMES SILTY VERY WET
10	4 5 4 4	0.5 ppm	ML/CL	VERY FINE GRAINED SAND, PLASTIC CLAY VERY WET SILTY
11	3 3 3 3	0 ppm	CL	SILTY CLAY WET MEDIUM GRAY SILTY CLAY WITH GRAVEL, WET, SOFT, PLASTIC WITH VERY FINE GRAINED SAND STRINGER SOME VERY FINE GRAINED SILTY SAND STRINGERS
12	3 3 3 3	0 ppm		SILTY CLAY WET SOFT MEDIUM GRAY
13	26 26	0 ppm 0 ppm		VERY FINE GRAINED SILTY SAND MEDIUM GRAY WET

Elevation (ft): 460, 450, 440, 430
Depth (ft): 10, 20, 30

Well Construction

MP. EL. 462.76



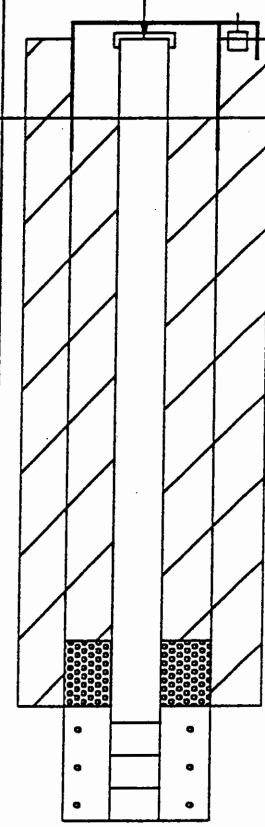
Delta Environmental Consultants, Inc.	Project Number:	Site Id: MW-203
	Project Name: H.B. Fuller	Location: Geneva, New York
	Contractor:	Elevation: 451.16'

Consulting Firm: Delta Environmental	Datum: Mean Sea Level
Logged By: B. Botterman	Conductor Casing: type: Carbon Steel dia: 4.00in fm: -2.40' to: 18.00'
Date(s): 07/17/97 - 07/17/97	
Purpose: Monitoring Well, Deep	Blank Casing: type: PVC dia: 2.00in fm: -2.4' to: 18.50'
Drilling Method: Hollow Stem Auger	
Annular Fill: type: BENTONITE-CEMENT GROUT fm: 0.00' to: 16.00' type: Bentonite Chips fm: 16.00' to: 18.00' type: SAND PACK #2 fm: 18.00' to: 21.50'	Screens: type: Slotted size: 0.010in dia: 2.00in fm: 18.50' to: 21.50' Remarks:

Elevation (ft)	Depth (ft)	Recovery	Sample No.	Blow Count	HNU	Graphic Log	USCS Code	Material Description
450			1	5 11 11 10	0 ppm		CL	TOPSOIL BROWN SILTY CLAY DRY SILTY CLAY BECOMES DAMP
			2	9 14 15 19	0 ppm		ML	VERY FINE GRAINED MEDIUM BROWN MOIST BECOMES WET
			3	12 8 4 2	0 ppm		ML/CL	MEDIUM GRAY VERY FINE GRAINED SAND WET SOME IRON STAINING WET. MEDIUM GRAY VERY FINE GRAINED SAND. MEDIUM GRAY SILTY CLAY WET PLASTIC
			4	8 4 4 6	0 ppm		CL	CLAY MEDIUM GRAY PLASTIC WET
			5	2 1 1 2	0 ppm			
440	10		6	2 1 2 2	0 ppm			VERY FINE GRAINED SAND STRINGER MEDIUM GRAY WET CLAY SAME AS ABOVE VERY FINE GRAINED SAND STRINGER MEDIUM GRAY WET CLAY SAME AS ABOVE
			7	2 1 2 1	0 ppm			
			8	2 6 2 2	0 ppm			
			9		0 ppm			MEDIUM BROWN SILTY CLAY WITH SOME ROCK FRAGMENTS MEDIUM GRAY CLAY WITH FINE GRAVEL SUB ROUNDED GRAVEL BLACK DOLOMITE
			10		0 ppm		CL	
	20				0 ppm			LARGER ROUNDED DOLOMITE GRAVEL (TILL) TILL MEDIUM GRAY CLAY WITH ROUNDED DOLOMITE FRAGMENTS
430								
	30							
420								

Well Construction

MP. EL. 453.54



Delta Environmental Consultants, Inc.	Project Number:	Site Id: P-01
	Project Name: H.B. Fuller	Location: Geneva, New York
	Contractor:	Elevation: 462.79'

Consulting Firm: Delta Environmental

Datum: Mean Sea Level

Logged By: B. Botterman

Date(s): 07/19/97 - 07/19/97

Conductor Casing:
type: dia: 0.00in fm: 0.00' to: 0.00'

Purpose: Municipal Well

Drilling Method: Hallow Stem Auger

Blank Casing:
type: PVC dia: 1.00in fm: 0.6' to: 23.00'

Annulor Fill:

type	fm	to
Bentonite Grout	0.00'	20.00'
Bentonite Pellets	20.00'	21.00'
SAND PACK #3	21.00'	25.00'

Screens:
type: Slotted size: 0.010in dia: 1.00in fm: 23.00' to: 25.00'

Remarks:

Elevation (ft)	Depth (ft)	Recovery	Sample No.	Blow Count	Vapor	Graphic Log	USCS Code	Material Description
							GC	GRAVEL AND CLAY, MEDIUM BROWN, DAMP
							SP	FINE SAND, DARK GRAY, DAMP. BRICK FRAGMENTS
460							CL	CLAY, MEDIUM BROWN, DAMP
							SC	SOFT CLAY AND VERY FINE SAND, MEDIUM BROWN, DAMP
							SP	SAND, FINE GRAINED, BROWN, DAMP, WELL SORTED
								SAND BECOMES SATURATED
	10						SC	SAND, FINE GRAINED, BROWN, WET; CLAY CONTENT INCREASING
							CL	SOFT WET CLAY
450								CLAY BECOMES GRAYISH/BROWN, SOFT, VERY PLASTIC, WET
							SP	VERY FINE GRAINED SAND, GRAYISH/BROWN, WELL SORTED
	20							SOFT SAND, POOR RECOVERY
								VERY FINE GRAINED SAND, BROWNISH/GRAY, WELL SORTED
440							CL	VERY SOFT CLAY, BROWNISH/GRAY, WET, VERY PLASTIC
								SAME AS ABOVE
	30							
430								

Well Construction

MP. EL. 462.16

Delta Environmental Consultants, Inc.

Project Number: S096-015	Site Id: SB-1
Project Name: H.B. Fuller	Location: Geneva, New York
Contractor: Zebra	Elevation: 461.70'
Consulting Firm: Delta Environmental	Datum: Mean Sea Level
Logged By: R. Jenkins	Measuring Point: N/A
Date(s): 02/17/98 - 02/17/98	Conductor Casing: type: dia: 0.00in fm: 0.00' to: 0.00'
Purpose: Soil Boring	Blank Casing: type: dia: 0.00in fm: 0.0' to: 16.00'
Drilling Method: GEOPROBE	Screens: type: size: dia: fm: to:
Remarks:	Annular Fill: type: fm: to: type: fm: to: type: fm: to:

Elevation (ft)	Depth (ft)	Recovery	Sample No.	Blow Count	Vapor	Graphic Log	USCS Code	Material Description	Well Construction
							GW	ASPHALT	Well Not Installed
460							ML	FILL MATERIAL, GRAVEL, SAND	
								SILT, DARK GRAY TO REDDISH BROWN, TRACE CLAY	
								SILT, RED BROWN, TRACE SAND, VERY FINE	
							SM	SAND, RED BROWN, VERY FINE, TRACE SILT	
							CL	CLAY, RED BROWN, MOIST	
	10								
450							ML	SILT, RED BROWN, TRACE SAND, FINE	
								SAND, VERY FINE, TRACE SILT, RED BROWN	
	20								
440									

Delta Environmental Consultants, Inc.

	Project Number: S096-015	Site Id: SB-2
	Project Name: H.B. Fuller	Location: Geneva, New York
	Contractor: Zebra	Elevation: 463.02'

Consulting Firm: Delta Environmental	Datum: Mean Sea Level
Logged By: R. Jenkins	Measuring Point: N/A
Date(s): 02/17/98 - 02/17/98	Conductor Casing: type: dia: 0.00in fm: 0.00' to: 0.00'
Purpose: Soil Boring	
Drilling Method: GEOPROBE	Blank Casing: type: dia: 0.00in fm: 0.0' to: 20.00'
Remarks:	Screens: type: size: dia: fm: to:
	Annular Fill: type: fm: to: type: fm: to: type: fm: to:

Elevation (ft)	Depth (ft)	Recovery	Sample No.	Blow Count	Vapor	Graphic Log	USCS Code	Material Description	Well Construction Well Not Installed
							GW	FILL MATERIAL, GRAVEL, SAND	
460							ML	SILT, RED BROWN	
								SILT, RED BROWN, TRACE SAND, VERY FINE, MOIST	
							CL/ML	CLAY, RED BROWN TO GRAY, TRACE STIFF, WET	
	10								
450							CL	CLAY, RED BROWN, WET	
							SM	SAND, RED BROWN, VERY FINE, TRACE SILT	
							SM	SILT, PINKISH BROWN, TRACE SAND, VERY FINE	
	20								
440									

Delta Environmental Consultants, Inc.

Project Number: S096-015	Site Id: SB-3	
Project Name: H.B. Fuller	Location: Geneva, New York	
Contractor: Zebra	Elevation: 461.57'	
Consulting Firm: Delta Environmental	Datum: Mean Sea Level	
Logged By: R. Jenkins	Measuring Point: N/A	
Date(s): 02/17/98 - 02/17/98	Conductor Casing: type: dia: 0.00in fm: 0.00' to: 0.00'	
Purpose: Monitoring Well, Shallow		
Drilling Method: GEOPROBE	Blank Casing: type: dia: 0.00in fm: 0.0' to: 8.00'	
Remarks:	Screens: type: size: dia: fm: to:	
	Annular Fill: type: fm: to: type: fm: to: type: fm: to:	

Elevation (ft)	Depth (ft)	Recovery	Sample No.	Blow Count	Vapor	Graphic Log	USCS Code	Material Description	Well Construction
							GW	ORGANIC MATERIAL	Well Not Installed
460							ML	FILL MATERIAL, SILT, GRAVEL, SAND	
								SILT, RED BROWN, TRACE SAND, VERY FINE	
								SILT, DARK BROWN TO GRAY, TRACE GRAVEL, COURSE	
								SILT, RED BROWN, TRACE SAND, VERY FINE	
							CL	CLAY, RED BROWN	
								SILT, RED BROWN, TRACE SAND, VERY FINE	
	10								
450									
	20								
440									

APPENDIX B

DAILY PRECIPITATION LOG

DAILY PRECIPITATION
GENEVA AREA
August 9, 1997 through September 20, 1997

Date	Rainfall (inches)	Date	Rainfall (inches)
8/9/97	0.00	9/6/97	0.00
8/10/97	0.00	9/7/97	0.03
8/11/97	0.00	9/8/97	0.04
8/12/97	0.26	9/9/97	0.00
8/13/97	0.14	9/10/97	0.00
8/14/97	0.26	9/11/97	0.09
8/15/97	0.00	9/12/97	0.45
8/16/97	0.20	9/13/97	0.02
8/17/97	0.03	9/14/97	0.00
8/18/97	0.10	9/15/97	0.00
8/19/97	0.00	9/16/97	0.00
8/20/97	0.00	9/17/97	0.00
8/21/97	0.29	9/18/97	0.12
8/22/97	0.04	9/19/97	0.00
8/23/97	0.13	9/20/97	0.04
8/24/97	0.01	9/21/97	0.02
8/25/97	0.02	9/22/97	0.00
8/26/97	0.00	9/23/97	0.00
8/27/97	0.02	9/24/97	0.07
8/28/97	0.01	9/25/97	0.00
8/29/97	0.00	9/26/97	0.31
8/30/97	0.00	9/27/97	0.03
8/31/97	0.00	9/28/97	0.00
9/1/97	0.06	9/29/97	1.47
9/2/97	0.00	9/30/97	0.23
9/3/97	0.62	10/1/97	0.14
9/4/97	0.00	10/2/97	0.00
9/5/97	0.00	10/3/97	0.01

Inches of precipitation preceding 24 hours
(as of 8:00 AM)

WATER USAGE

FORMER MONARCH CHEMICAL

August 11, 1997 through September 29, 1997

Date	Neutralization Tank Release (gallons)	Water Used in Production (week ending) (gallons)	Meter Readings (used) Production (gallons)	Meter Readings (used) Wash (gallons)	Meter Readings Production (ft^3)	Meter Readings Wash (ft^3)	Meter Readings Production (gallons)	Meter Readings Wash (gallons)
8/11/97	1,600	--	--	--				
8/15/97	--	1,846	--	--	[illegible]	[illegible]	[illegible]	[illegible]
8/18/97	--	--	0.0	0.0	109436.4	111836.2	818584.3	836534.78
8/25/97	--	15,427	20.2	56.1	109439.1	111843.7	818604.5	836590.88
9/2/97	--	363	114.4	-753160.5	109454.4	11153.8	818718.9	83430.424
9/8/97	1,600	2,340	162.3	753301.1	109476.1	111862.5	818881.2	836731.5
9/15/97	--	216	11.2	-753151.5	109477.6	11173.8	818892.4	83580.024
9/22/97	--	614	112.2	753321.3	109492.6	111885.2	819004.6	836901.3
9/29/97	--	423	128.7	112.9	109509.8	111900.3	819133.3	837014.24

APPENDIX C

VERTICAL HYDRAULIC GRADIENT CALCULATIONS

HORIZONTAL HYDRAULIC GRADIENT CALCULATIONS
FORMER MONARCH CHEMICAL FACILITY
GENEVA, NEW YORK
DELTA PROJECT NO. S096-015

Based on data obtained from February 18, 1998.
Using data from monitoring wells MW-1, MW-5 and MW-11.

Water Table Elevations		Distance between MW-1 & MW-11
MW-1	458.74	208 ft
MW-5	451.61	
MW-11	447.79	

$$\frac{458.74 - 451.61}{X} = \frac{458.74 - 447.79}{208}$$

$$\frac{7.13}{X} = \frac{10.95}{208}$$

$$10.95\ X = 1{,}483$$

$$X = 135.43$$

(distance between MW-1 & MW-11 at which the water table elevation is the same as the intermediate well)

$$\frac{\Delta h}{\Delta L} = \frac{458.74 - 451.61}{127 \text{ ft}}$$

(distance between MW-1 and contour 451.61)

$$= \frac{7.13}{127} \quad \frac{\Delta h}{\Delta L} \quad 0.056$$

$$\boxed{\frac{\Delta h}{\Delta L} = \mathbf{0.056}}$$

VERTICAL HYDRAULIC GRADIENT CALCULATIONS
FORMER MONARCH CHEMICAL FACILITY
GENEVA, NEW YORK
DELTA PROJECT NO. S096-015

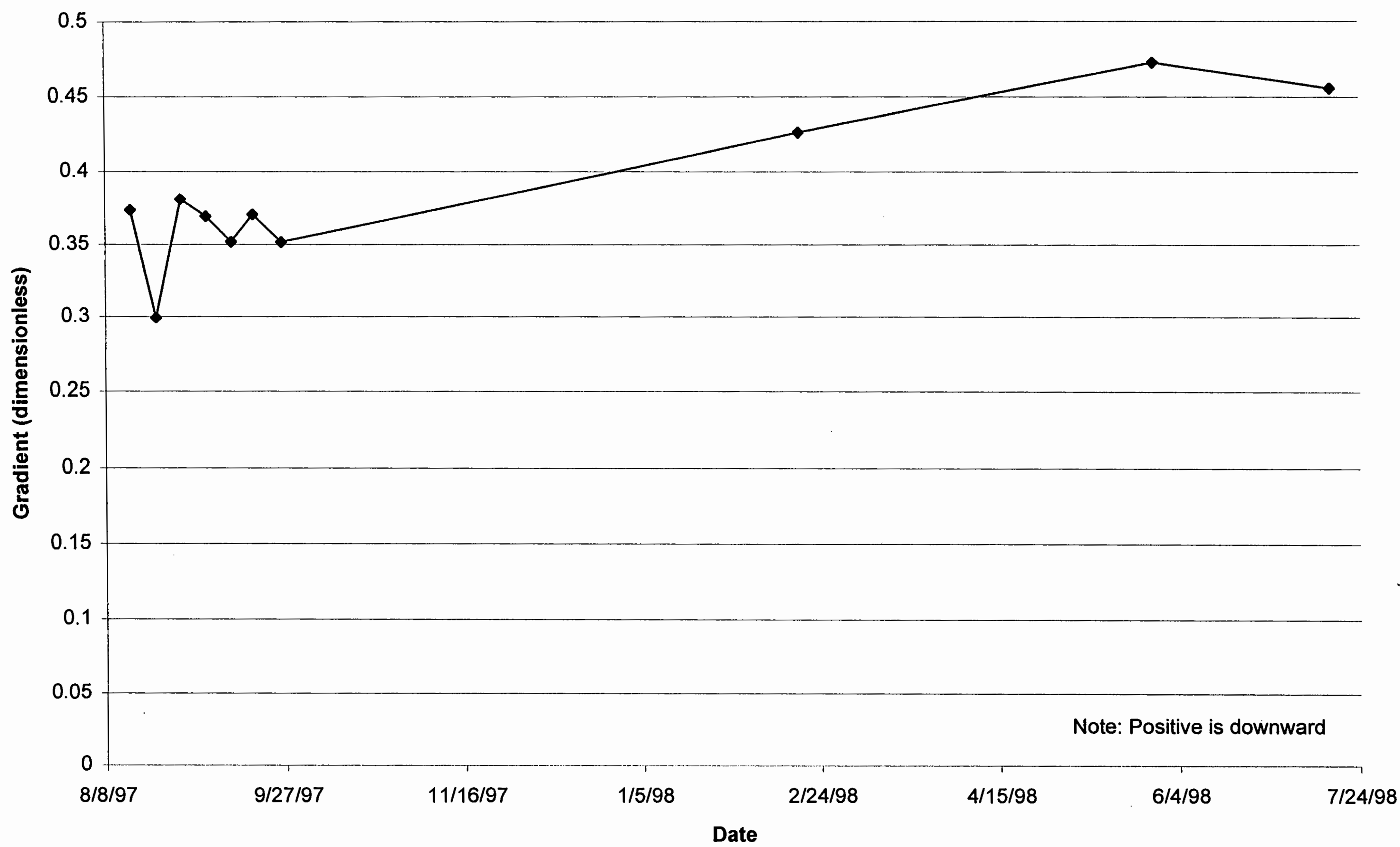
Well ID	Date	Water Elevation *	Well ID	Date	Water Elevation *	Δ h	Δ L	Δ h / Δ L (gradient)
MW-101	8/15/97	453.93	MW-201	8/15/97	449.69	4.24	11.35	0.373568
MW-101	8/22/97	452.97	MW-201	8/22/97	449.86	3.11	10.39	0.299326
MW-101	8/29/97	453.76	MW-201	8/29/97	449.5	4.26	11.18	0.381038
MW-101	9/5/97	453.95	MW-201	9/5/97	449.75	4.2	11.37	0.369393
MW-101	9/12/97	453.78	MW-201	9/12/97	449.84	3.94	11.20	0.351786
MW-101	9/18/97	453.59	MW-201	9/18/97	449.51	4.08	11.01	0.370572
MW-101	9/26/97	453.50	MW-201	9/26/97	449.66	3.84	10.92	0.351648
MW-101	2/18/98	458.74	MW-201	2/18/98	451.85	6.89	16.16	0.426361
MW-101	5/28/98	457.64	MW-201	5/28/98	450.52	7.12	15.06	0.472776
MW-101	7/16/98	457.79	MW-201	7/16/98	450.86	6.93	15.21	0.455621
MW-102	8/15/97	453.09	MW-202	8/15/97	448.33	4.76	10.41	0.457253
MW-102	8/22/97	452.88	MW-202	8/22/97	448.49	4.39	10.2	0.430392
MW-102	8/29/97	452.69	MW-202	8/29/97	448.3	4.39	10.01	0.438561
MW-102	9/5/97	453.49	MW-202	9/5/97	448.46	5.03	10.81	0.465310
MW-102	9/12/97	453.07	MW-202	9/12/97	448.47	4.6	10.39	0.442733
MW-102	9/18/97	452.66	MW-202	9/18/97	448.23	4.43	9.98	0.443888
MW-102	9/26/97	452.13	MW-202	9/26/97	448.37	3.76	9.45	0.397884
MW-102	2/18/98	458.82	MW-202	2/18/98	450.46	8.36	16.14	0.517968
MW-102	5/28/98	455.73	MW-202	5/28/98	449.35	6.38	13.05	0.488889
MW-102	7/16/98	456.68	MW-202	7/16/98	449.67	7.01	14.00	0.500714
MW-108	8/15/97	443.10	MW-203	8/15/97	432	11.1	10.44	1.063218
MW-108	8/22/97	443.02	MW-203	8/22/97	432.51	10.51	10.36	1.014479
MW-108	8/29/97	442.91	MW-203	8/29/97	433.25	9.66	10.25	0.942439
MW-108	9/5/97	442.83	MW-203	9/5/97	433.91	8.92	10.17	0.877089
MW-108	9/12/97	442.72	MW-203	9/12/97	434.48	8.24	10.06	0.819085
MW-108	9/18/97	442.72	MW-203	9/18/97	435.03	7.69	10.06	0.764414
MW-108	9/26/97	442.68	MW-203	9/26/97	435.53	7.15	10.02	0.713573
MW-108	2/18/98	450.72	MW-203	2/18/98	445.14	5.58	18.06	0.308970
MW-108	5/28/98	445.61	MW-203	5/28/98	443.54	2.07	12.95	0.159846
MW-108	7/16/98	445.77	MW-203	7/16/98	444.92	0.85	13.11	0.064836

* Measurements based on mean sea level.

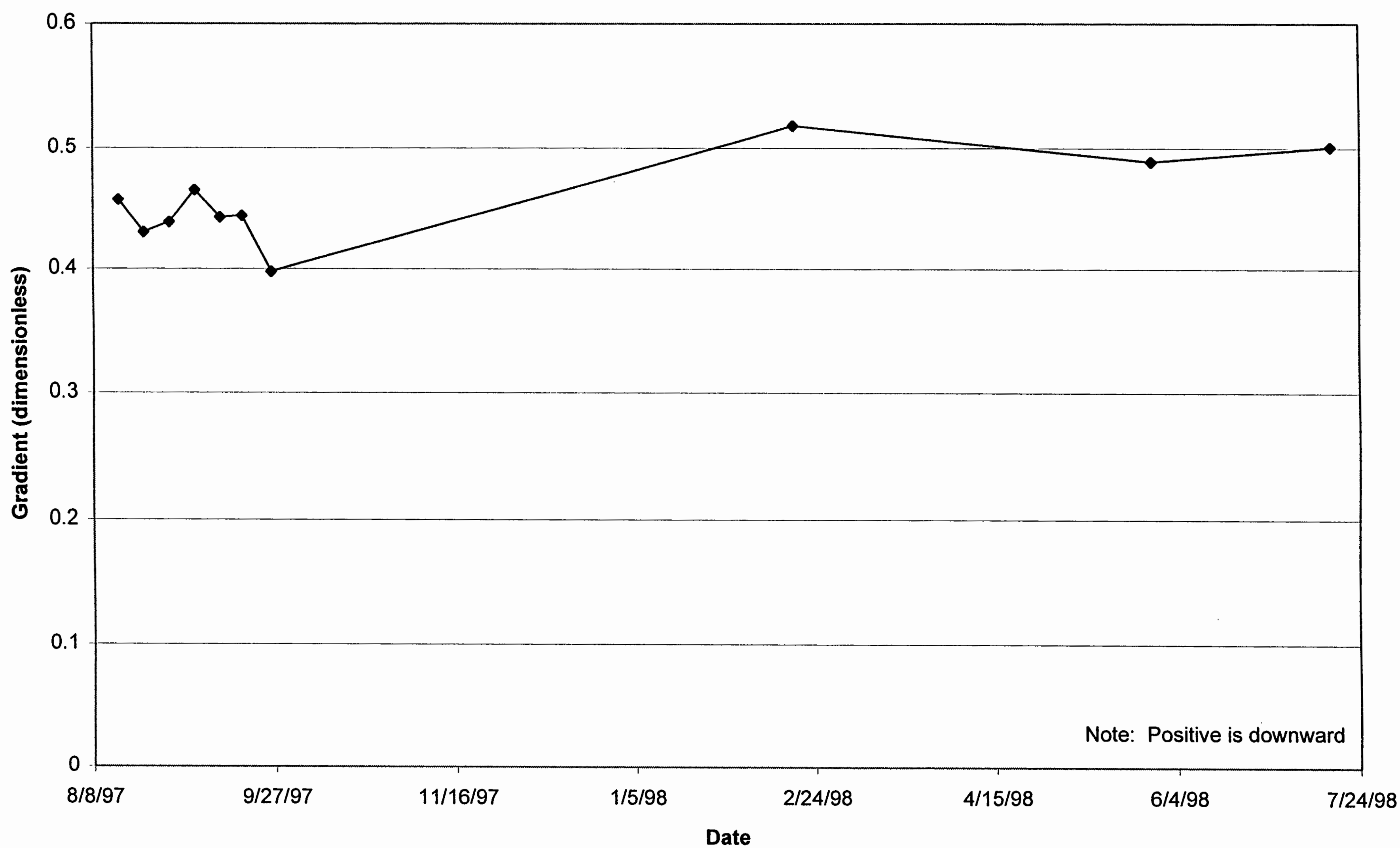
ΔL was determined by subtracting the elevation of the top of the screen interval for the deep well from the water elevation of the water table well.

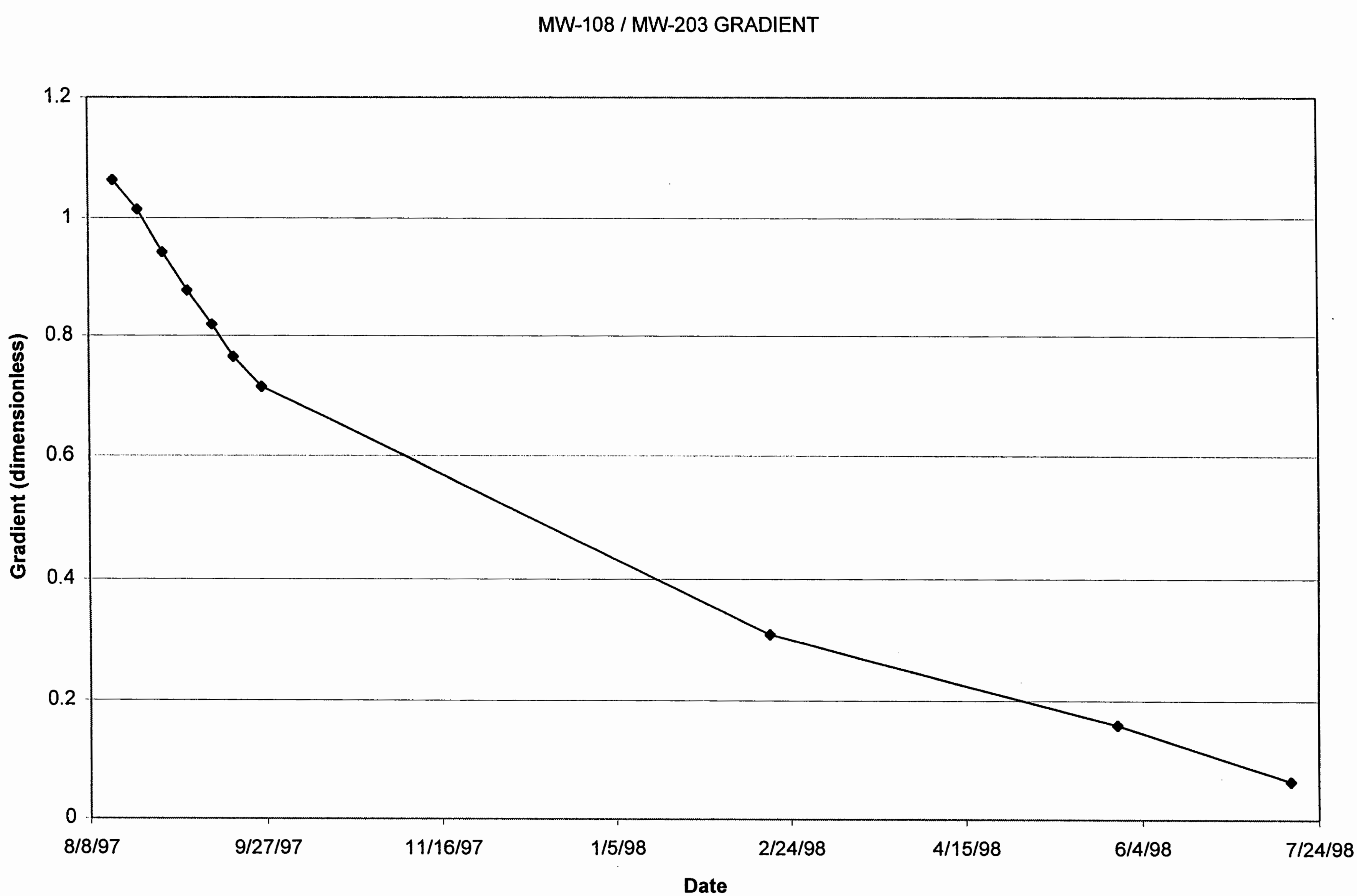
A positive Δh / ΔL indicates a downward gradient.

MW-101 / MW-201 GRADIENT



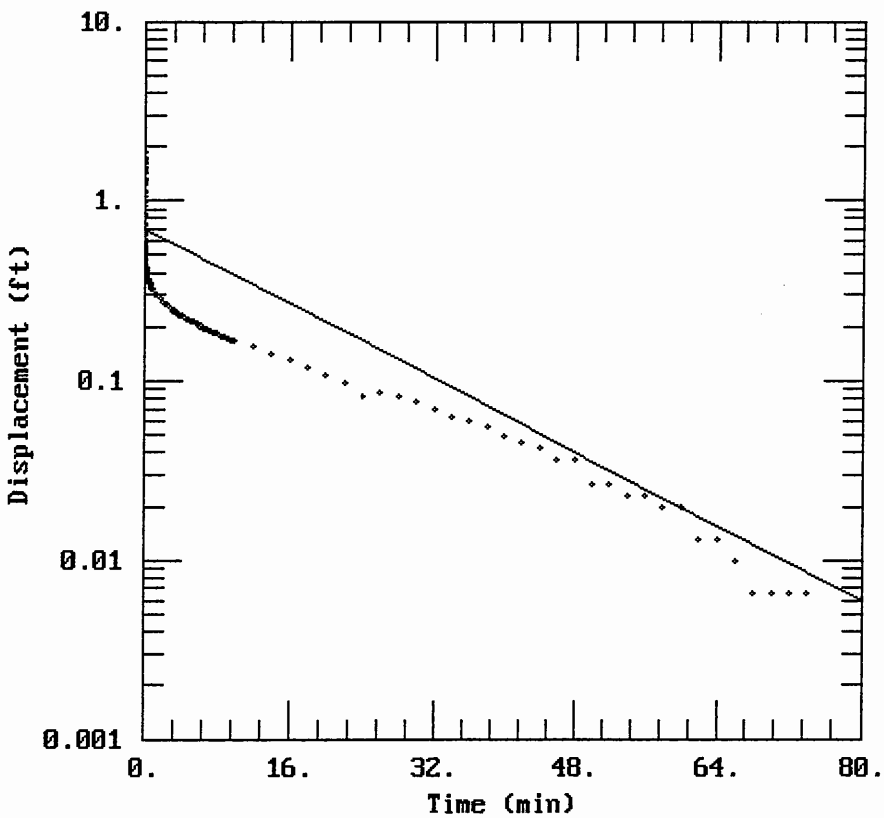
MW-102 / MW-202 GRADIENT




MW-108 / MW-203 GRADIENT
Gradient (dimensionless)
1.2
1
0.8
0.6
0.4
0.2
0
8/8/97
9/27/97
11/16/97
1/5/98
2/24/98
4/15/98
6/4/98
7/24/98
Date

APPENDIX D

SLUG TEST RESULTS



DATA SET:
MW01.DAT
05/14/98

AQUIFER MODEL:
Unconfined

SOLUTION METHOD:
Bouwer-Rice

TEST DATA:
H0= 3. ft
r_c= 0.1667 ft
r_w= 0.6875 ft
L = 5.99 ft
b = 5.99 ft
H = 5.99 ft

PARAMETER ESTIMATES:
K = 0.0007191 cm/sec
y0 = 0.6978 ft

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A Q T E S O L V   R E S U L T S
Version 2.0

Developed by Glenn M. Duffield
(c) 1993, 1994 Geraghty & Miller, Inc.

05/14/98 19:00:20

TEST DESCRIPTION

Data set........... MW01.DAT
Output file........ MW01A.OUT
Data set title..... MW-1 - test using ft converstion &bail
Company............ HB Fuller
Project............ S095-015
Test well.......... MW-01

Units of Measurement
Length.......... ft
Time............ min

Test Well Data
Initial displacement in well..... 3
Radius of well casing............ 0.1667
Radius of wellbore............... 0.6875
Aquifer saturated thickness...... 5.99
Well screen length............... 5.99
Static height of water in well... 5.99
Gravel pack porosity............. 0.35
Effective well casing radius..... 0.4284
Effective wellbore radius........ 0.6875
Log(Re/Rw)....................... 1.547
Constants A, B and C............. 0.000 , 0.000, 1.205
No. of observations.............. 213

ANALYTICAL METHOD

Bouwer-Rice (Unconfined Aquifer Slug Test)

RESULTS FROM STATISTICAL CURVE MATCHING

STATISTICAL MATCH PARAMETER ESTIMATES

	Estimate		Std. Error	
K =	6.8949E-002	+/-	4.3159E-003	cm/sec
y0 =	1.5853E+000	+/-	6.8109E-002	ft

ANALYSIS OF MODEL RESIDUALS

residual = observed - calculated
weighted residual = residual * weight

Weighted Residual Statistics:
Number of residuals............... 213
Number of estimated parameters.... 2
Degrees of freedom................ 211
Residual mean..................... 0.102
Residual standard deviation....... 0.1927
Residual variance................. 0.03712

Model Residuals:

Time	Observed	Calculated	Residual	Weight
0.0166	1.8471	1.4415	0.40562	1
0.02	1.7257	1.4137	0.31203	1
0.0233	1.6962	1.3872	0.30897	1
0.0266	1.6371	1.3612	0.2759	1
0.03	1.5912	1.335	0.25622	1
0.0333	1.542	1.31	0.23201	1
0.0366	1.4829	1.2854	0.19748	1
0.04	1.4436	1.2606	0.1829	1
0.0433	1.4042	1.237	0.16714	1
0.0466	1.3254	1.2139	0.11157	1
0.05	1.2959	1.1905	0.10546	1
0.0533	1.2566	1.1682	0.088381	1
0.0566	1.227	1.1463	0.080726	1
0.06	1.1417	1.1242	0.017535	1
0.0633	1.1155	1.1031	0.012337	1
0.0666	1.0564	1.0825	-0.026056	1
0.07	1.0138	1.0616	-0.047828	1
0.0733	0.97112	1.0417	-0.070602	1
0.0766	0.92847	1.0222	-0.093746	1
0.08	0.89238	1.0025	-0.11012	1
0.0833	0.85629	0.98372	-0.12743	1
0.0866	0.8202	0.9653	-0.1451	1
0.09	0.80052	0.94668	-0.14617	1
0.0933	0.74802	0.92896	-0.18093	1
0.0966	0.72506	0.91156	-0.1865	1
0.1	0.69225	0.89398	-0.20173	1
0.1033	0.666	0.87724	-0.21124	1
0.1066	0.63976	0.86081	-0.22106	1
0.11	0.61679	0.84421	-0.22742	1
0.1133	0.59711	0.8284	-0.23129	1
0.1166	0.5807	0.81289	-0.23219	1
0.12	0.56758	0.79721	-0.22963	1
0.1233	0.55446	0.78228	-0.22783	1
0.1266	0.54133	0.76763	-0.2263	1
0.13	0.53149	0.75283	-0.22134	1
0.1333	0.52165	0.73873	-0.21708	1
0.1366	0.51181	0.7249	-0.21309	1
0.14	0.50524	0.71091	-0.20567	1
0.1433	0.49868	0.6976	-0.19892	1
0.1466	0.4954	0.68454	-0.18914	1
0.15	0.48556	0.67133	-0.18578	1
0.1533	0.48556	0.65876	-0.17321	1
0.1566	0.47572	0.64643	-0.17071	1
0.16	0.47572	0.63396	-0.15824	1
0.1633	0.46915	0.62209	-0.15293	1
0.1666	0.46259	0.61044	-0.14785	1
0.17	0.46259	0.59867	-0.13607	1

0.1733	0.45931	0.58745	-0.12814	1
0.1766	0.45931	0.57645	-0.11714	1
0.18	0.45603	0.56534	-0.1093	1
0.1833	0.44947	0.55475	-0.10528	1
0.1866	0.44947	0.54436	-0.094891	1
0.19	0.44619	0.53386	-0.087673	1
0.1933	0.44291	0.52386	-0.080957	1
0.1966	0.44291	0.51405	-0.071147	1
0.2	0.44291	0.50414	-0.061232	1
0.2033	0.43635	0.4947	-0.058354	1
0.2066	0.43307	0.48544	-0.05237	1
0.21	0.43307	0.47607	-0.043007	1
0.2133	0.4265	0.46716	-0.040654	1
0.2166	0.4265	0.45841	-0.031906	1
0.22	0.4265	0.44957	-0.023065	1
0.2233	0.4265	0.44115	-0.014646	1
0.2266	0.42322	0.43289	-0.0096662	1
0.23	0.42322	0.42454	-0.0013168	1
0.2333	0.41994	0.41659	0.0033521	1
0.2366	0.41994	0.40879	0.011153	1
0.24	0.41994	0.4009	0.019038	1
0.2433	0.41338	0.3934	0.019984	1
0.2466	0.41338	0.38603	0.027351	1
0.25	0.41338	0.37858	0.034796	1
0.2533	0.4101	0.3715	0.038604	1
0.2566	0.4101	0.36454	0.045561	1
0.26	0.4101	0.35751	0.052592	1
0.2633	0.40682	0.35081	0.056006	1
0.2666	0.40682	0.34424	0.062575	1
0.27	0.40682	0.3376	0.069215	1
0.2733	0.40682	0.33128	0.075537	1
0.2766	0.40026	0.32508	0.075179	1
0.28	0.40026	0.31881	0.081449	1
0.2833	0.40026	0.31284	0.087419	1
0.2866	0.40026	0.30698	0.093277	1
0.29	0.40026	0.30106	0.099198	1
0.2933	0.39698	0.29542	0.10155	1
0.2966	0.39698	0.28989	0.10709	1
0.3	0.39698	0.2843	0.11268	1
0.3033	0.39698	0.27898	0.118	1
0.3066	0.39042	0.27375	0.11666	1
0.31	0.39042	0.26847	0.12194	1
0.3133	0.39042	0.26344	0.12697	1
0.3166	0.39042	0.25851	0.1319	1
0.32	0.39042	0.25352	0.13689	1
0.3233	0.39042	0.24878	0.14164	1
0.3266	0.38713	0.24412	0.14302	1
0.33	0.38713	0.23941	0.14772	1
0.3333	0.38385	0.23493	0.14893	1
0.35	0.38713	0.21349	0.17364	1
0.3666	0.38385	0.19413	0.18973	1
0.3833	0.37729	0.17642	0.20087	1
0.4	0.37401	0.16032	0.21369	1
0.4166	0.37401	0.14578	0.22823	1
0.4333	0.37073	0.13248	0.23825	1
0.45	0.37073	0.1204	0.25033	1
0.4666	0.36417	0.10947	0.25469	1
0.4833	0.36089	0.099488	0.2614	1
0.5	0.36089	0.090411	0.27048	1
0.5166	0.35433	0.08221	0.27212	1

0.5333	0.35433	0.07471	0.27962	1
0.55	0.35105	0.067895	0.28315	1
0.5666	0.35105	0.061736	0.28931	1
0.5833	0.35105	0.056104	0.29494	1
0.6	0.35105	0.050986	0.30006	1
0.6166	0.34777	0.046361	0.3014	1
0.6333	0.34777	0.042131	0.30563	1
0.65	0.34777	0.038288	0.30948	1
0.6666	0.3412	0.034815	0.30639	1
0.6833	0.3412	0.031639	0.30956	1
0.7	0.3412	0.028752	0.31245	1
0.7166	0.33792	0.026144	0.31178	1
0.7333	0.33792	0.023759	0.31416	1
0.75	0.33792	0.021592	0.31633	1
0.7666	0.33464	0.019633	0.31501	1
0.7833	0.33464	0.017842	0.3168	1
0.8	0.33464	0.016214	0.31843	1
0.8166	0.33464	0.014743	0.3199	1
0.8333	0.32808	0.013398	0.31468	1
0.85	0.32808	0.012176	0.3159	1
0.8666	0.32808	0.011072	0.31701	1
0.8833	0.32808	0.010062	0.31802	1
0.9	0.3248	0.0091436	0.31566	1
0.9166	0.3248	0.0083142	0.31648	1
0.9333	0.3248	0.0075557	0.31724	1
0.95	0.3248	0.0068664	0.31793	1
0.9666	0.3248	0.0062436	0.31856	1
0.9833	0.32152	0.005674	0.31584	1
1	0.32152	0.0051564	0.31636	1
1.2	0.30511	0.0016398	0.30347	1
1.4	0.30183	0.00052148	0.30131	1
1.6	0.29199	0.00016584	0.29183	1
1.8	0.28543	5.2739E-005	0.28538	1
2	0.27559	1.6772E-005	0.27557	1
2.2	0.26903	5.3337E-006	0.26902	1
2.4	0.26575	1.6962E-006	0.26574	1
2.6	0.26246	5.3942E-007	0.26246	1
2.8	0.2559	1.7154E-007	0.2559	1
3	0.24278	5.4553E-008	0.24278	1
3.2	0.24934	1.7349E-008	0.24934	1
3.4	0.24278	5.5172E-009	0.24278	1
3.6	0.2395	1.7546E-009	0.2395	1
3.8	0.22966	5.5797E-010	0.22966	1
4	0.22966	1.7744E-010	0.22966	1
4.2	0.22966	5.643E-011	0.22966	1
4.4	0.22638	1.7946E-011	0.22637	1
4.6	0.21981	5.707E-012	0.21981	1
4.8	0.21981	1.8149E-012	0.21981	1
5	0.21653	5.7717E-013	0.21653	1
5.2	0.21653	1.8355E-013	0.21653	1
5.4	0.21325	5.8371E-014	0.21325	1
5.6	0.20669	1.8563E-014	0.20669	1
5.8	0.20669	5.9033E-015	0.20669	1
6	0.20013	1.8773E-015	0.20013	1
6.2	0.20341	5.9702E-016	0.20341	1
6.4	0.20013	1.8986E-016	0.20013	1
6.6	0.19357	6.0379E-017	0.19357	1
6.8	0.19357	1.9201E-017	0.19357	1
7	0.19357	6.1063E-018	0.19357	1
7.2	0.19029	1.9419E-018	0.19029	1

7.4	0.19029	6.1756E-019	0.19029	1
7.6	0.18373	1.9639E-019	0.18373	1
7.8	0.18373	6.2456E-020	0.18373	1
8	0.18373	1.9862E-020	0.18373	1
8.2	0.18044	6.3164E-021	0.18044	1
8.4	0.17716	2.0087E-021	0.17716	1
8.6	0.17716	6.388E-022	0.17716	1
8.8	0.17716	2.0315E-022	0.17716	1
9	0.1706	6.4604E-023	0.1706	1
9.2	0.1706	2.0545E-023	0.1706	1
9.4	0.16732	6.5336E-024	0.16732	1
9.6	0.16732	2.0778E-024	0.16732	1
9.8	0.16732	6.6077E-025	0.16732	1
10	0.16732	2.1014E-025	0.16732	1
12	0.1542	2.2232E-030	0.1542	1
14	0.14107	2.3521E-035	0.14107	1
16	0.13123	2.4885E-040	0.13123	1
18	0.11811	2.6328E-045	0.11811	1
20	0.10827	2.7855E-050	0.10827	1
22	0.098424	2.947E-055	0.098424	1
24	0.08202	3.1178E-060	0.08202	1
26	0.085301	3.2986E-065	0.085301	1
28	0.08202	3.4899E-070	0.08202	1
30	0.075458	3.6923E-075	0.075458	1
32	0.068897	3.9063E-080	0.068897	1
34	0.062335	4.1329E-085	0.062335	1
36	0.059054	4.3725E-090	0.059054	1
38	0.055774	4.626E-095	0.055774	1
40	0.049212	4.8943E-100	0.049212	1
42	0.045931	5.1781E-105	0.045931	1
44	0.04265	5.4783E-110	0.04265	1
46	0.036089	5.796E-115	0.036089	1
48	0.036089	6.132E-120	0.036089	1
50	0.026246	6.4876E-125	0.026246	1
52	0.026246	6.8638E-130	0.026246	1
54	0.022966	7.2618E-135	0.022966	1
56	0.022966	7.6828E-140	0.022966	1
58	0.019685	8.1283E-145	0.019685	1
60	0.019685	8.5996E-150	0.019685	1
62	0.013123	9.0983E-155	0.013123	1
64	0.013123	9.6258E-160	0.013123	1
66	0.009842	1.0184E-164	0.009842	1
68	0.006562	1.0774E-169	0.006562	1
70	0.006562	1.1399E-174	0.006562	1
72	0.006562	1.206E-179	0.006562	1
74	0.006562	1.276E-184	0.006562	1

===

RESULTS FROM VISUAL CURVE MATCHING

VISUAL MATCH PARAMETER ESTIMATES

	Estimate
K =	7.1911E-004 cm/sec
y0 =	6.9783E-001 ft

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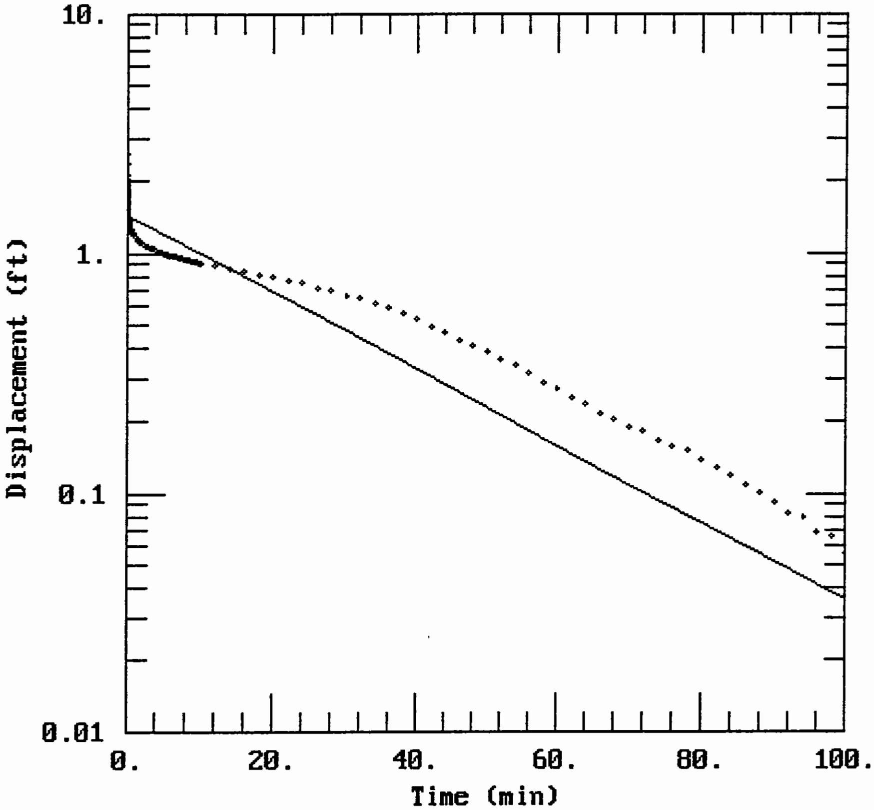

DATA SET:
MW02.DAT
05/14/98

AQUIFER MODEL:
Unconfined

SOLUTION METHOD:
Bouwer-Rice

TEST DATA:
H0= 3. ft
r_c= 0.1667 ft
r_w= 0.6875 ft
L = 5.8 ft
b = 5.8 ft
H = 5.8 ft

PARAMETER ESTIMATES:
K = 0.0004533 cm/sec
y0 = 1.445 ft

```
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                        A Q T E S O L V   R E S U L T S
                                  Version 2.0

                        Developed by Glenn M. Duffield
                     (c) 1993, 1994 Geraghty & Miller, Inc.

05/14/98                                                                18:41:18

================================================================================
                                TEST DESCRIPTION

Data set........... MW02.DAT
Output file........ MW02.OUT
Data set title..... MW-2 - test using ft converstion &bail

Units of Measurement
   Length.......... ft
   Time............ min

Test Well Data
   Initial displacement in well..... 3
   Radius of well casing............ 0.1667
   Radius of wellbore............... 0.6875
   Aquifer saturated thickness...... 5.8
   Well screen length............... 5.8
   Static height of water in well... 5.8
   Gravel pack porosity............. 0.35
   Effective well casing radius..... 0.4284
   Effective wellbore radius........ 0.6875
   Log(Re/Rw)....................... 1.523
   Constants A, B and C............. 0.000 ,  0.000,  1.186
   No. of observations.............. 230

================================================================================
                               ANALYTICAL METHOD

Bouwer-Rice (Unconfined Aquifer Slug Test)

================================================================================
                     RESULTS FROM STATISTICAL CURVE MATCHING


STATISTICAL MATCH PARAMETER ESTIMATES

           Estimate          Std. Error
   K  =   4.5326E-004 +/-   3.3482E-005 cm/sec
   y0 =   1.4453E+000 +/-   1.7319E-002 ft


ANALYSIS OF MODEL RESIDUALS

residual = observed - calculated
weighted residual = residual * weight

Weighted Residual Statistics:
   Number of residuals.............. 230
   Number of estimated parameters.... 2
```

Degrees of freedom............... 228
Residual mean..................... 0.009813
Residual standard deviation....... 0.2106
Residual variance................. 0.04437

Model Residuals:

Time	Observed	Calculated	Residual	Weight
0.0033	2.5853	1.4451	1.1401	1
0.0066	2.3359	1.445	0.89097	1
0.01	2.1063	1.4448	0.66149	1
0.0133	2.0997	1.4446	0.65511	1
0.0166	2.0374	1.4444	0.59296	1
0.02	2.0079	1.4442	0.56361	1
0.0233	1.975	1.4441	0.53098	1
0.0266	1.9619	1.4439	0.51803	1
0.03	1.9258	1.4437	0.48212	1
0.0333	1.9029	1.4435	0.45933	1
0.0366	1.8799	1.4434	0.43655	1
0.04	1.8569	1.4432	0.41376	1
0.0433	1.8405	1.443	0.39753	1
0.0466	1.8176	1.4428	0.37474	1
0.05	1.8012	1.4426	0.35852	1
0.0533	1.7848	1.4425	0.3423	1
0.0566	1.7684	1.4423	0.32607	1
0.06	1.7552	1.4421	0.31313	1
0.0633	1.7421	1.4419	0.30018	1
0.0666	1.7224	1.4418	0.28067	1
0.07	1.6995	1.4416	0.25788	1
0.0733	1.6995	1.4414	0.25806	1
0.0766	1.6863	1.4412	0.24511	1
0.08	1.6798	1.441	0.23873	1
0.0833	1.6634	1.4409	0.22251	1
0.0866	1.6568	1.4407	0.21612	1
0.09	1.647	1.4405	0.20646	1
0.0933	1.6338	1.4403	0.19351	1
0.0966	1.624	1.4402	0.18385	1
0.1	1.6142	1.44	0.17418	1
0.1033	1.6076	1.4398	0.1678	1
0.1066	1.5978	1.4396	0.15813	1
0.11	1.5879	1.4394	0.14847	1
0.1133	1.5781	1.4393	0.13881	1
0.1166	1.5715	1.4391	0.13242	1
0.12	1.5649	1.4389	0.12604	1
0.1233	1.5584	1.4387	0.11965	1
0.1266	1.5485	1.4386	0.10999	1
0.13	1.542	1.4384	0.10361	1
0.1333	1.5354	1.4382	0.097216	1
0.1366	1.5256	1.438	0.087551	1
0.14	1.5223	1.4378	0.084452	1
0.1433	1.5125	1.4377	0.074788	1
0.1466	1.5059	1.4375	0.068404	1
0.15	1.4993	1.4373	0.062025	1
0.1533	1.4928	1.4371	0.05563	1
0.1566	1.4895	1.437	0.052526	1
0.16	1.4862	1.4368	0.049427	1
0.1633	1.4796	1.4366	0.043042	1
0.1666	1.4731	1.4364	0.036658	1

0.17	1.4665	1.4362	0.030278	1
0.1733	1.4632	1.4361	0.027174	1
0.1766	1.4567	1.4359	0.020789	1
0.18	1.4534	1.4357	0.01768	1
0.1833	1.4501	1.4355	0.014576	1
0.1866	1.4436	1.4354	0.008191	1
0.19	1.4403	1.4352	0.0050917	1
0.1933	1.4403	1.435	0.005267	1
0.1966	1.437	1.4348	0.0021623	1
0.2	1.4304	1.4346	-0.004217	1
0.2033	1.4272	1.4345	-0.0073218	1
0.2066	1.4206	1.4343	-0.013706	1
0.21	1.4206	1.4341	-0.013526	1
0.2133	1.4173	1.4339	-0.016631	1
0.2166	1.414	1.4338	-0.019736	1
0.22	1.4075	1.4336	-0.026125	1
0.2233	1.4075	1.4334	-0.02595	1
0.2266	1.4042	1.4332	-0.029055	1
0.23	1.4042	1.4331	-0.028874	1
0.2333	1.4009	1.4329	-0.031979	1
0.2366	1.3943	1.4327	-0.038364	1
0.24	1.3943	1.4325	-0.038184	1
0.2433	1.3943	1.4323	-0.038009	1
0.2466	1.3911	1.4322	-0.041114	1
0.25	1.3845	1.432	-0.047494	1
0.2533	1.3845	1.4318	-0.047319	1
0.2566	1.3845	1.4316	-0.047144	1
0.26	1.3812	1.4315	-0.050243	1
0.2633	1.3812	1.4313	-0.050069	1
0.2666	1.3779	1.4311	-0.053174	1
0.27	1.3779	1.4309	-0.052993	1
0.2733	1.3714	1.4308	-0.059389	1
0.2766	1.3714	1.4306	-0.059214	1
0.28	1.3714	1.4304	-0.059034	1
0.2833	1.3681	1.4302	-0.062139	1
0.2866	1.3681	1.4301	-0.061964	1
0.29	1.3648	1.4299	-0.065064	1
0.2933	1.3648	1.4297	-0.06489	1
0.2966	1.3583	1.4295	-0.071275	1
0.3	1.3583	1.4293	-0.071095	1
0.3033	1.3583	1.4292	-0.07092	1
0.3066	1.355	1.429	-0.074026	1
0.31	1.355	1.4288	-0.073846	1
0.3133	1.355	1.4286	-0.073671	1
0.3166	1.3517	1.4285	-0.076777	1
0.32	1.3517	1.4283	-0.076597	1
0.3233	1.3517	1.4281	-0.076422	1
0.3266	1.3451	1.4279	-0.082808	1
0.33	1.3451	1.4278	-0.082628	1
0.3333	1.3451	1.4276	-0.082454	1
0.35	1.3353	1.4267	-0.091411	1
0.3666	1.332	1.4258	-0.093815	1
0.3833	1.3222	1.4249	-0.10278	1
0.4	1.3189	1.4241	-0.10518	1
0.4166	1.309	1.4232	-0.11415	1
0.4333	1.3058	1.4223	-0.11655	1
0.45	1.2992	1.4214	-0.12223	1
0.4666	1.2926	1.4206	-0.12792	1
0.4833	1.2861	1.4197	-0.13361	1
0.5	1.2828	1.4188	-0.13601	1

0.5166	1.2795	1.4179	-0.13842	1
0.5333	1.273	1.4171	-0.1441	1
0.55	1.2697	1.4162	-0.14651	1
0.5666	1.2631	1.4153	-0.15219	1
0.5833	1.2598	1.4144	-0.1546	1
0.6	1.2566	1.4136	-0.15701	1
0.6166	1.25	1.4127	-0.1627	1
0.6333	1.25	1.4118	-0.16182	1
0.65	1.2467	1.4109	-0.16424	1
0.6666	1.2434	1.4101	-0.16665	1
0.6833	1.2369	1.4092	-0.17234	1
0.7	1.2369	1.4083	-0.17147	1
0.7166	1.2336	1.4075	-0.17389	1
0.7333	1.2303	1.4066	-0.1763	1
0.75	1.2303	1.4057	-0.17543	1
0.7666	1.2237	1.4049	-0.18112	1
0.7833	1.2205	1.404	-0.18353	1
0.8	1.2205	1.4031	-0.18267	1
0.8166	1.2139	1.4023	-0.18836	1
0.8333	1.2106	1.4014	-0.19078	1
0.85	1.2106	1.4005	-0.18991	1
0.8666	1.2073	1.3997	-0.19234	1
0.8833	1.2008	1.3988	-0.19804	1
0.9	1.2008	1.3979	-0.19717	1
0.9166	1.1975	1.3971	-0.19959	1
0.9333	1.1975	1.3962	-0.19873	1
0.95	1.1942	1.3954	-0.20115	1
0.9666	1.1942	1.3945	-0.20029	1
0.9833	1.1942	1.3936	-0.19943	1
1	1.1877	1.3928	-0.20512	1
1.2	1.1614	1.3825	-0.2211	1
1.4	1.1417	1.3723	-0.23058	1
1.6	1.1253	1.3622	-0.23686	1
1.8	1.1122	1.3521	-0.23993	1
2	1.0991	1.3421	-0.24308	1
2.2	1.0892	1.3322	-0.24302	1
2.4	1.0794	1.3224	-0.24304	1
2.6	1.0728	1.3127	-0.23984	1
2.8	1.0663	1.303	-0.23672	1
3	1.0564	1.2934	-0.23694	1
3.2	1.0531	1.2838	-0.23068	1
3.4	1.0433	1.2743	-0.23106	1
3.6	1.04	1.2649	-0.22494	1
3.8	1.0302	1.2556	-0.22544	1
4	1.0203	1.2463	-0.22602	1
4.2	1.0171	1.2372	-0.2201	1
4.4	1.0138	1.228	-0.21426	1
4.6	1.0039	1.219	-0.21504	1
4.8	1.0006	1.21	-0.20933	1
5	0.99408	1.201	-0.20696	1
5.2	0.9908	1.1922	-0.20138	1
5.4	0.98752	1.1834	-0.19587	1
5.6	0.98096	1.1747	-0.1937	1
5.8	0.98096	1.166	-0.18503	1
6	0.97112	1.1574	-0.18627	1
6.2	0.96784	1.1488	-0.18101	1
6.4	0.96784	1.1404	-0.17254	1
6.6	0.96456	1.132	-0.16741	1
6.8	0.95799	1.1236	-0.16561	1
7	0.95471	1.1153	-0.16061	1

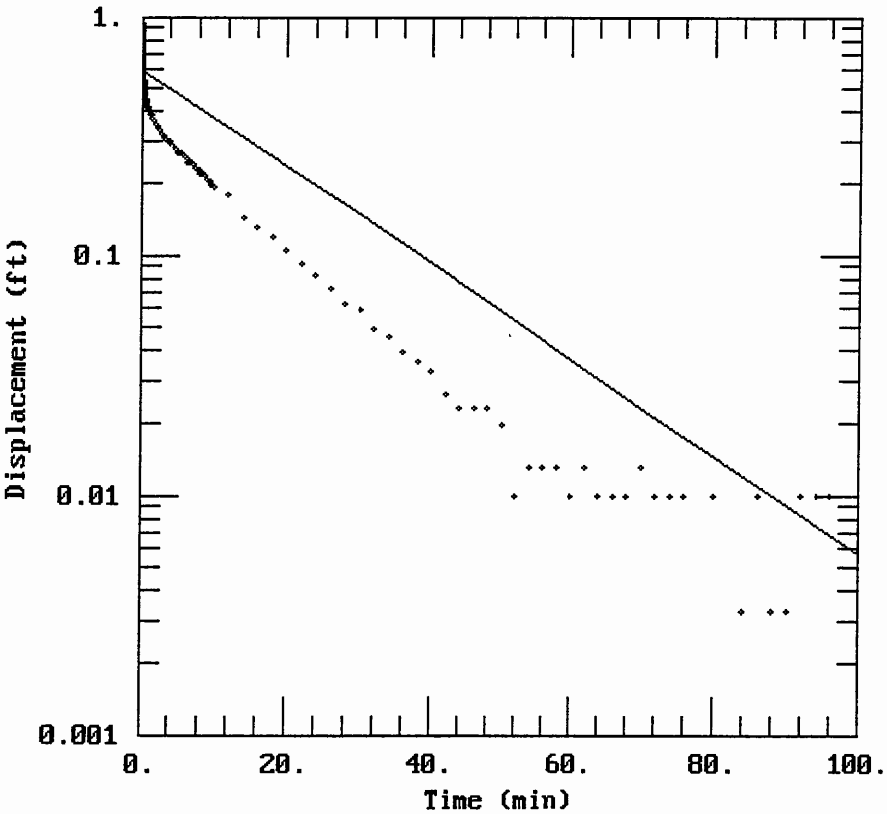
7.2	0.95471	1.1071	-0.15238	1
7.4	0.95143	1.0989	-0.14749	1
7.6	0.94487	1.0908	-0.14594	1
7.8	0.94159	1.0828	-0.14118	1
8	0.93503	1.0748	-0.13975	1
8.2	0.93503	1.0668	-0.13182	1
8.4	0.93175	1.059	-0.12723	1
8.6	0.92847	1.0512	-0.1227	1
8.8	0.92847	1.0434	-0.11494	1
9	0.92191	1.0357	-0.11381	1
9.2	0.91862	1.0281	-0.10945	1
9.4	0.91862	1.0205	-0.10186	1
9.6	0.91534	1.013	-0.097612	1
9.8	0.90878	1.0055	-0.0967	1
10	0.90878	0.99806	-0.089282	1
12	0.88582	0.92682	-0.041009	1
14	0.85629	0.86067	-0.0043818	1
16	0.8366	0.79924	0.037365	1
18	0.81036	0.74219	0.068167	1
20	0.78739	0.68922	0.098176	1
22	0.76443	0.64002	0.1244	1
24	0.74474	0.59434	0.1504	1
26	0.71521	0.55192	0.1633	1
28	0.69225	0.51252	0.17973	1
30	0.666	0.47594	0.19006	1
32	0.64304	0.44197	0.20107	1
34	0.61679	0.41042	0.20637	1
36	0.59054	0.38113	0.20942	1
38	0.55774	0.35392	0.20381	1
40	0.52821	0.32866	0.19955	1
42	0.4954	0.3052	0.1902	1
44	0.46587	0.28342	0.18246	1
46	0.43635	0.26319	0.17316	1
48	0.4101	0.2444	0.1657	1
50	0.38385	0.22696	0.1569	1
52	0.35761	0.21076	0.14685	1
54	0.33792	0.19572	0.14221	1
56	0.31496	0.18175	0.13321	1
58	0.28871	0.16877	0.11994	1
60	0.27231	0.15673	0.11558	1
62	0.24934	0.14554	0.1038	1
64	0.23622	0.13515	0.10107	1
66	0.21653	0.12551	0.091028	1
68	0.20341	0.11655	0.086863	1
70	0.19029	0.10823	0.082058	1
72	0.18044	0.1005	0.079941	1
74	0.16732	0.09333	0.073991	1
76	0.15748	0.086668	0.07081	1
78	0.15092	0.080482	0.070435	1
80	0.13779	0.074737	0.063057	1
82	0.12795	0.069403	0.058548	1
84	0.11811	0.064449	0.05366	1
86	0.10827	0.059849	0.048417	1
88	0.10171	0.055577	0.046128	1
90	0.091862	0.05161	0.040252	1
92	0.08202	0.047926	0.034094	1
94	0.078739	0.044506	0.034233	1
96	0.068897	0.041329	0.027568	1
98	0.065616	0.038379	0.027237	1
100	0.055774	0.03564	0.020134	1

```
================================================================================
                        RESULTS FROM VISUAL CURVE MATCHING

VISUAL MATCH PARAMETER ESTIMATES

           Estimate
   K  =   4.5326E-004 cm/sec
   y0 =   1.4453E+000 ft


<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>
```



DATA SET:
MW05.DAT
05/14/98

AQUIFER MODEL:
Unconfined

SOLUTION METHOD:
Bouwer-Rice

TEST DATA:
H0= 3. ft
r_c= 0.1667 ft
r_w= 0.6875 ft
L = 5.97 ft
b = 5.97 ft
H = 5.97 ft

PARAMETER ESTIMATES:
K = 0.0005605 cm/sec
y0 = 0.5925 ft

```
<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>

                     A Q T E S O L V   R E S U L T S
                               Version 2.0

                      Developed by Glenn M. Duffield
                  (c) 1993, 1994 Geraghty & Miller, Inc.

05/14/98                                                              19:05:33

================================================================================
                             TEST DESCRIPTION

Data set........... MW05.DAT
Output file........ MW05C.OUT
Data set title..... MW-5 - test using ft converstion & bail

Units of Measurement
   Length.......... ft
   Time............ min

Test Well Data
   Initial displacement in well..... 3
   Radius of well casing............ 0.1667
   Radius of wellbore............... 0.6875
   Aquifer saturated thickness...... 5.97
   Well screen length............... 5.97
   Static height of water in well... 5.97
   Gravel pack porosity............. 0.35
   Effective well casing radius..... 0.4284
   Effective wellbore radius........ 0.6875
   Log(Re/Rw)....................... 1.545
   Constants A, B and C............. 0.000 ,  0.000,  1.203
   No. of observations.............. 226

================================================================================
                             ANALYTICAL METHOD

Bouwer-Rice (Unconfined Aquifer Slug Test)

================================================================================
                  RESULTS FROM STATISTICAL CURVE MATCHING


STATISTICAL MATCH PARAMETER ESTIMATES

           Estimate          Std. Error
   K  =   2.3792E-003 +/-   1.8075E-004 cm/sec
   y0 =   6.3477E-001 +/-   9.8420E-003 ft


ANALYSIS OF MODEL RESIDUALS

residual = observed - calculated
weighted residual = residual * weight

Weighted Residual Statistics:
   Number of residuals............... 226
   Number of estimated parameters.... 2
```

Degrees of freedom............... 224
Residual mean...................... 0.009516
Residual standard deviation....... 0.1007
Residual variance................. 0.01014

Model Residuals:

Time	Observed	Calculated	Residual	Weight
0.0033	0.9416	0.63436	0.30725	1
0.0066	0.93176	0.63394	0.29782	1
0.01	0.92192	0.63352	0.2884	1
0.0133	0.91864	0.6331	0.28553	1
0.0166	0.90551	0.63269	0.27282	1
0.02	0.88583	0.63227	0.25356	1
0.0233	0.8727	0.63186	0.24085	1
0.0266	0.85302	0.63145	0.22157	1
0.03	0.84646	0.63102	0.21544	1
0.0333	0.83989	0.63061	0.20928	1
0.0366	0.83661	0.6302	0.20641	1
0.04	0.83333	0.62978	0.20355	1
0.0433	0.82349	0.62937	0.19412	1
0.0466	0.82021	0.62896	0.19125	1
0.05	0.81365	0.62854	0.18511	1
0.0533	0.80381	0.62813	0.17568	1
0.0566	0.80053	0.62772	0.17281	1
0.06	0.79068	0.6273	0.16338	1
0.0633	0.7874	0.62689	0.16051	1
0.0666	0.77756	0.62648	0.15108	1
0.07	0.77428	0.62606	0.14822	1
0.0733	0.76772	0.62565	0.14206	1
0.0766	0.76116	0.62525	0.13591	1
0.08	0.75459	0.62483	0.12977	1
0.0833	0.74803	0.62442	0.12361	1
0.0866	0.74147	0.62401	0.11746	1
0.09	0.73819	0.6236	0.11459	1
0.0933	0.72835	0.62319	0.10516	1
0.0966	0.72507	0.62278	0.10228	1
0.1	0.7185	0.62237	0.096138	1
0.1033	0.71194	0.62196	0.089981	1
0.1066	0.70538	0.62156	0.083825	1
0.11	0.7021	0.62114	0.080961	1
0.1133	0.69882	0.62074	0.078084	1
0.1166	0.69226	0.62033	0.071926	1
0.12	0.68898	0.61991	0.069061	1
0.1233	0.67913	0.61951	0.059623	1
0.1266	0.67585	0.61911	0.056745	1
0.13	0.66929	0.61869	0.050598	1
0.1333	0.66601	0.61829	0.047721	1
0.1366	0.66273	0.61789	0.044842	1
0.14	0.65617	0.61747	0.038695	1
0.1433	0.65289	0.61707	0.035815	1
0.1466	0.64633	0.61667	0.029655	1
0.15	0.64305	0.61626	0.026789	1
0.1533	0.63976	0.61586	0.023909	1
0.1566	0.6332	0.61545	0.017748	1
0.16	0.62992	0.61504	0.014879	1
0.1633	0.62664	0.61464	0.011999	1
0.1666	0.62664	0.61424	0.012399	1

0.17	0.62008	0.61383	0.0062498	1
0.1733	0.6168	0.61343	0.0033684	1
0.1766	0.61024	0.61303	-0.0027943	1
0.18	0.60696	0.61262	-0.0056642	1
0.1833	0.60696	0.61222	-0.0052654	1
0.1866	0.60368	0.61182	-0.0081469	1
0.19	0.59711	0.61141	-0.014299	1
0.1933	0.59383	0.61101	-0.017182	1
0.1966	0.59383	0.61062	-0.016784	1
0.2	0.59055	0.61021	-0.019655	1
0.2033	0.58399	0.60981	-0.025819	1
0.2066	0.58399	0.60941	-0.025422	1
0.21	0.58071	0.609	-0.028295	1
0.2133	0.58071	0.60861	-0.027898	1
0.2166	0.57743	0.60821	-0.030783	1
0.22	0.57087	0.6078	-0.036937	1
0.2233	0.57087	0.60741	-0.036541	1
0.2266	0.56759	0.60701	-0.039427	1
0.23	0.56759	0.6066	-0.03902	1
0.2333	0.56102	0.60621	-0.045186	1
0.2366	0.55774	0.60582	-0.048073	1
0.24	0.55774	0.60541	-0.047666	1
0.2433	0.55446	0.60502	-0.050553	1
0.2466	0.55446	0.60462	-0.050159	1
0.25	0.5479	0.60422	-0.056316	1
0.2533	0.5479	0.60382	-0.055923	1
0.2566	0.54462	0.60343	-0.058811	1
0.26	0.54462	0.60302	-0.058406	1
0.2633	0.54134	0.60263	-0.061293	1
0.2666	0.54134	0.60224	-0.060901	1
0.27	0.53478	0.60184	-0.067059	1
0.2733	0.53478	0.60144	-0.066667	1
0.2766	0.5315	0.60105	-0.069557	1
0.28	0.5315	0.60065	-0.069154	1
0.2833	0.52493	0.60026	-0.075325	1
0.2866	0.52493	0.59987	-0.074934	1
0.29	0.52493	0.59947	-0.074532	1
0.2933	0.52493	0.59908	-0.074142	1
0.2966	0.52165	0.59869	-0.077032	1
0.3	0.52165	0.59828	-0.07663	1
0.3033	0.51837	0.59789	-0.079522	1
0.3066	0.51837	0.59751	-0.079133	1
0.31	0.51837	0.5971	-0.078732	1
0.3133	0.51181	0.59672	-0.084905	1
0.3166	0.51181	0.59633	-0.084517	1
0.32	0.50853	0.59593	-0.087398	1
0.3233	0.50853	0.59554	-0.08701	1
0.3266	0.50853	0.59515	-0.086622	1
0.33	0.50525	0.59475	-0.089504	1
0.3333	0.50525	0.59437	-0.089117	1
0.35	0.49869	0.59241	-0.093723	1
0.3666	0.48885	0.59047	-0.10163	1
0.3833	0.48556	0.58853	-0.10297	1
0.4	0.48228	0.58659	-0.10431	1
0.4166	0.47572	0.58468	-0.10895	1
0.4333	0.47244	0.58275	-0.11031	1
0.45	0.46916	0.58084	-0.11168	1
0.4666	0.4626	0.57894	-0.11634	1
0.4833	0.4626	0.57703	-0.11443	1
0.5	0.45932	0.57513	-0.11582	1

0.5166	0.45604	0.57325	-0.11722	1
0.5333	0.44948	0.57137	-0.12189	1
0.55	0.44948	0.56949	-0.12001	1
0.5666	0.44619	0.56763	-0.12143	1
0.5833	0.44619	0.56576	-0.11956	1
0.6	0.43963	0.5639	-0.12426	1
0.6166	0.43963	0.56205	-0.12242	1
0.6333	0.43635	0.5602	-0.12385	1
0.65	0.43635	0.55836	-0.12201	1
0.6666	0.43307	0.55654	-0.12346	1
0.6833	0.43307	0.5547	-0.12163	1
0.7	0.43307	0.55288	-0.11981	1
0.7166	0.42651	0.55107	-0.12456	1
0.7333	0.42651	0.54926	-0.12275	1
0.75	0.42651	0.54745	-0.12094	1
0.7666	0.42323	0.54566	-0.12243	1
0.7833	0.42323	0.54387	-0.12064	1
0.8	0.41995	0.54208	-0.12213	1
0.8166	0.41995	0.5403	-0.12036	1
0.8333	0.41995	0.53853	-0.11858	1
0.85	0.41995	0.53676	-0.11681	1
0.8666	0.41339	0.535	-0.12161	1
0.8833	0.41339	0.53324	-0.11985	1
0.9	0.41339	0.53149	-0.1181	1
0.9166	0.41339	0.52975	-0.11636	1
0.9333	0.41011	0.52801	-0.1179	1
0.95	0.41011	0.52627	-0.11616	1
0.9666	0.40354	0.52455	-0.121	1
0.9833	0.40354	0.52282	-0.11928	1
1	0.40354	0.5211	-0.11756	1
1.2	0.39042	0.50094	-0.11052	1
1.4	0.38386	0.48156	-0.097697	1
1.6	0.37402	0.46292	-0.088906	1
1.8	0.36417	0.44501	-0.080836	1
2	0.35433	0.42779	-0.073459	1
2.2	0.34777	0.41124	-0.063468	1
2.4	0.33793	0.39532	-0.057398	1
2.6	0.33465	0.38003	-0.045382	1
2.8	0.3248	0.36532	-0.04052	1
3	0.31824	0.35119	-0.032946	1
3.2	0.31168	0.3376	-0.025918	1
3.4	0.30512	0.32453	-0.019417	1
3.6	0.30184	0.31198	-0.01014	1
3.8	0.29856	0.29991	-0.0013496	1
4	0.292	0.2883	0.003694	1
4.2	0.28871	0.27715	0.011569	1
4.4	0.28215	0.26642	0.015731	1
4.6	0.27887	0.25611	0.022759	1
4.8	0.27559	0.2462	0.029389	1
5	0.26903	0.23668	0.032353	1
5.2	0.26903	0.22752	0.041511	1
5.4	0.26903	0.21871	0.050315	1
5.6	0.26575	0.21025	0.055497	1
5.8	0.26247	0.20212	0.060351	1
6	0.25591	0.19429	0.061611	1
6.2	0.25263	0.18678	0.065848	1
6.4	0.24606	0.17955	0.066513	1
6.6	0.24278	0.1726	0.07018	1
6.8	0.24278	0.16592	0.076859	1
7	0.2395	0.1595	0.079998	1

7.2	0.2395	0.15333	0.08617	1
7.4	0.23294	0.1474	0.085542	1
7.6	0.22638	0.14169	0.084683	1
7.8	0.22638	0.13621	0.090166	1
8	0.21982	0.13094	0.088875	1
8.2	0.21982	0.12587	0.093941	1
8.4	0.21982	0.121	0.098812	1
8.6	0.21654	0.11632	0.10021	1
8.8	0.21326	0.11182	0.10143	1
9	0.20669	0.10749	0.099199	1
9.2	0.20341	0.10333	0.10008	1
9.4	0.20341	0.099336	0.10408	1
9.6	0.19685	0.095493	0.10136	1
9.8	0.19685	0.091798	0.10505	1
10	0.19357	0.088245	0.10532	1
12	0.17717	0.059471	0.11769	1
14	0.14436	0.04008	0.10428	1
16	0.13123	0.027011	0.10422	1
18	0.11811	0.018203	0.099907	1
20	0.10499	0.012268	0.092719	1
22	0.091864	0.0082677	0.083596	1
24	0.082021	0.0055719	0.076449	1
26	0.072178	0.0037551	0.068423	1
28	0.062336	0.0025306	0.059805	1
30	0.059055	0.0017055	0.05735	1
32	0.049213	0.0011494	0.048064	1
34	0.045932	0.0007746	0.045157	1
36	0.03937	0.00052203	0.038848	1
38	0.036089	0.00035181	0.035737	1
40	0.032808	0.0002371	0.032571	1
42	0.026247	0.00015979	0.026087	1
44	0.022966	0.00010768	0.022858	1
46	0.022966	7.2572E-005	0.022893	1
48	0.022966	4.8909E-005	0.022917	1
50	0.019685	3.2961E-005	0.019652	1
52	0.009843	2.2213E-005	0.0098208	1
54	0.013123	1.497E-005	0.013108	1
56	0.013123	1.0089E-005	0.013113	1
58	0.013123	6.7993E-006	0.013116	1
60	0.009843	4.5822E-006	0.0098384	1
62	0.013123	3.0881E-006	0.01312	1
64	0.009843	2.0812E-006	0.0098409	1
66	0.009843	1.4026E-006	0.0098416	1
68	0.009843	9.4524E-007	0.0098421	1
70	0.013123	6.3702E-007	0.013122	1
72	0.009843	4.2931E-007	0.0098426	1
74	0.009843	2.8933E-007	0.0098427	1
76	0.009843	1.9499E-007	0.0098428	1
80	0.009843	8.8559E-008	0.0098429	1
84	0.003281	4.0222E-008	0.003281	1
86	0.009843	2.7107E-008	0.009843	1
88	0.003281	1.8268E-008	0.003281	1
90	0.003281	1.2311E-008	0.003281	1
92	0.009843	8.2971E-009	0.009843	1
94	0.009843	5.5917E-009	0.009843	1
96	0.009843	3.7684E-009	0.009843	1

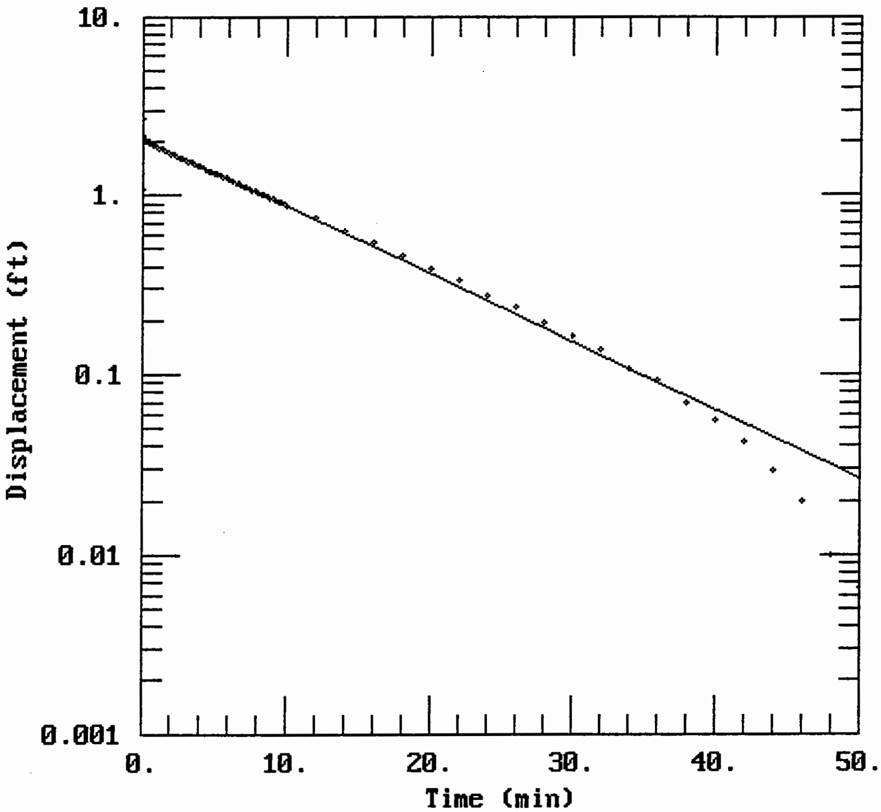
==

RESULTS FROM VISUAL CURVE MATCHING

VISUAL MATCH PARAMETER ESTIMATES

```
          Estimate
   K  =   5.6054E-004 cm/sec
   y0 =   5.9246E-001 ft
```

<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<>>



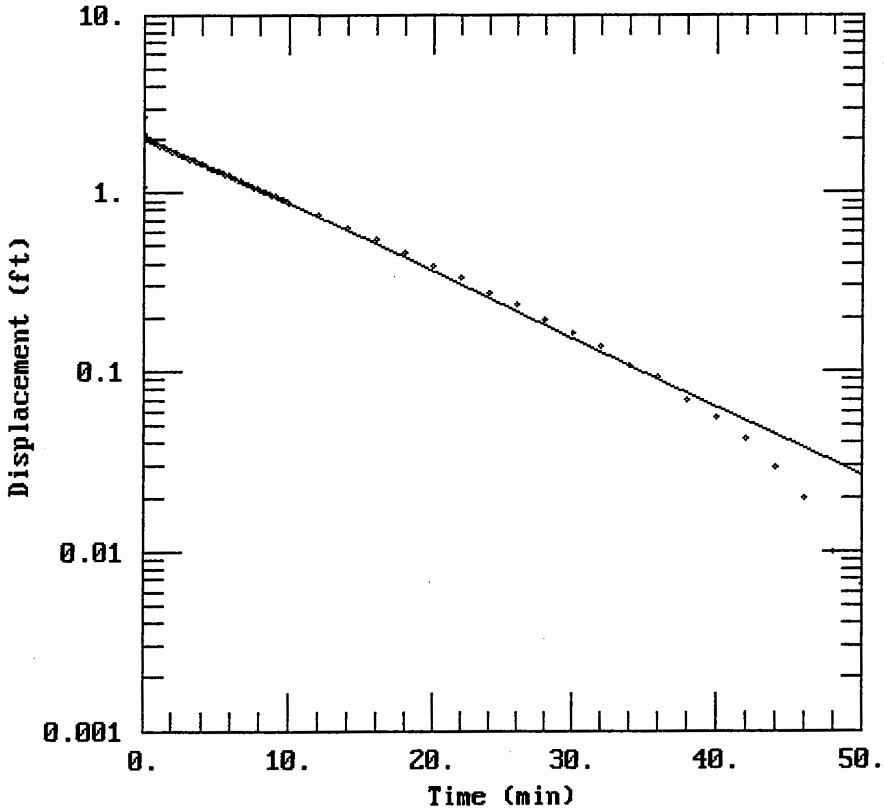
DATA SET:
MW201.DAT
05/14/98

AQUIFER MODEL:
Confined

SOLUTION METHOD:
Bouwer-Rice

TEST DATA:
H0= 3. ft
r_c= 0.1667 ft
r_w= 0.8333 ft
L = 3. ft
b = 12.14 ft
H = 12.14 ft

PARAMETER ESTIMATES:
K = 0.0003374 cm/sec
y0 = 2.058 ft



DATA SET:
MW201.DAT
05/14/98

AQUIFER MODEL:
Confined

SOLUTION METHOD:
Bouwer-Rice

TEST DATA:
H0= 3. ft
r_c= 0.1667 ft
r_w= 0.8333 ft
L = 3. ft
b = 12.14 ft
H = 12.14 ft

PARAMETER ESTIMATES:
K = 0.0003374 cm/sec
y0 = 2.058 ft

```
<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>

                        A Q T E S O L V   R E S U L T S
                                  Version 2.0

                         Developed by Glenn M. Duffield
                      (c) 1993, 1994 Geraghty & Miller, Inc.

05/14/98                                                                18:28:00

================================================================================
                                TEST DESCRIPTION

Data set........... MW201.DAT
Output file........ MW201.OUT
Data set title..... MW-201 - test using ft converstion &bail

Units of Measurement
   Length.......... ft
   Time............ min

Test Well Data
   Initial displacement in well..... 3
   Radius of well casing............ 0.1667
   Radius of wellbore............... 0.8333
   Aquifer saturated thickness...... 12.14
   Well screen length............... 3
   Static height of water in well... 12.14
   Gravel pack porosity............. 0
   Effective well casing radius..... 0.1667
   Effective wellbore radius........ 0.8333
   Log(Re/Rw)....................... 1.646
   Constants A, B and C............. 0.000 ,  0.000,  0.709
   No. of observations.............. 205

================================================================================
                               ANALYTICAL METHOD

Bouwer-Rice (Confined Aquifer Slug Test)

================================================================================
                     RESULTS FROM STATISTICAL CURVE MATCHING


STATISTICAL MATCH PARAMETER ESTIMATES

            Estimate          Std. Error
   K  =   3.3738E-004 +/-   6.9011E-006 cm/sec
   y0 =   2.0582E+000 +/-   7.4917E-003 ft


ANALYSIS OF MODEL RESIDUALS

residual = observed - calculated
weighted residual = residual * weight

Weighted Residual Statistics:
   Number of residuals............... 205
   Number of estimated parameters.... 2
```

```
Degrees of freedom............... 203
Residual mean.................... 0.0002535
Residual standard deviation....... 0.08375
Residual variance................ 0.007013
```

Model Residuals:

Time	Observed	Calculated	Residual	Weight
0.0033	1.086	2.0576	-0.97162	1
0.0066	2.6837	2.057	0.62674	1
0.01	2.1522	2.0564	0.095853	1
0.0133	2.1358	2.0558	0.080044	1
0.0166	2.1654	2.0552	0.11016	1
0.02	2.0997	2.0546	0.045154	1
0.0233	2.1129	2.054	0.058865	1
0.0266	2.103	2.0534	0.049616	1
0.03	2.0997	2.0528	0.046945	1
0.0333	2.0932	2.0522	0.040975	1
0.0366	2.0899	2.0516	0.038285	1
0.04	2.0801	2.051	0.029043	1
0.0433	2.0866	2.0504	0.036193	1
0.0466	2.0801	2.0498	0.030223	1
0.05	2.0768	2.0492	0.02755	1
0.0533	2.0866	2.0486	0.03798	1
0.0566	2.0768	2.048	0.028729	1
0.06	2.0702	2.0474	0.022776	1
0.0633	2.0669	2.0468	0.020085	1
0.0666	2.0669	2.0463	0.020674	1
0.07	2.126	2.0456	0.08033	1
0.0733	2.0768	2.0451	0.031709	1
0.0766	2.0702	2.0445	0.025737	1
0.08	2.0637	2.0439	0.019783	1
0.0833	2.0637	2.0433	0.02037	1
0.0866	2.0702	2.0427	0.027518	1
0.09	2.0702	2.0421	0.028124	1
0.0933	2.0505	2.0415	0.0090309	1
0.0966	2.0571	2.0409	0.016178	1
0.1	2.0538	2.0403	0.013503	1
0.1033	2.0669	2.0397	0.02721	1
0.1066	2.0538	2.0391	0.014676	1
0.11	2.0505	2.0385	0.012001	1
0.1133	2.0505	2.0379	0.012587	1
0.1166	2.044	2.0374	0.0066033	1
0.12	2.044	2.0368	0.007207	1
0.1233	2.044	2.0362	0.0077929	1
0.1266	2.044	2.0356	0.0083785	1
0.13	2.044	2.035	0.0089818	1
0.1333	2.0407	2.0344	0.0062871	1
0.1366	2.0407	2.0338	0.0068722	1
0.14	2.0407	2.0332	0.0074749	1
0.1433	2.0407	2.0326	0.0080598	1
0.1466	2.0341	2.032	0.0020844	1
0.15	2.0341	2.0314	0.0026866	1
0.1533	2.0341	2.0308	0.0032709	1
0.1566	2.0341	2.0303	0.003855	1
0.16	2.0308	2.0297	0.0011767	1
0.1633	2.0308	2.0291	0.0017605	1
0.1666	2.0308	2.0285	0.0023441	1

0.17	2.0308	2.0279	0.0029452	1
0.1733	2.0308	2.0273	0.0035285	1
0.1766	2.0308	2.0267	0.0041116	1
0.18	2.0276	2.0261	0.0014323	1
0.1833	2.0276	2.0255	0.002015	1
0.1866	2.0276	2.025	0.0025976	1
0.19	2.0276	2.0244	0.0031977	1
0.1933	2.021	2.0238	-0.00278	1
0.1966	2.021	2.0232	-0.0021979	1
0.2	2.021	2.0226	-0.0015983	1
0.2033	2.021	2.022	-0.0010166	1
0.2066	2.021	2.0214	-0.00043498	1
0.21	2.0177	2.0208	-0.0031159	1
0.2133	2.0177	2.0203	-0.0025347	1
0.2166	2.0177	2.0197	-0.0019536	1
0.22	2.0177	2.0191	-0.0013551	1
0.2233	2.0177	2.0185	-0.00077433	1
0.2266	2.0144	2.0179	-0.0034737	1
0.23	2.0177	2.0173	0.00040425	1
0.2333	2.0144	2.0167	-0.0022955	1
0.2366	2.0144	2.0162	-0.0017154	1
0.24	2.0144	2.0156	-0.0011179	1
0.2433	2.0144	2.015	-0.00053821	1
0.2466	2.0079	2.0144	-0.0065286	1
0.25	2.0079	2.0138	-0.0059317	1
0.2533	2.0079	2.0132	-0.0053525	1
0.2566	2.0079	2.0126	-0.0047734	1
0.26	2.0079	2.012	-0.004177	1
0.2633	2.0079	2.0115	-0.0035982	1
0.2666	2.0079	2.0109	-0.0030197	1
0.27	2.0079	2.0103	-0.0024237	1
0.2733	2.0046	2.0097	-0.0051255	1
0.2766	2.0046	2.0091	-0.0045475	1
0.28	1.998	2.0085	-0.010512	1
0.2833	1.998	2.008	-0.0099344	1
0.2866	1.998	2.0074	-0.0093568	1
0.29	1.998	2.0068	-0.0087619	1
0.2933	1.998	2.0062	-0.0081847	1
0.2966	1.998	2.0056	-0.0076077	1
0.3	1.998	2.005	-0.0070133	1
0.3033	1.998	2.0045	-0.0064366	1
0.3066	1.998	2.0039	-0.00586	1
0.31	1.9948	2.0033	-0.0085462	1
0.3133	1.998	2.0027	-0.00469	1
0.3166	1.9948	2.0021	-0.0073939	1
0.32	1.9948	2.0016	-0.0068006	1
0.3233	1.9948	2.001	-0.0062249	1
0.3266	1.9915	2.0004	-0.0089294	1
0.33	1.9948	1.9998	-0.0050566	1
0.3333	1.9915	1.9992	-0.0077613	1
0.35	1.9915	1.9963	-0.004853	1
0.3666	1.9849	1.9934	-0.0085262	1
0.3833	1.9816	1.9905	-0.0089063	1
0.4	1.9816	1.9876	-0.0060106	1
0.4166	1.9784	1.9848	-0.0064164	1
0.4333	1.9718	1.9819	-0.010089	1
0.45	1.9685	1.979	-0.010496	1
0.4666	1.9685	1.9761	-0.0076343	1
0.4833	1.9619	1.9733	-0.01132	1
0.5	1.9587	1.9704	-0.011729	1

0.5166	1.9554	1.9675	-0.01216	1
0.5333	1.9554	1.9647	-0.0092975	1
0.55	1.9488	1.9618	-0.012999	1
0.5666	1.9455	1.959	-0.013443	1
0.5833	1.9423	1.9561	-0.013873	1
0.6	1.9423	1.9533	-0.011027	1
0.6166	1.9357	1.9505	-0.014763	1
0.6333	1.9357	1.9476	-0.011925	1
0.65	1.9324	1.9448	-0.012372	1
0.6666	1.9291	1.942	-0.01285	1
0.6833	1.9226	1.9392	-0.016585	1
0.7	1.9226	1.9363	-0.013764	1
0.7166	1.9193	1.9335	-0.014244	1
0.7333	1.9127	1.9307	-0.017991	1
0.75	1.9127	1.9279	-0.015182	1
0.7666	1.9095	1.9251	-0.015674	1
0.7833	1.9062	1.9223	-0.016154	1
0.8	1.9062	1.9195	-0.013357	1
0.8166	1.8996	1.9168	-0.017142	1
0.8333	1.8996	1.914	-0.014353	1
0.85	1.8963	1.9112	-0.014849	1
0.8666	1.8931	1.9084	-0.015365	1
0.8833	1.8931	1.9056	-0.012589	1
0.9	1.8865	1.9029	-0.016387	1
0.9166	1.8832	1.9001	-0.016915	1
0.9333	1.8832	1.8974	-0.014151	1
0.95	1.8766	1.8946	-0.017951	1
0.9666	1.8734	1.8919	-0.018491	1
0.9833	1.8701	1.8891	-0.019019	1
1	1.8602	1.8864	-0.026111	1
1.2	1.8274	1.8537	-0.026318	1
1.4	1.7979	1.8217	-0.023809	1
1.6	1.7651	1.7902	-0.025133	1
1.8	1.7356	1.7593	-0.023722	1
2	1.706	1.7289	-0.022835	1
2.2	1.6765	1.699	-0.022484	1
2.4	1.647	1.6696	-0.022649	1
2.6	1.6207	1.6408	-0.020032	1
2.8	1.5945	1.6124	-0.017924	1
3	1.5682	1.5845	-0.016305	1
3.2	1.5354	1.5572	-0.021729	1
3.4	1.5092	1.5302	-0.021056	1
3.6	1.4862	1.5038	-0.017577	1
3.8	1.46	1.4778	-0.017836	1
4	1.437	1.4523	-0.015255	1
4.2	1.4108	1.4272	-0.016404	1
4.4	1.3911	1.4025	-0.011418	1
4.6	1.3648	1.3783	-0.013428	1
4.8	1.3419	1.3544	-0.012577	1
5	1.3189	1.331	-0.012127	1
5.2	1.3025	1.308	-0.0055321	1
5.4	1.2795	1.2854	-0.0058848	1
5.6	1.2566	1.2632	-0.0066383	1
5.8	1.2402	1.2414	-0.0012057	1
6	1.2172	1.2199	-0.0027205	1
6.2	1.1975	1.1988	-0.0013161	1
6.4	1.1745	1.1781	-0.0035661	1
6.6	1.1581	1.1577	0.00039582	1
6.8	1.1385	1.1377	0.00071577	1
7	1.1188	1.1181	0.00069988	1

7.2	1.1056	1.0987	0.0068941	1
7.4	1.0827	1.0798	0.0029244	1
7.6	1.063	1.0611	0.0018964	1
7.8	1.0466	1.0428	0.0038359	1
8	1.0335	1.0247	0.0087384	1
8.2	1.0138	1.007	0.0067594	1
8.4	0.99738	0.98962	0.0077593	1
8.6	0.98097	0.97251	0.0084594	1
8.8	0.96457	0.9557	0.0088639	1
9	0.95144	0.93919	0.012259	1
9.2	0.93176	0.92295	0.0088063	1
9.4	0.91864	0.907	0.011634	1
9.6	0.90223	0.89132	0.010906	1
9.8	0.89239	0.87592	0.016469	1
10	0.87598	0.86078	0.015204	1
12	0.74475	0.72306	0.021691	1
14	0.62992	0.60737	0.022546	1
16	0.53806	0.5102	0.02786	1
18	0.45604	0.42857	0.027468	1
20	0.38714	0.36	0.027138	1
22	0.33137	0.3024	0.028963	1
24	0.27559	0.25402	0.021571	1
26	0.23622	0.21338	0.022842	1
28	0.19357	0.17924	0.014331	1
30	0.16404	0.15056	0.01348	1
32	0.1378	0.12647	0.011322	1
34	0.10827	0.10624	0.0020304	1
36	0.091864	0.08924	0.0026238	1
38	0.068898	0.074962	-0.0060643	1
40	0.055774	0.062969	-0.0071947	1
42	0.042651	0.052894	-0.010243	1
44	0.029528	0.044431	-0.014903	1
46	0.019685	0.037323	-0.017638	1
48	0.009843	0.031351	-0.021508	1
50	0.006562	0.026335	-0.019773	1

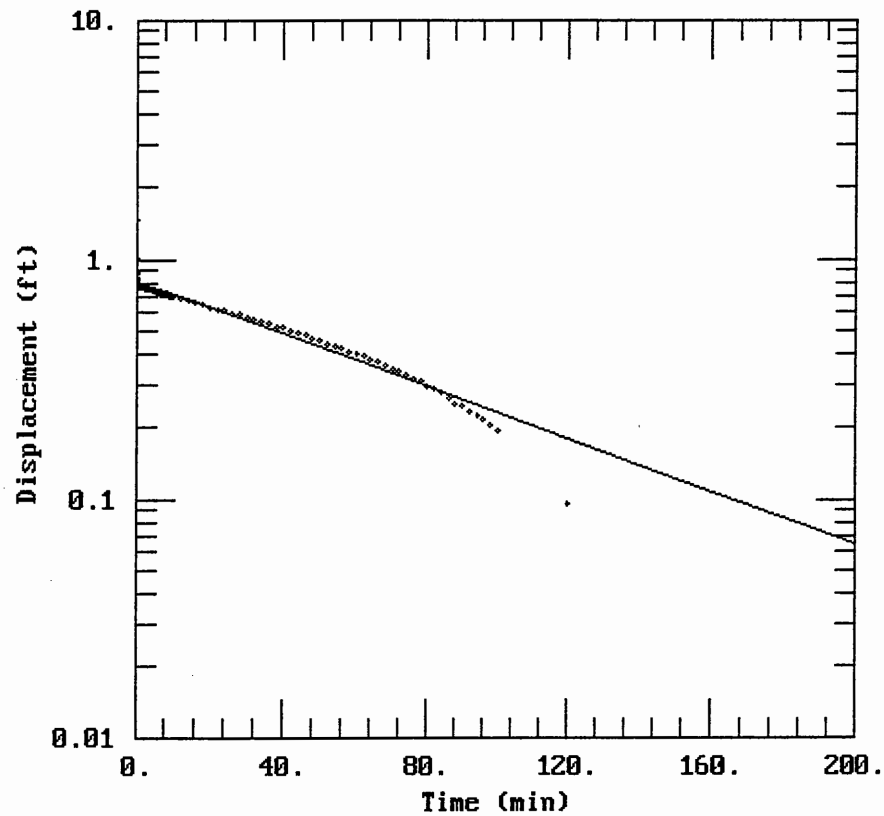
==

RESULTS FROM VISUAL CURVE MATCHING

VISUAL MATCH PARAMETER ESTIMATES

	Estimate
K =	3.3738E-004 cm/sec
y0 =	2.0582E+000 ft

<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<>>



DATA SET:
MW202.DAT
05/14/98

AQUIFER MODEL:
Confined

SOLUTION METHOD:
Bouwer-Rice

TEST DATA:
H0= 3. ft
r_c= 0.1667 ft
r_w= 0.8333 ft
L = 3. ft
b = 10.57 ft
H = 10.57 ft

PARAMETER ESTIMATES:
K = 4.73E-05 cm/sec
y0 = 0.8116 ft

```
<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>

                         A Q T E S O L V   R E S U L T S
                                  Version 2.0

                          Developed by Glenn M. Duffield
                      (c) 1993, 1994 Geraghty & Miller, Inc.

05/14/98                                                                18:36:58

================================================================================
                                TEST DESCRIPTION

Data set........... MW202.DAT
Output file........ MW202.OUT
Data set title..... MW-202 - test using ft converstion

Units of Measurement
   Length.......... ft
   Time............ min

Test Well Data
   Initial displacement in well..... 3
   Radius of well casing............ 0.1667
   Radius of wellbore............... 0.8333
   Aquifer saturated thickness...... 10.57
   Well screen length............... 3
   Static height of water in well... 10.57
   Gravel pack porosity............. 0
   Effective well casing radius..... 0.1667
   Effective wellbore radius........ 0.8333
   Log(Re/Rw)....................... 1.587
   Constants A, B and C............. 0.000 ,  0.000,  0.709
   No. of observations.............. 231

================================================================================
                               ANALYTICAL METHOD

Bouwer-Rice (Confined Aquifer Slug Test)

================================================================================
                    RESULTS FROM STATISTICAL CURVE MATCHING


STATISTICAL MATCH PARAMETER ESTIMATES

           Estimate          Std. Error
   K  =   4.7298E-005 +/-   1.4313E-006 cm/sec
   y0 =   8.1160E-001 +/-   3.9384E-003 ft


ANALYSIS OF MODEL RESIDUALS

residual = observed - calculated
weighted residual = residual * weight

Weighted Residual Statistics:
   Number of residuals............... 231
   Number of estimated parameters.... 2
```

```
Degrees of freedom............... 229
Residual mean.................... -0.0001313
Residual standard deviation....... 0.05145
Residual variance................ 0.002647
```

Model Residuals:

Time	Observed	Calculated	Residual	Weight
0.0033	0.98796	0.81156	0.17639	1
0.0066	1.467	0.81153	0.65543	1
0.01	0.78783	0.81149	-0.023667	1
0.0133	0.90594	0.81146	0.094477	1
0.0166	0.89281	0.81143	0.081388	1
0.02	0.89281	0.81139	0.081423	1
0.0233	1.0175	0.81136	0.20613	1
0.0266	0.88953	0.81132	0.07821	1
0.03	0.78127	0.81129	-0.030024	1
0.0333	0.82392	0.81125	0.012661	1
0.0366	0.86657	0.81122	0.055346	1
0.04	0.83376	0.81119	0.022573	1
0.0433	0.83704	0.81115	0.025887	1
0.0466	0.83048	0.81112	0.01936	1
0.05	0.82064	0.81108	0.0095521	1
0.0533	0.84688	0.81105	0.035833	1
0.0566	0.8436	0.81102	0.032586	1
0.06	0.83704	0.81098	0.026059	1
0.0633	0.83048	0.81095	0.019532	1
0.0666	0.83048	0.81091	0.019566	1
0.07	0.82064	0.81088	0.0097576	1
0.0733	0.79767	0.81084	-0.013175	1
0.0766	0.82064	0.81081	0.0098254	1
0.08	0.80751	0.81077	-0.0032627	1
0.0833	0.81735	0.81074	0.0066132	1
0.0866	0.81079	0.81071	8.6129E-005	1
0.09	0.81079	0.81067	0.00012106	1
0.0933	0.81079	0.81064	0.00015495	1
0.0966	0.81079	0.8106	0.00018885	1
0.1	0.81079	0.81057	0.00022377	1
0.1033	0.81079	0.81054	0.00025766	1
0.1066	0.81079	0.8105	0.00029155	1
0.11	0.78127	0.81047	-0.029202	1
0.1133	0.80751	0.81043	-0.0029206	1
0.1166	0.81079	0.8104	0.00039425	1
0.12	0.78783	0.81036	-0.022537	1
0.1233	0.80751	0.81033	-0.002818	1
0.1266	0.82392	0.8103	0.01362	1
0.13	0.81079	0.81026	0.00053184	1
0.1333	0.80751	0.81023	-0.0027153	1
0.1366	0.81079	0.81019	0.00059959	1
0.14	0.81079	0.81016	0.0006345	1
0.1433	0.81079	0.81012	0.00066837	1
0.1466	0.80751	0.81009	-0.0025788	1
0.15	0.80751	0.81006	-0.0025439	1
0.1533	0.81079	0.81002	0.00077102	1
0.1566	0.80751	0.80999	-0.0024761	1
0.16	0.80751	0.80995	-0.0024412	1
0.1633	0.80751	0.80992	-0.0024073	1
0.1666	0.80751	0.80989	-0.0023735	1

0.17	0.80751	0.80985	-0.0023386	1
0.1733	0.80751	0.80982	-0.0023047	1
0.1766	0.80751	0.80978	-0.0022709	1
0.18	0.80751	0.80975	-0.002236	1
0.1833	0.80751	0.80971	-0.0022021	1
0.1866	0.80751	0.80968	-0.0021683	1
0.19	0.80751	0.80965	-0.0021334	1
0.1933	0.80751	0.80961	-0.0020995	1
0.1966	0.80751	0.80958	-0.0020657	1
0.2	0.80751	0.80954	-0.0020308	1
0.2033	0.80751	0.80951	-0.001997	1
0.2066	0.80751	0.80948	-0.0019631	1
0.21	0.80751	0.80944	-0.0019282	1
0.2133	0.80751	0.80941	-0.0018944	1
0.2166	0.80751	0.80937	-0.0018605	1
0.22	0.80751	0.80934	-0.0018257	1
0.2233	0.80751	0.8093	-0.0017918	1
0.2266	0.80751	0.80927	-0.001758	1
0.23	0.80751	0.80924	-0.0017231	1
0.2333	0.80751	0.8092	-0.0016893	1
0.2366	0.80751	0.80917	-0.0016555	1
0.24	0.80751	0.80913	-0.0016206	1
0.2433	0.80751	0.8091	-0.0015868	1
0.2466	0.80751	0.80906	-0.0015529	1
0.25	0.80751	0.80903	-0.0015181	1
0.2533	0.80751	0.809	-0.0014842	1
0.2566	0.80751	0.80896	-0.0014504	1
0.26	0.80751	0.80893	-0.0014156	1
0.2633	0.80095	0.80889	-0.0079437	1
0.2666	0.80095	0.80886	-0.0079099	1
0.27	0.80751	0.80883	-0.0013131	1
0.2733	0.80095	0.80879	-0.0078413	1
0.2766	0.80751	0.80876	-0.0012454	1
0.28	0.80751	0.80872	-0.0012106	1
0.2833	0.80751	0.80869	-0.0011768	1
0.2866	0.80095	0.80865	-0.007705	1
0.29	0.80095	0.80862	-0.0076701	1
0.2933	0.80751	0.80859	-0.0010743	1
0.2966	0.80751	0.80855	-0.0010405	1
0.3	0.80751	0.80852	-0.0010057	1
0.3033	0.80751	0.80848	-0.00097186	1
0.3066	0.80751	0.80845	-0.00093806	1
0.31	0.80095	0.80842	-0.0074652	1
0.3133	0.80095	0.80838	-0.0074314	1
0.3166	0.80095	0.80835	-0.0073976	1
0.32	0.80095	0.80831	-0.0073628	1
0.3233	0.80095	0.80828	-0.007329	1
0.3266	0.80095	0.80825	-0.0072952	1
0.33	0.80095	0.80821	-0.0072604	1
0.3333	0.80095	0.80818	-0.0072266	1
0.35	0.80751	0.80801	-0.00049359	1
0.3666	0.80095	0.80784	-0.0068857	1
0.3833	0.80095	0.80766	-0.0067147	1
0.4	0.80095	0.80749	-0.0065438	1
0.4166	0.80095	0.80732	-0.006374	1
0.4333	0.80095	0.80715	-0.0062032	1
0.45	0.80095	0.80698	-0.0060324	1
0.4666	0.80095	0.80681	-0.0058627	1
0.4833	0.79767	0.80664	-0.008973	1
0.5	0.79767	0.80647	-0.0088023	1

0.5166	0.79767	0.8063	-0.0086327	1
0.5333	0.79767	0.80613	-0.0084621	1
0.55	0.79767	0.80596	-0.0082915	1
0.5666	0.79767	0.80579	-0.008122	1
0.5833	0.79767	0.80562	-0.0079515	1
0.6	0.79767	0.80545	-0.0077811	1
0.6166	0.79767	0.80528	-0.0076117	1
0.6333	0.79767	0.80511	-0.0074413	1
0.65	0.79767	0.80494	-0.0072709	1
0.6666	0.79439	0.80477	-0.010383	1
0.6833	0.79439	0.8046	-0.010212	1
0.7	0.79439	0.80443	-0.010042	1
0.7166	0.79439	0.80426	-0.0098729	1
0.7333	0.79439	0.80409	-0.0097028	1
0.75	0.78455	0.80392	-0.019375	1
0.7666	0.7747	0.80375	-0.029049	1
0.7833	0.78455	0.80358	-0.019035	1
0.8	0.78455	0.80341	-0.018865	1
0.8166	0.77142	0.80324	-0.031819	1
0.8333	0.78455	0.80307	-0.018527	1
0.85	0.78127	0.8029	-0.021638	1
0.8666	0.78127	0.80273	-0.021469	1
0.8833	0.78127	0.80256	-0.021299	1
0.9	0.78127	0.80239	-0.021129	1
0.9166	0.78127	0.80223	-0.02096	1
0.9333	0.78127	0.80206	-0.020791	1
0.95	0.78127	0.80189	-0.020621	1
0.9666	0.78127	0.80172	-0.020452	1
0.9833	0.78127	0.80155	-0.020283	1
1	0.78127	0.80138	-0.020113	1
1.2	0.7747	0.79935	-0.024647	1
1.4	0.77142	0.79733	-0.025904	1
1.6	0.77142	0.79531	-0.023886	1
1.8	0.76814	0.7933	-0.025154	1
2	0.76814	0.79129	-0.023146	1
2.2	0.76158	0.78928	-0.027705	1
2.4	0.7583	0.78729	-0.028988	1
2.6	0.7583	0.78529	-0.026996	1
2.8	0.7583	0.78331	-0.025008	1
3	0.75174	0.78132	-0.029587	1
3.2	0.75174	0.77935	-0.027609	1
3.4	0.74846	0.77737	-0.028917	1
3.6	0.74846	0.77541	-0.02695	1
3.8	0.74518	0.77344	-0.028268	1
4	0.74518	0.77149	-0.026311	1
4.2	0.74518	0.76953	-0.024358	1
4.4	0.73861	0.76759	-0.028972	1
4.6	0.73533	0.76564	-0.030311	1
4.8	0.73533	0.76371	-0.028373	1
5	0.73533	0.76177	-0.02644	1
5.2	0.73205	0.75984	-0.027793	1
5.4	0.73205	0.75792	-0.02587	1
5.6	0.73205	0.756	-0.023951	1
5.8	0.72549	0.75409	-0.028599	1
6	0.72549	0.75218	-0.02669	1
6.2	0.72221	0.75028	-0.028067	1
6.4	0.72221	0.74838	-0.026168	1
6.6	0.72221	0.74648	-0.024274	1
6.8	0.71565	0.74459	-0.028947	1
7	0.71565	0.74271	-0.027062	1

7.2	0.71565	0.74083	-0.025183	1
7.4	0.71237	0.73896	-0.026589	1
7.6	0.71237	0.73709	-0.024718	1
7.8	0.71237	0.73522	-0.022853	1
8	0.70909	0.73336	-0.024272	1
8.2	0.70909	0.7315	-0.022416	1
8.4	0.70909	0.72965	-0.020564	1
8.6	0.70253	0.7278	-0.025279	1
8.8	0.70253	0.72596	-0.023437	1
9	0.70253	0.72412	-0.0216	1
9.2	0.69924	0.72229	-0.023048	1
9.4	0.69924	0.72046	-0.02122	1
9.6	0.69924	0.71864	-0.019397	1
9.8	0.69596	0.71682	-0.020859	1
10	0.69596	0.71501	-0.019044	1
12	0.68612	0.69712	-0.010994	1
14	0.673	0.67967	-0.0066737	1
16	0.65987	0.66266	-0.0027888	1
18	0.64347	0.64608	-0.0026105	1
20	0.63035	0.62991	0.00043292	1
22	0.61722	0.61415	0.0030727	1
24	0.61066	0.59878	0.011879	1
26	0.59426	0.5838	0.010459	1
28	0.5877	0.56919	0.018507	1
30	0.56801	0.55495	0.013064	1
32	0.55817	0.54106	0.017109	1
34	0.55161	0.52752	0.024086	1
36	0.53848	0.51432	0.024164	1
38	0.52208	0.50145	0.02063	1
40	0.51552	0.4889	0.026616	1
42	0.50239	0.47667	0.025727	1
44	0.49255	0.46474	0.027812	1
46	0.47943	0.45311	0.026319	1
48	0.4663	0.44177	0.024533	1
50	0.45974	0.43072	0.029027	1
52	0.44334	0.41994	0.023401	1
54	0.4335	0.40943	0.024067	1
56	0.42365	0.39918	0.02447	1
58	0.41053	0.38919	0.021335	1
60	0.40069	0.37946	0.021232	1
62	0.39413	0.36996	0.024166	1
64	0.381	0.3607	0.020301	1
66	0.37116	0.35168	0.019484	1
68	0.35804	0.34288	0.015161	1
70	0.34819	0.3343	0.013898	1
72	0.33835	0.32593	0.012421	1
74	0.32523	0.31777	0.0074534	1
76	0.31539	0.30982	0.0055633	1
78	0.30882	0.30207	0.0067542	1
80	0.2957	0.29451	0.0011902	1
82	0.28586	0.28714	-0.001283	1
84	0.27602	0.27996	-0.0039397	1
86	0.26289	0.27295	-0.010058	1
88	0.24977	0.26612	-0.016351	1
90	0.24321	0.25946	-0.016254	1
92	0.23008	0.25297	-0.022884	1
94	0.22352	0.24664	-0.023116	1
96	0.21368	0.24047	-0.026786	1
98	0.20384	0.23445	-0.030611	1
100	0.194	0.22858	-0.034582	1

120	0.09557	0.17741	-0.081841	1

==

RESULTS FROM VISUAL CURVE MATCHING

VISUAL MATCH PARAMETER ESTIMATES

	Estimate
K =	4.7298E-005 cm/sec
y0 =	8.1160E-001 ft

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APPENDIX E

ANALYTICAL RESULTS

ACCUTEST.

06/13/96

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JUN 14 1996
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Technical Report for

Leggette, Brashears & Graham, Inc.

HB Fuller - Monarch Chemical, Geneva, NY

Accutest Job Number: E11942-

Report to:

Leggette, Brashears And Graham, Inc.
500B Lake Street
Ramsey, NJ 07446

ATTN: Dave Terry

Total number of pages in report: 380

Vincent J. Pugliese
President

Results relate only to the items tested.

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ACCUTEST.

Sample Summary

Leggette, Brashears & Graham, Inc.

HB Fuller - Monarch Chemical, Geneva, NY

Date: 06/12/96
Job No: E11942

Sample Number	Collected Date	Time	By	Received	Matrix Code	Type	Client Sample ID
E11942-1	05/29/96	09:45	RJS	05/30/96	AQ	Ground Water	MW-5
E11942-2	05/29/96	10:45	RJS	05/30/96	AQ	Ground Water	MW-4
E11942-3	05/29/96	11:45	RJS	05/30/96	AQ	Ground Water	MW-3
E11942-4	05/29/96	12:45	RJS	05/30/96	AQ	Ground Water	MW-2
E11942-5	05/29/96	13:30	RJS	05/30/96	AQ	Ground Water	MW-1

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ACCUTEST.

Report of Analysis

Client Sample ID:	MW-5		
Lab Sample ID:	E11942-1	**Date Sampled:**	05/29/96
Matrix:	AQ - Ground Water	**Date Received:**	05/30/96
Method:	SW846 8240	**Percent Solids:**	n/a
Project:	HB Fuller - Monarch Chemical, Geneva, NY		

	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	>O6775	1	06/03/96	SRP	n/a	n/a	VO961
Run #2							

VOA PPL List

CAS No.	Compound	Result	RDL	Units	Q
107-02-8	Acrolein	ND	7.2	ug/l	
107-13-1	Acrylonitrile	ND	6.0	ug/l	
71-43-2	Benzene	ND	0.40	ug/l	
75-27-4	Bromodichloromethane	ND	0.55	ug/l	
75-25-2	Bromoform	ND	0.47	ug/l	
74-83-9	Bromomethane	ND	1.2	ug/l	
108-90-7	Chlorobenzene	ND	0.67	ug/l	
75-00-3	Chloroethane	ND	0.89	ug/l	
67-66-3	Chloroform	ND	0.94	ug/l	
74-87-3	Chloromethane	ND	1.0	ug/l	
56-23-5	Carbon tetrachloride	ND	0.66	ug/l	
110-75-8	2-Chloroethyl vinyl ether	ND	1.0	ug/l	
75-34-3	1,1-Dichloroethane	1.8	0.89	ug/l	
75-35-4	1,1-Dichloroethylene	ND	0.97	ug/l	
95-50-1	1,2-Dichlorobenzene	ND	0.67	ug/l	
107-06-2	1,2-Dichloroethane	ND	0.83	ug/l	
78-87-5	1,2-Dichloropropane	ND	0.72	ug/l	
541-73-1	1,3-Dichlorobenzene	ND	0.52	ug/l	
106-46-7	1,4-Dichlorobenzene	ND	0.44	ug/l	
124-48-1	Dibromochloromethane	ND	0.21	ug/l	
156-69-4	cis-1,2-Dichloroethylene	ND	0.92	ug/l	
156-60-5	trans-1,2-Dichloroethylene	ND	0.92	ug/l	
10061-01-5	cis-1,3-Dichloropropene	ND	0.56	ug/l	
10061-02-6	trans-1,3-Dichloropropene	ND	0.47	ug/l	
100-41-4	Ethylbenzene	ND	0.76	ug/l	
75-09-2	Methylene chloride	ND	0.64	ug/l	
71-55-6	1,1,1-Trichloroethane	3.4	0.65	ug/l	
79-34-5	1,1,2,2-Tetrachloroethane	ND	0.31	ug/l	
79-00-5	1,1,2-Trichloroethane	ND	0.59	ug/l	
127-18-4	Tetrachloroethylene	1.8	0.95	ug/l	
108-88-3	Toluene	ND	0.38	ug/l	
79-01-6	Trichloroethylene	ND	0.54	ug/l	
75-69-4	Trichlorofluoromethane	ND	1.1	ug/l	
75-01-4	Vinyl chloride	ND	1.6	ug/l	
1330-20-7	Xylenes (total)	ND	1.0	ug/l	

ND = Not detected
RDL = Reported Detection Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates that analyte is found in associated method blank
N = Indicates presumptive evidence of a compound

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Report of Analysis

Client Sample ID:	MW-5		
Lab Sample ID:	E11942-1	**Date Sampled:**	05/29/96
Matrix:	AQ - Ground Water	**Date Received:**	05/30/96
Method:	SW846 8240	**Percent Solids:**	n/a
Project:	HB Fuller - Monarch Chemical, Geneva, NY		

	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	>O6775	1	06/03/96	SRP	n/a	n/a	VO961
Run #2							

VOA PPL List

CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits
17060-07-0	1,2-Dichloroethane-D4 (SUR)	93.0%		76-114%
2037-26-5	Toluene-D8 (SUR)	102.2%		88-110%
460-00-4	4-Bromofluorobenzene (SUR)	93.2%		86-115%

CAS No.	Tentatively Identified Compounds	R.T.	Est. Conc.	Units	Q
	Unknown	2.36	16	ug/l	J
76-13-1	Ethane, 1,1,2-trichloro-1,2,2-trif	4.43	36	ug/l	JN
	Total TIC, Volatile		52	ug/l	

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E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates that analyte is found in associated method blank
N = Indicates presumptive evidence of a compound

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Report of Analysis

Client Sample ID:	MW-4		
Lab Sample ID:	E11942-2	**Date Sampled:**	05/29/96
Matrix:	AQ - Ground Water	**Date Received:**	05/30/96
Method:	SW846 8240	**Percent Solids:**	n/a
Project:	HB Fuller - Monarch Chemical, Geneva, NY		

	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	>O6777	1	06/03/96	SRP	n/a	n/a	VO961
Run #2							

VOA PPL List

CAS No.	Compound	Result	RDL	Units	Q
107-02-8	Acrolein	ND	7.2	ug/l	
107-13-1	Acrylonitrile	ND	6.0	ug/l	
71-43-2	Benzene	ND	0.40	ug/l	
75-27-4	Bromodichloromethane	ND	0.55	ug/l	
75-25-2	Bromoform	ND	0.47	ug/l	
74-83-9	Bromomethane	ND	1.2	ug/l	
108-90-7	Chlorobenzene	ND	0.67	ug/l	
75-00-3	Chloroethane	ND	0.89	ug/l	
67-66-3	Chloroform	23.1	0.94	ug/l	
74-87-3	Chloromethane	ND	1.0	ug/l	
56-23-5	Carbon tetrachloride	ND	0.66	ug/l	
110-75-8	2-Chloroethyl vinyl ether	ND	1.0	ug/l	
75-34-3	1,1-Dichloroethane	ND	0.89	ug/l	
75-35-4	1,1-Dichloroethylene	ND	0.97	ug/l	
95-50-1	1,2-Dichlorobenzene	ND	0.67	ug/l	
107-06-2	1,2-Dichloroethane	ND	0.83	ug/l	
78-87-5	1,2-Dichloropropane	ND	0.72	ug/l	
541-73-1	1,3-Dichlorobenzene	ND	0.52	ug/l	
106-46-7	1,4-Dichlorobenzene	ND	0.44	ug/l	
124-48-1	Dibromochloromethane	ND	0.21	ug/l	
156-69-4	cis-1,2-Dichloroethylene	ND	0.92	ug/l	
156-60-5	trans-1,2-Dichloroethylene	ND	0.92	ug/l	
10061-01-5	cis-1,3-Dichloropropene	ND	0.56	ug/l	
10061-02-6	trans-1,3-Dichloropropene	ND	0.47	ug/l	
100-41-4	Ethylbenzene	ND	0.76	ug/l	
75-09-2	Methylene chloride	2.7	0.64	ug/l	
71-55-6	1,1,1-Trichloroethane	1.2	0.65	ug/l	
79-34-5	1,1,2,2-Tetrachloroethane	ND	0.31	ug/l	
79-00-5	1,1,2-Trichloroethane	ND	0.59	ug/l	
127-18-4	Tetrachloroethylene	ND	0.95	ug/l	
108-88-3	Toluene	ND	0.38	ug/l	
79-01-6	Trichloroethylene	ND	0.54	ug/l	
75-69-4	Trichlorofluoromethane	ND	1.1	ug/l	
75-01-4	Vinyl chloride	ND	1.6	ug/l	
1330-20-7	Xylenes (total)	ND	1.0	ug/l	

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E = Indicates value exceeds calibration range
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B = Indicates that analyte is found in associated method blank
N = Indicates presumptive evidence of a compound

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Report of Analysis

Client Sample ID:	MW-4		
Lab Sample ID:	E11942-2	**Date Sampled:**	05/29/96
Matrix:	AQ - Ground Water	**Date Received:**	05/30/96
Method:	SW846 8240	**Percent Solids:**	n/a
Project:	HB Fuller - Monarch Chemical, Geneva, NY		

	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	>O6777	1	06/03/96	SRP	n/a	n/a	VO961
Run #2							

VOA PPL List

CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits
17060-07-0	1,2-Dichloroethane-D4 (SUR)	90.2%		76-114%
2037-26-5	Toluene-D8 (SUR)	102.4%		88-110%
460-00-4	4-Bromofluorobenzene (SUR)	90.4%		86-115%

CAS No.	Tentatively Identified Compounds	R.T.	Est. Conc.	Units	Q
	Unknown	2.36	28	ug/l	J
76-13-1	Ethane, 1,1,2-trichloro-1,2,2-trif	4.43	45	ug/l	JN
	Total TIC, Volatile		73	ug/l	

ND = Not detected
RDL = Reported Detection Limit
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J = Indicates an estimated value
B = Indicates that analyte is found in associated method blank
N = Indicates presumptive evidence of a compound

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Report of Analysis

Client Sample ID:	MW-3		
Lab Sample ID:	E11942-3	**Date Sampled:**	05/29/96
Matrix:	AQ - Ground Water	**Date Received:**	05/30/96
Method:	SW846 8240	**Percent Solids:**	n/a
Project:	HB Fuller - Monarch Chemical, Geneva, NY		

	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	>O6778	1	06/03/96	SRP	n/a	n/a	VO961
Run #2							

VOA PPL List

CAS No.	Compound	Result	RDL	Units	Q
107-02-8	Acrolein	ND	7.2	ug/l	
107-13-1	Acrylonitrile	ND	6.0	ug/l	
71-43-2	Benzene	ND	0.40	ug/l	
75-27-4	Bromodichloromethane	ND	0.55	ug/l	
75-25-2	Bromoform	ND	0.47	ug/l	
74-83-9	Bromomethane	ND	1.2	ug/l	
108-90-7	Chlorobenzene	6.2	0.67	ug/l	
75-00-3	Chloroethane	ND	0.89	ug/l	
67-66-3	Chloroform	18.7	0.94	ug/l	
74-87-3	Chloromethane	ND	1.0	ug/l	
56-23-5	Carbon tetrachloride	ND	0.66	ug/l	
110-75-8	2-Chloroethyl vinyl ether	ND	1.0	ug/l	
75-34-3	1,1-Dichloroethane	14.1	0.89	ug/l	
75-35-4	1,1-Dichloroethylene	ND	0.97	ug/l	
95-50-1	1,2-Dichlorobenzene	1.4	0.67	ug/l	
107-06-2	1,2-Dichloroethane	ND	0.83	ug/l	
78-87-5	1,2-Dichloropropane	ND	0.72	ug/l	
541-73-1	1,3-Dichlorobenzene	ND	0.52	ug/l	
106-46-7	1,4-Dichlorobenzene	ND	0.44	ug/l	
124-48-1	Dibromochloromethane	ND	0.21	ug/l	
156-69-4	cis-1,2-Dichloroethylene	11.9	0.92	ug/l	
156-60-5	trans-1,2-Dichloroethylene	ND	0.92	ug/l	
10061-01-5	cis-1,3-Dichloropropene	ND	0.56	ug/l	
10061-02-6	trans-1,3-Dichloropropene	ND	0.47	ug/l	
100-41-4	Ethylbenzene	ND	0.76	ug/l	
75-09-2	Methylene chloride	11.3	0.64	ug/l	
71-55-6	1,1,1-Trichloroethane	7.4	0.65	ug/l	
79-34-5	1,1,2,2-Tetrachloroethane	ND	0.31	ug/l	
79-00-5	1,1,2-Trichloroethane	ND	0.59	ug/l	
127-18-4	Tetrachloroethylene	40.1	0.95	ug/l	
108-88-3	Toluene	1.4	0.38	ug/l	
79-01-6	Trichloroethylene	32.7	0.54	ug/l	
75-69-4	Trichlorofluoromethane	ND	1.1	ug/l	
75-01-4	Vinyl chloride	5.8	1.6	ug/l	
1330-20-7	Xylenes (total)	ND	1.0	ug/l	

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RDL = Reported Detection Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates that analyte is found in associated method blank
N = Indicates presumptive evidence of a compound

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Report of Analysis

Client Sample ID:	MW-3		
Lab Sample ID:	E11942-3	**Date Sampled:**	05/29/96
Matrix:	AQ - Ground Water	**Date Received:**	05/30/96
Method:	SW846 8240	**Percent Solids:**	n/a
Project:	HB Fuller - Monarch Chemical, Geneva, NY		

	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	>O6778	1	06/03/96	SRP	n/a	n/a	VO961
Run #2							

VOA PPL List

CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits
17060-07-0	1,2-Dichloroethane-D4 (SUR)	92.6%		76-114%
2037-26-5	Toluene-D8 (SUR)	101.2%		88-110%
460-00-4	4-Bromofluorobenzene (SUR)	92.4%		86-115%

CAS No.	Tentatively Identified Compounds	R.T.	Est. Conc.	Units	Q
	Unknown	2.36	140	ug/l	J
76-13-1	Ethane, 1,1,2-trichloro-1,2,2-trif	4.45	66	ug/l	JN
55320-58-6	Hexanal, 5,5-dimethyl- (9CI)	18.61	21	ug/l	JN
	Total TIC, Volatile		227	ug/l	

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N = Indicates presumptive evidence of a compound

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Report of Analysis

Client Sample ID:	MW-2		
Lab Sample ID:	E11942-4	**Date Sampled:**	05/29/96
Matrix:	AQ - Ground Water	**Date Received:**	05/30/96
Method:	SW846 8240	**Percent Solids:**	n/a
Project:	HB Fuller - Monarch Chemical, Geneva, NY		

	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	>O6771	1	06/03/96	SRP	n/a	n/a	VO961
Run #2							

VOA PPL List

CAS No.	Compound	Result	RDL	Units	Q
107-02-8	Acrolein	ND	7.2	ug/l	
107-13-1	Acrylonitrile	ND	6.0	ug/l	
71-43-2	Benzene	2.7	0.40	ug/l	
75-27-4	Bromodichloromethane	ND	0.55	ug/l	
75-25-2	Bromoform	ND	0.47	ug/l	
74-83-9	Bromomethane	ND	1.2	ug/l	
108-90-7	Chlorobenzene	1.9	0.67	ug/l	
75-00-3	Chloroethane	ND	0.89	ug/l	
67-66-3	Chloroform	16.7	0.94	ug/l	
74-87-3	Chloromethane	ND	1.0	ug/l	
56-23-5	Carbon tetrachloride	ND	0.66	ug/l	
110-75-8	2-Chloroethyl vinyl ether	ND	1.0	ug/l	
75-34-3	1,1-Dichloroethane	66.1	0.89	ug/l	
75-35-4	1,1-Dichloroethylene	9.1	0.97	ug/l	
95-50-1	1,2-Dichlorobenzene	ND	0.67	ug/l	
107-06-2	1,2-Dichloroethane	ND	0.83	ug/l	
78-87-5	1,2-Dichloropropane	ND	0.72	ug/l	
541-73-1	1,3-Dichlorobenzene	ND	0.52	ug/l	
106-46-7	1,4-Dichlorobenzene	ND	0.44	ug/l	
124-48-1	Dibromochloromethane	ND	0.21	ug/l	
156-69-4	cis-1,2-Dichloroethylene	283	0.92	ug/l	
156-60-5	trans-1,2-Dichloroethylene	2.1	0.92	ug/l	
10061-01-5	cis-1,3-Dichloropropene	ND	0.56	ug/l	
10061-02-6	trans-1,3-Dichloropropene	ND	0.47	ug/l	
100-41-4	Ethylbenzene	ND	0.76	ug/l	
75-09-2	Methylene chloride	6.2	0.64	ug/l	
71-55-6	1,1,1-Trichloroethane	6.3	0.65	ug/l	
79-34-5	1,1,2,2-Tetrachloroethane	ND	0.31	ug/l	
79-00-5	1,1,2-Trichloroethane	2.3	0.59	ug/l	
127-18-4	Tetrachloroethylene	110	0.95	ug/l	
108-88-3	Toluene	0.84	0.38	ug/l	
79-01-6	Trichloroethylene	242	0.54	ug/l	
75-69-4	Trichlorofluoromethane	ND	1.1	ug/l	
75-01-4	Vinyl chloride	162	1.6	ug/l	
1330-20-7	Xylenes (total)	ND	1.0	ug/l	

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N = Indicates presumptive evidence of a compound

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Report of Analysis

Client Sample ID:	MW-2		
Lab Sample ID:	E11942-4	**Date Sampled:**	05/29/96
Matrix:	AQ - Ground Water	**Date Received:**	05/30/96
Method:	SW846 8240	**Percent Solids:**	n/a
Project:	HB Fuller - Monarch Chemical, Geneva, NY		

	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	>06771	1	06/03/96	SRP	n/a	n/a	VO961
Run #2							

VOA PPL List

CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits
17060-07-0	1,2-Dichloroethane-D4 (SUR)	90.4%		76-114%
2037-26-5	Toluene-D8 (SUR)	104.4%		88-110%
460-00-4	4-Bromofluorobenzene (SUR)	93.2%		86-115%

CAS No.	Tentatively Identified Compounds	R.T.	Est. Conc.	Units	Q
	Unknown	2.37	81	ug/l	J
	Total TIC, Volatile		81	ug/l	

ND = Not detected
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B = Indicates that analyte is found in associated method blank
N = Indicates presumptive evidence of a compound

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Report of Analysis

Client Sample ID:	MW-1		
Lab Sample ID:	E11942-5	**Date Sampled:**	05/29/96
Matrix:	AQ - Ground Water	**Date Received:**	05/30/96
Method:	SW846 8240	**Percent Solids:**	n/a
Project:	HB Fuller - Monarch Chemical, Geneva, NY		

	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	>O6776	1	06/03/96	SRP	n/a	n/a	VO961
Run #2							

VOA PPL List

CAS No.	Compound	Result	RDL	Units	Q
107-02-8	Acrolein	ND	7.2	ug/l	
107-13-1	Acrylonitrile	ND	6.0	ug/l	
71-43-2	Benzene	ND	0.40	ug/l	
75-27-4	Bromodichloromethane	ND	0.55	ug/l	
75-25-2	Bromoform	ND	0.47	ug/l	
74-83-9	Bromomethane	ND	1.2	ug/l	
108-90-7	Chlorobenzene	ND	0.67	ug/l	
75-00-3	Chloroethane	ND	0.89	ug/l	
67-66-3	Chloroform	ND	0.94	ug/l	
74-87-3	Chloromethane	ND	1.0	ug/l	
56-23-5	Carbon tetrachloride	ND	0.66	ug/l	
110-75-8	2-Chloroethyl vinyl ether	ND	1.0	ug/l	
75-34-3	1,1-Dichloroethane	ND	0.89	ug/l	
75-35-4	1,1-Dichloroethylene	ND	0.97	ug/l	
95-50-1	1,2-Dichlorobenzene	ND	0.67	ug/l	
107-06-2	1,2-Dichloroethane	ND	0.83	ug/l	
78-87-5	1,2-Dichloropropane	ND	0.72	ug/l	
541-73-1	1,3-Dichlorobenzene	ND	0.52	ug/l	
106-46-7	1,4-Dichlorobenzene	ND	0.44	ug/l	
124-48-1	Dibromochloromethane	ND	0.21	ug/l	
156-69-4	cis-1,2-Dichloroethylene	2.0	0.92	ug/l	
156-60-5	trans-1,2-Dichloroethylene	ND	0.92	ug/l	
10061-01-5	cis-1,3-Dichloropropene	ND	0.56	ug/l	
10061-02-6	trans-1,3-Dichloropropene	ND	0.47	ug/l	
100-41-4	Ethylbenzene	11.5	0.76	ug/l	
75-09-2	Methylene chloride	ND	0.64	ug/l	
71-55-6	1,1,1-Trichloroethane	0.74	0.65	ug/l	
79-34-5	1,1,2,2-Tetrachloroethane	ND	0.31	ug/l	
79-00-5	1,1,2-Trichloroethane	ND	0.59	ug/l	
127-18-4	Tetrachloroethylene	11.0	0.95	ug/l	
108-88-3	Toluene	ND	0.38	ug/l	
79-01-6	Trichloroethylene	ND	0.54	ug/l	
75-69-4	Trichlorofluoromethane	ND	1.1	ug/l	
75-01-4	Vinyl chloride	ND	1.6	ug/l	
1330-20-7	Xylenes (total)	2.5	1.0	ug/l	

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N = Indicates presumptive evidence of a compound

ACCUTEST

Report of Analysis

Client Sample ID:	MW-1		
Lab Sample ID:	E11942-5	**Date Sampled:**	05/29/96
Matrix:	AQ - Ground Water	**Date Received:**	05/30/96
Method:	SW846 8240	**Percent Solids:**	n/a
Project:	HB Fuller - Monarch Chemical, Geneva, NY		

	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	>06776	1	06/03/96	SRP	n/a	n/a	VO961
Run #2							

VOA PPL List

CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits
17060-07-0	1,2-Dichloroethane-D4 (SUR)	88.4%		76-114%
2037-26-5	Toluene-D8 (SUR)	100.8%		88-110%
460-00-4	4-Bromofluorobenzene (SUR)	93.2%		86-115%

CAS No.	Tentatively Identified Compounds	R.T.	Est. Conc.	Units	Q
76-13-1	Ethane, 1,1,2-trichloro-1,2,2-trif	4.43	39	ug/l	JN
526-73-8	Benzene, 1,2,3-trimethyl- (8CI9CI)	21.40	17	ug/l	JN
611-14-3	Benzene, 1-ethyl-2-methyl- (9CI)	21.79	36	ug/l	JN
526-73-8	Benzene, 1,2,3-trimethyl- (8CI9CI)	22.18	88	ug/l	JN
98-82-8	Benzene, (1-methylethyl)- (9CI)	22.98	22	ug/l	JN
873-49-4	Benzene, cyclopropyl- (8CI9CI)	23.31	19	ug/l	JN
1074-43-7	Benzene, 1-methyl-3-propyl- (9CI)	23.43	27	ug/l	JN
934-80-5	Benzene, 4-ethyl-1,2-dimethyl- (9C	23.57	27	ug/l	JN
535-77-3	Benzene, 1-methyl-3-(1-methylethyl	24.06	42	ug/l	JN
99-87-6	Benzene, 1-methyl-4-(1-methylethyl	24.20	30	ug/l	JN
527-84-4	Benzene, 1-methyl-2-(1-methylethyl	24.92	43	ug/l	JN
767-58-8	1H-Indene, 2,3-dihydro-1-methyl- (	25.31	23	ug/l	JN
535-77-3	Benzene, 1-methyl-3-(1-methylethyl	25.57	100	ug/l	JN
635-51-8	Butanedioic acid, phenyl- (9CI)	25.80	26	ug/l	JN
4706-90-5	Benzene, 1,3-dimethyl-5-(1-methyle	26.16	27	ug/l	JN
	Total TIC, Volatile		566	ug/l	

ND = Not detected
RDL = Reported Detection Limit
E = Indicates value exceeds calibration range
J = Indicates an estimated value
B = Indicates that analyte is found in associated method blank
N = Indicates presumptive evidence of a compound

New Jersey • Fresh Ponds Corporate Village • Building B • 2235 Route 130 • Dayton NJ 08810 • tel 908-329-0200 • fax 908-329-3499 • http://www.accutest.com

ACCUTEST

CHAIN OF CUSTODY

FRESH PONDS CORPORATE VILLAGE, BUILDING B
2235 ROUTE 130, DAYTON, NJ 08810
908-329-0200 FAX: 908-329-3499/3480

ACCUTEST JOB #:

ACCUTEST QUOTE #: DM5-96 /2038

CLIENT INFORMATION

NAME: HB Fuller c/o LBG
ADDRESS: 500 B Lake St
CITY, STATE ZIP: Ramsey, NJ 07446
SEND REPORT TO: David Terry
PHONE #: (201) 818-0700

FACILITY INFORMATION

PROJECT NAME: HB Fuller - Monarch Chemical
LOCATION: Geneva, NY
PROJECT NO.:
FAX #: (201) 818-0505

ACCUTEST SAMPLE #	FIELD ID / POINT OF COLLECTION	DATE	TIME	SAMPLED BY:	MATRIX	# OF BOTTLES	HCl	NaOH	HNO3	H2SO4	NONE	ICE	PP+40	MBAS	PHC*	LAB USE ONLY
E11542-1	MW-5	5/29/96	945	RJS	GW	13	X	X	X	X			X	X	X	6C, 2G, SE, 7N, 8B6
-2	MW-4	5/29/96	1045	RJS		13							X	X	X	
-3	MW-3	5/29/96	1145	RJS		13							X	X	X	
-4	MW-2	5/29/96	1245	JB		13							X	X	X	
-5	MW-1	5/29/96	1330	RJS		13							X	X	X	

MATRIX CODES

DW - DRINKING WATER
GW - GROUND WATER
WW - WASTE WATER
SO - SOIL
SL - SLUDGE
OI - OIL
LIQ - OTHER LIQUID
SOL - OTHER SOLID

DATA TURNAROUND INFORMATION

☐ 21 DAYS STANDARD
☒ 14 DAYS ~~RUSH~~
☐ 7 DAYS EMERGENCY
☐ OTHER

APPROVED BY: 14 day (calendar) results - no extra charge

21 DAY TURNAROUND HARDCOPY. EMERGENCY OR RUSH IS FAX DATA UNLESS PREVIOUSLY APPROVED

DATA DELIVERABLE INFORMATION

☒ NJ REDUCED
☐ NJ Full
☐ FULL CLP
☐ DISK DELIVERABLE
☐ OTHER (SPECIFY)
☐ COMMERCIAL "A"
☐ COMMERCIAL "B"
☐ STATE FORMS

RED/T2

COMMENTS/REMARKS

* also rec'd PHC bottles for all samples. RJB 5-30-96
* add PHC to COFC as per DOM. RJB 5-31-96

SAMPLE CUSTODY MUST BE DOCUMENTED BELOW EACH TIME SAMPLES CHANGE POSSESION, INCLUDING COURIER DELIVERY

RELINQUISHED BY SAMPLER:	DATE TIME:	RECEIVED BY:	RELINQUISHED BY:	DATE TIME:	RECEIVED BY:
1. RJS	5/30/96 10:20	1.	2.	5/30/96 12:15	2.
RELINQUISHED BY: 3.	DATE TIME:	RECEIVED BY: 3.	RELINQUISHED BY: 4.	DATE TIME:	RECEIVED BY: 4.
RELINQUISHED BY: 5.	DATE TIME:	RECEIVED BY: 5.	SEAL #	PRESERVE WHERE APPLICABLE ☐	ON ICE ☐ TEMPERATURE

MICROSEEPS
University of Pittsburgh Applied Research Center
220 William Pitt Way, Pittsburgh, PA 15238
(412) 826-5245
FAX (412) 826-3433

NOV - 7 1996

November 4, 1996

Mr. Steve Zbur
Delta Environmental Consultants, Inc.
4068 Mt. Royal Boulevard
Suite 115-Gamma
Allison Park, PA 15101

Dear Mr. Zbur:

Attached are the final data listings for the samples we received on October 25, 1996, your project #96-015.

Please give me a call if you have questions or I can be of further assistance. Thank you for using MICROSEEPS.

Sincerely,

David J. Masdea

David J. Masdea

DJM/lsp

Attachments: DE11-962996

MICROSEEPS

FILE NOTE

SUBJECT: Light Hydrocarbon Analysis of Water Samples

The VOA vials are removed from the refrigerator (4°C) and allowed to reach ambient temperature over a period of 4 hours. Samples are prepared by withdrawing 30 cc of water from the bottom of the vial into a 50 cc Hamilton gas tight, locking syringe. Then 10 cc of helium is withdrawn from a reservoir and the syringe is locked. The syringe is then shaken by hand for five minutes and allowed to equilibrate for 15 minutes. With the syringe in a near vertical position, the headspace is injected through a septum-fitting into a 0.5 cc sample loop. The loop is allowed to equilibrate at 1 atmosphere pressure prior to switching the valve to place the sample loop into the carrier gas flow stream.

First, headspace concentrations of the analyzed gases are determined by comparison to the results of analysis of a gas standard. Subsequently, the headspace concentrations are converted to the dissolved water concentrations using Henry's Law.

Results of analysis and applicable quality control parameters are supplied on the attached data sheets.

THE RESULTS SUPPLIED ARE THE ORIGINAL DISSOLVED CONCENTRATIONS OF THE ANALYTES IN NG/L AS CALCULATED FROM DETERMINED HEADSPACE CONCENTRATIONS.

220 William Pitt Way, Pittsburgh, PA 15238 • Phone (412) 826-5245, Fax (412) 826-3433

MICROSEEPS

DE11-962996

----- DELTA ENVIRONMENTAL -----
----- PROJECT: 96-015 -----
----- LOCATION: GENOVA, NY -----

SAMPLE NAME	METHANE (ng/l)	ETHANE (ng/l)	ETHYLENE (ng/l)	FILE NAME	DATE SAMPLED	DATE RECEIVED	DATE ANALYZED
MW-1	>300000	<5	19	C3 12	10/22/96	10/25/96	10/29/96
MW-2	268626	766	53322	C3 13	10/22/96	10/25/96	10/29/96
MW-3	134313	310	5095	C3 14	10/22/96	10/25/96	10/29/96
MW-4	2203	13	55	C3 15	10/22/96	10/25/96	10/29/96
MW-5	58933	19	18	C3 16	10/22/96	10/25/96	10/29/96
GP-2	14746	628	282	C3 17	10/23/96	10/25/96	10/29/96
GP-4	24236	47	159	C3 18	10/23/96	10/25/96	10/29/96
GP-6	9361	249	684	C3 19	10/24/96	10/25/96	10/29/96
GP-8	63045	110	155	C3 20	10/23/96	10/25/96	10/29/96
GP-9	42979	111	80	C3 21	10/23/96	10/25/96	10/29/96
MDLs FOR ABOVE SAMPLES	15	5	5				

01-Nov-96

ANALYST INITIALS AS

LAB MANAGER INITIALS DOM

MICROSEEPS

DE11-962996

**** QUALITY CONTROL ****

----- DELTA ENVIRONMENTAL -----
----- PROJECT: 96-015 -----
----- LOCATION: GENOVA, NY -----

CONTINUING CALIBRATION CHECK

STANDARD: "M"
REFERENCE: C3 22

COMPOUND	KNOWN (ppmv)	RESULT (ppmv)	PERCENT DIFFERENCE
METHANE	10.00	10.009	0.09
ETHANE	1.00	1.040	4.00
ETHYLENE	1.00	1.042	4.20

LABORATORY BLANK RESULTS

BLANK: N2 IN LOOP
REFERENCE: C3 11

COMPOUND	BLANK (ppmv)	LOWER DETECTION LIMIT (ppmv)
METHANE	ND	0.01
ETHANE	ND	0.01
ETHYLENE	ND	0.01

01-Nov-96

ANALYST INITIALS AS

LAB MANAGER INITIALS DJM

DE11-96a14p

MICROSEEPS, Inc.

220 William Pitt Way, Pittsburgh, PA 15238
Phone: (412) 826-5245 Fax: (412) 826-3433

CHAIN-OF-CUSTODY RECORD

Company Name: DELTA Environmental
Address: 4068 Mt. Royal Blvd.
Proj. Manager: Steve Zbur
Proj. Location: Geneva, NY
Proj. Number: 96-015
Phone #: 412 487 7700 Fax #: 487 9785

Sampler's signature: [signature]

Note: Enter proper letters in Requested Analyses columns below.
Note: If analysis D,E,or K is selected, scratch (option) NOT wanted.

Analysis Options

* A	C1 -C4	G	Chlorinated HC
* B	Hydrogen & Helium	H	BTEX
* C	Permanent Gases (CH_4, CO, CO_2, N_2, O_2)	J	BTEX & C5 - C10
D	Mercury (Soil) or (Air **)	K	TPH (C5 - C10) or (C4 -C12)
E	TO-14 by GC/MS (Ambient) or (Source **)	L	C11 - C18
F	601 & 602 Compounds	Other	Specify below.

* An additional 22 ml vial of sample is required when requested in combination with another analysis.
** Available upon request.

Collection Date	Collection Time	Number of Containers	"Summa" # if Can. used	Sample Type	Sample Identification	Requested Analyses					(Other)	Remarks
10/22/96	14:00	1 glass vial		water	MW-1	C					light hydrocarbons	
	17:43				MW-2	C						
	15:53				MW-3	C						
	12:33				MW-4	C						
	10:31				MW-5	C						
10/23/96	10:00				GP-2	C						
	12:00				GP-4	C						
10/24/96	9:30				GP-6	C						
10/23/96	13:59				GP-8	C						
	19:30				GP-9	C						

Results to: Steve Zbur/DELTA

Invoice to:

Relinquished by	Company	Date	Time	Received by	Company	Date	Time
[signature]	DELTA	10/24/96	10:00	J C Williams	MICROSEEPS	10/25/96	1030

WHITE COPY : Laboratory to return. YELLOW COPY : Laboratory PINK COPY : Submitter

NOV 18 1996

TRAVERSE ANALYTICAL

November 13, 1996

Mr. Steve Zbur
Delta Environmental
4068 Mt. Royal Blvd., Ste. 115-gamma
Allison Park, PA 15101

RE: Delta/HB Fuller Geneva, N.Y.
Chain of Custody (COC) #5511

Dear Mr. Zbur:

Enclosed is a report of laboratory analysis for the above referenced project. Samples were received under COC number 5511 on October 25, 1996 by Traverse Analytical.

This report has been reviewed for accuracy and completeness and conforms to your analytical requirements. The data presented in this report meets both the minimum quality assurance standards specified in the referenced analytical methodology(s) and the standards established by this laboratory. I have personally examined and am familiar with the information contained in this report, and based on my review and/or inquiry of those individuals directly responsible for obtaining the information, I believe the submitted information is true, accurate, and complete.

If you have any questions regarding this report, or need additional information please feel free to contact myself or Jim Tomalia at (616) 947-2389.

Sincerely,

G J Pierce

Gregory J. Pierce
Laboratory Director

TRAVERSE ANALYTICAL

Acetate/Formate/Lactate/Butyric Acid/Benzoic Acid
Analysis Results
EPA Method HPLC/UV

Client/Site: Delta Environmental
Project Number: 96015
COC Number: 5511
Collection Date: 10/22/96
Collected By: ND
Submittal Date: 10/25/96
Analysis Date: 11/05/96
Analyzed By: JT
Report Date: 11/13/96

Remarks: Results in mg/l. Level of Detection
Acetate, Formate, & Lactate <1 mg/l.
Butyric Acid & Benzoic Acid <10 mg/l.
ND = Nondetect. No dilution.

Sample ID: TA25682
Sample Name: MW-1
Matrix: Water

Compound	Result
Lactate	ND
Butyric Acid	ND
Benzoic Acid	ND
Acetate	ND
Formate	ND

James A. Tomalia
Laboratory Manager

TRAVERSE ANALYTICAL

Acetate/Formate/Lactate/Butyric Acid/Benzoic Acid Analysis Results
EPA Method HPLC/UV

Client/Site: Delta Environmental
Project Number: 96015
COC Number: 5511
Collection Date: 10/22/96
Collected By: ND
Submittal Date: 10/25/96
Analysis Date: 11/05/96
Analyzed By: JT
Report Date: 11/13/96

Remarks: Results in mg/l. Level of Detection
Acetate, Formate, & Lactate <1 mg/l.
Butyric Acid & Benzoic Acid <10 mg/l.
ND = Nondetect. No dilution.

Sample ID: TA25683
Sample Name: MW-2
Matrix: Water

Compound	Result
Lactate	ND
Butyric Acid	ND
Benzoic Acid	ND
Acetate	ND
Formate	ND

James A. Tomalia
Laboratory Manager

TRAVERSE ANALYTICAL

Acetate/Formate/Lactate/Butyric Acid/Benzoic Acid
Analysis Results
EPA Method HPLC/UV

Client/Site: Delta Environmental
Project Number: 96015
COC Number: 5511
Collection Date: 10/22/96
Collected By: ND
Submittal Date: 10/25/96
Analysis Date: 11/05/96
Analyzed By: JT
Report Date: 11/13/96

Remarks: Results in mg/l. Level of Detection
Acetate, Formate, & Lactate <1 mg/l.
Butyric Acid & Benzoic Acid <10 mg/l.
ND = Nondetect. No dilution.

Sample ID: TA25684
Sample Name: MW-3
Matrix: Water

Compound	Result
Lactate	11
Butyric Acid	ND
Benzoic Acid	ND
Acetate	ND
Formate	ND

James A. Tomalia
Laboratory Manager

Complete Environmental Analysis
3141 Logan Valley Road • Traverse City, Michigan 49686 • Phone: (616) 947-2389 • Fax: (616) 947-3629

TRAVERSE ANALYTICAL

Acetate/Formate/Lactate/Butyric Acid/Benzoic Acid Analysis Results
EPA Method HPLC/UV

Client/Site: Delta Environmental
Project Number: 96015
COC Number: 5511
Collection Date: 10/22/96
Collected By: ND
Submittal Date: 10/25/96
Analysis Date: 11/05/96
Analyzed By: JT
Report Date: 11/13/96

Remarks: Results in mg/l. Level of Detection
Acetate, Formate, & Lactate <1 mg/l.
Butyric Acid & Benzoic Acid <10 mg/l.
ND = Nondetect. No dilution.

Sample ID: TA25685
Sample Name: MW-4
Matrix: Water

Compound	Result
Lactate	ND
Butyric Acid	ND
Benzoic Acid	ND
Acetate	ND
Formate	ND

James A. Tomalia
Laboratory Manager

TRAVERSE ANALYTICAL

Acetate/Formate/Lactate/Butyric Acid/Benzoic Acid
Analysis Results
EPA Method HPLC/UV

Client/Site: Delta Environmental
Project Number: 96015
COC Number: 5511
Collection Date: 10/22/96
Collected By: ND
Submittal Date: 10/25/96
Analysis Date: 11/05/96
Analyzed By: JT
Report Date: 11/13/96

Remarks: Results in mg/l. Level of Detection
Acetate, Formate, & Lactate <1 mg/l.
Butyric Acid & Benzoic Acid <10 mg/l.
ND = Nondetect. No dilution.

Sample ID: TA25686
Sample Name: MW-5
Matrix: Water

Compound	Result
Lactate	ND
Butyric Acid	ND
Benzoic Acid	ND
Acetate	ND
Formate	ND

James A. Tomalia
Laboratory Manager

Complete Environmental Analysis
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TRAVERSE ANALYTICAL

Acetate/Formate/Lactate/Butyric Acid/Benzoic Acid
Analysis Results
EPA Method HPLC/UV

Client/Site: Delta Environmental
Project Number: 96015
COC Number: 5511
Collection Date: 10/23/96
Collected By: ND
Submittal Date: 10/25/96
Analysis Date: 11/05/96
Analyzed By: JT
Report Date: 11/13/96

Remarks: Results in mg/l. Level of Detection
Acetate, Formate, & Lactate <1 mg/l.
Butyric Acid & Benzoic Acid <10 mg/l.
ND = Nondetect. No dilution.

Sample ID: TA25687
Sample Name: GP-2
Matrix: Water

Compound	Result
Lactate	ND
Butyric Acid	ND
Benzoic Acid	ND
Acetate	ND
Formate	ND

James A. Tomalia
Laboratory Manager

TRAVERSE ANALYTICAL

Acetate/Formate/Lactate/Butyric Acid/Benzoic Acid
Analysis Results
EPA Method HPLC/UV

Client/Site: Delta Environmental
Project Number: 96015
COC Number: 5511
Collection Date: 10/23/96
Collected By: ND
Submittal Date: 10/25/96
Analysis Date: 11/05/96
Analyzed By: JT
Report Date: 11/13/96

Remarks: Results in mg/l. Level of Detection
Acetate, Formate, & Lactate <1 mg/l.
Butyric Acid & Benzoic Acid <10 mg/l.
ND = Nondetect. No dilution.

Sample ID: TA25688
Sample Name: GP-4
Matrix: Water

Compound	Result
Lactate	ND
Butyric Acid	ND
Benzoic Acid	ND
Acetate	ND
Formate	ND

James A. Tomalia
Laboratory Manager

TRAVERSE ANALYTICAL

Acetate/Formate/Lactate/Butyric Acid/Benzoic Acid Analysis Results
EPA Method HPLC/UV

Client/Site: Delta Environmental
Project Number: 96015
COC Number: 5511
Collection Date: 10/24/96
Collected By: ND
Submittal Date: 10/25/96
Analysis Date: 11/05/96
Analyzed By: JT
Report Date: 11/13/96

Remarks: Results in mg/l. Level of Detection
Acetate, Formate, & Lactate <1 mg/l.
Butyric Acid & Benzoic Acid <10 mg/l.
ND = Nondetect. No dilution.

Sample ID: TA25689
Sample Name: GP-6
Matrix: Water

Compound	Result
Lactate	320
Butyric Acid	ND
Benzoic Acid	ND
Acetate	ND
Formate	ND

James A. Tomalia
Laboratory Manager

TRAVERSE ANALYTICAL

Acetate/Formate/Lactate/Butyric Acid/Benzoic Acid Analysis Results
EPA Method HPLC/UV

Client/Site: Delta Environmental
Project Number: 96015
COC Number: 5511
Collection Date: 10/23/96
Collected By: ND
Submittal Date: 10/25/96
Analysis Date: 11/05/96
Analyzed By: JT
Report Date: 11/13/96

Remarks: Results in mg/l. Level of Detection
Acetate, Formate, & Lactate <1 mg/l.
Butyric Acid & Benzoic Acid <10 mg/l.
ND = Nondetect. No dilution.

Sample ID: TA25690
Sample Name: GP-8
Matrix: Water

Compound	Result
Lactate	18
Butyric Acid	ND
Benzoic Acid	ND
Acetate	ND
Formate	ND

James A. Tomalia
Laboratory Manager

TRAVERSE ANALYTICAL

Acetate/Formate/Lactate/Butyric Acid/Benzoic Acid Analysis Results
EPA Method HPLC/UV

Client/Site: Delta Environmental
Project Number: 96015
COC Number: 5511
Collection Date: 10/23/96
Collected By: ND
Submittal Date: 10/25/96
Analysis Date: 11/05/96
Analyzed By: JT
Report Date: 11/13/96

Remarks: Results in mg/l. Level of Detection Acetate, Formate, & Lactate <1 mg/l. Butyric Acid & Benzoic Acid <10 mg/l. ND = Nondetect. No dilution.

Sample ID: TA25691
Sample Name: GP-9
Matrix: Water

Compound	Result
Lactate	49
Butyric Acid	ND
Benzoic Acid	ND
Acetate	ND
Formate	ND

James A. Tomalia
Laboratory Manager

Complete Environmental Analysis
3141 Logan Valley Road ▪ Traverse City, Michigan 49686 ▪ Phone: (616) 947-2389 ▪ Fax: (616) 947-3629

Phone # ... Fax # 412 487 9785

TRAVERSE ANALYTICAL

3141 Logan Valley Road
Traverse City, Michigan 49686
(616) 947-2389 (947-BETX)
FAX: (616) 947-3629

CHAIN OF CUSTODY RECORD

FORWARD DELIVERABLES TO: Delta Environmental 4068 Mt. Royal Blvd. Ste. 115 Allison Park, PA 15101

PROJECT NO.: 96 015

PROJECT NAME / CLIENT SITE: HB Fuller / Geneva, NY

SAMPLER SIGNATURE:

TEMPERATURE RECEIVED: 10°C

LOG-IN NOTES: 10250701

STATION LOCATION	DATE	TIME	MATRIX ①	PRESERVATIVE	NUMBER OF CONTAINERS	TYPE OF LAB ANALYSIS: volatile fatty acids	DISSOLVED OXYGEN (PPM)	BOTTLE TARE WEIGHT	DEPTH TO WATER (IN FEET)	LAB TRACKING NO.	REMARKS
MW-1	10/22/96	14:00	water		2	X	0.2		7.20	25682	
MW-2	/ /	17:43					0.1		5.93	25683	
MW-3	/ /	15:53					0.1		5.18	25684	
MW-4	/ /	12:33					0.8		3.70	25685	
MW-5	/ /	10:31					0.9		4.63	25686	
GP-2	10/23/96	10:00					0.1		1.52	25687	
GP-4	/ /	12:00					0.1		5.36	25688	
GP-6 (~~No Sample~~)	10/24/96	9:30					0.1		5.92	25689	Dupe is OK Received Broken 10/25
GP-8	10/23/96	13:59					0.1		6.00	25690	" "
GP-9	/ /	19:30					0.1		6.25	25691	
	/ /	:									
	/ /	:									
	/ /	:									
	/ /	:									

* RELINQUISHED BY:	DATE / TIME	RECEIVED BY:	DATE / TIME	RELINQUISHED BY:	DATE / TIME	LAB RECEIVED BY:	DATE / TIME
SIGNATURE	10/24/96 10:30 AM	SIGNATURE	/ / :	SIGNATURE	/ / :	S Hemmick SIGNATURE	10/25/96 10: AM
RELINQUISHED BY: SIGNATURE	/ / :	RECEIVED BY: SIGNATURE	/ / :	DATA ENTERED BY: SIGNATURE	/ / :	SAMPLE DISPOSITION:	/ / :

REMARKS:

① SPECIFY: Air (A), Ground Water (GW), Leachate (LE), Liquid (LI), Sludge (SL), Soil (S), Solid (SD), Surface Water (SW), Wastewater (WW)

* Signatures indicate acceptance of the terms and conditions on the reverse.

№ 5511

A9602010.CDR/BN-029 REV: 02/21/96 DGH CHKD: VLP/LAA/GP

Dan Beechan

Upstate Laboratories inc.

Shipping: 6034 Corporate Dr. • E. Syracuse, NY 13057-1017 • (315) 437-0255 • Fax (315) 437-1209
Mailing: Box 289 • Syracuse, NY 13206
Albany (518) 459-3134
Binghamton (607) 724-0478
Buffalo (716) 649-2533
Rochester (716) 436-9070
New Jersey (201) 703-1324

November 22, 1996

Mr. Bob Botterman
Delta Environmental Consultants
4068 Mt. Royal Blvd.
Suite 225 - Gamma
Allison Park, PA 15101

Re: Analysis Report #29996001 - E196-015-1.0012

Dear Mr. Botterman:

Please find enclosed the results for your samples which were picked up by ULI personnel on October 24, 1996.

We have included the Chain of Custody Record as part of your report. You may need to reference this form for a more detailed explanation of your sample. Samples will be disposed of approximately one month from final report date.

Should you have any questions, please feel free to give us a call.

Thank you for your patronage.

Sincerely,

UPSTATE LABORATORIES, INC.

Anthony J. Scala
Director

AJS/jk

Enclosures: report, invoice

cc/encs: N. Scala, ULI
file

Disclaimer: The test results and procedures utilized, and laboratory interpretations of data obtained by ULI as contained in this report are believed by ULI to be accurate and reliable for sample(s) tested. In accepting this report, the customer agrees that the full extent of any and all liability for actual and consequential damages of ULI for the services performed shall be equal to the fee charged to the customer for the services as liquidated damages.

DATE: 11/22/96

Upstate Laboratories, Inc.
Analysis Results
Report Number: 29996001
Client I.D.: DELTA ENVIRONMENTAL CONSULTANT E146-015-1.0012
Sampled by: Client

APPROVAL:
QC:
Lab I.D.: 10170

GP-1 (4-5) 1100H 10/22/96 C

ULI I.D.: 29996001 Matrix: Soil

PARAMETERS	RESULTS	KEY	FILE#
Density	1.9g/ml		WB5021
Percent Solids	83%		WB4972
TOC	1200mg/kg		SC0001

dw = Dry weight

DATE: 11/22/96

Upstate Laboratories, Inc. APPROVAL: [signature]
Analysis Results QC: [signature]
Report Number: 29996001 Lab I.D.: 10170
Client I.D.: DELTA ENVIRONMENTAL CONSULTANT E146-015-1.0012
Sampled by: Client GP-1 (5-6) 1115H 10/22/96 C

ULI I.D.: 29996002 Matrix: Soil

PARAMETERS	RESULTS	KEY	FILE#
Percent Solids	85%		WB4972

dw = Dry weight

DATE: 11/22/96

Upstate Laboratories, Inc.
Analysis Results
Report Number: 29996001
Client I.D.: DELTA ENVIRONMENTAL CONSULTANT E146-015-1.0012
Sampled by: Client

APPROVAL:
QC:
Lab I.D.: 10170

GP-1 (9-10) 1200H 10/22/96 C

ULI I.D.: 29996003 Matrix: Soil

PARAMETERS	RESULTS	KEY	FILE#
Density	1.9g/ml		WB5021
Percent Solids	81%		WB4972
TOC	9100mg/kg		SC0001

dw = Dry weight

DATE: 11/22/96

Upstate Laboratories, Inc.
Analysis Results
Report Number: 29996001
Client I.D.: DELTA ENVIRONMENTAL CONSULTANT E146-015-1.0012
Sampled by: Client

APPROVAL:
QC:
Lab I.D.: 10170

GP-2 (1-2) 1530H 10/22/96 C

ULI I.D.: 29996004 Matrix: Soil

PARAMETERS	RESULTS	KEY	FILE#
Percent Solids	80%		WB5048
TCL Volatiles by EPA Method 8240			
Chloromethane	<0.32mg/kg dw		SC0001
Bromomethane	<0.32mg/kg dw		SC0001
Vinyl Chloride	<0.13mg/kg dw		SC0001
Chloroethane	<0.32mg/kg dw		SC0001
Methylene Chloride	<0.064mg/kg dw		SC0001
Acetone	<0.64mg/kg dw		SC0001
Carbon Disulfide	<0.064mg/kg dw		SC0001
1,1-Dichloroethene	<0.064mg/kg dw		SC0001
1,1-Dichloroethane	<0.064mg/kg dw		SC0001
trans-1,2-Dichloroethene	<0.064mg/kg dw		SC0001
cis-1,2-Dichloroethene	<0.064mg/kg dw		SC0001
Chloroform	<0.064mg/kg dw		SC0001
1,2-Dichloroethane	<0.064mg/kg dw		SC0001
2-Butanone	<0.32mg/kg dw		SC0001
1,1,1-Trichloroethane	<0.064mg/kg dw		SC0001
Carbon Tetrachloride	<0.064mg/kg dw		SC0001
Bromodichloromethane	<0.064mg/kg dw		SC0001
1,2-Dichloropropane	<0.064mg/kg dw		SC0001
cis-1,3-Dichloropropene	<0.064mg/kg dw		SC0001
Trichloroethene	0.14mg/kg dw		SC0001
Dibromochloromethane	<0.064mg/kg dw		SC0001
1,1,2-Trichloroethane	<0.064mg/kg dw		SC0001
Benzene	<0.064mg/kg dw		SC0001
trans-1,3-Dichloropropene	<0.064mg/kg dw		SC0001
Bromoform	<0.064mg/kg dw		SC0001
4-Methyl-2-pentanone	<0.32mg/kg dw		SC0001
2-Hexanone	<0.32mg/kg dw		SC0001
Tetrachloroethene	0.50mg/kg dw		SC0001
1,1,2,2-Tetrachloroethane	<0.064mg/kg dw		SC0001
Toluene	<0.064mg/kg dw		SC0001
Chlorobenzene	<0.064mg/kg dw		SC0001
Ethylbenzene	<0.064mg/kg dw		SC0001
Styrene	<0.064mg/kg dw		SC0001
m-Xylene and p-Xylene	<0.064mg/kg dw		SC0001
o-Xylene	<0.064mg/kg dw		SC0001

dw = Dry weight

DATE: 11/22/96

Upstate Laboratories, Inc. APPROVAL:
Analysis Results QC:
Report Number: 29996001 Lab I.D.: 10170
Client I.D.: DELTA ENVIRONMENTAL CONSULTANT E146-015-1.0012
Sampled by: Client GP-2 (9-10) 1645H 10/22/96 C

ULI I.D.: 29996005 Matrix: Soil

PARAMETERS	RESULTS	KEY	FILE#
Percent Solids	82%		WB5048
TCL Volatiles by EPA Method 8240			
Chloromethane	<0.30mg/kg dw		SC0001
Bromomethane	<0.30mg/kg dw		SC0001
Vinyl Chloride	<0.12mg/kg dw		SC0001
Chloroethane	<0.30mg/kg dw		SC0001
Methylene Chloride	<0.061mg/kg dw		SC0001
Acetone	<0.61mg/kg dw		SC0001
Carbon Disulfide	<0.061mg/kg dw		SC0001
1,1-Dichloroethene	<0.061mg/kg dw		SC0001
1,1-Dichloroethane	<0.061mg/kg dw		SC0001
trans-1,2-Dichloroethene	<0.061mg/kg dw		SC0001
cis-1,2-Dichloroethene	<0.061mg/kg dw		SC0001
Chloroform	<0.061mg/kg dw		SC0001
1,2-Dichloroethane	<0.061mg/kg dw		SC0001
2-Butanone	<0.30mg/kg dw		SC0001
1,1,1-Trichloroethane	<0.061mg/kg dw		SC0001
Carbon Tetrachloride	<0.061mg/kg dw		SC0001
Bromodichloromethane	<0.061mg/kg dw		SC0001
1,2-Dichloropropane	<0.061mg/kg dw		SC0001
cis-1,3-Dichloropropene	<0.061mg/kg dw		SC0001
Trichloroethene	<0.061mg/kg dw		SC0001
Dibromochloromethane	<0.061mg/kg dw		SC0001
1,1,2-Trichloroethane	<0.061mg/kg dw		SC0001
Benzene	<0.061mg/kg dw		SC0001
trans-1,3-Dichloropropene	<0.061mg/kg dw		SC0001
Bromoform	<0.061mg/kg dw		SC0001
4-Methyl-2-pentanone	<0.30mg/kg dw		SC0001
2-Hexanone	<0.30mg/kg dw		SC0001
Tetrachloroethene	<0.061mg/kg dw		SC0001
1,1,2,2-Tetrachloroethane	<0.061mg/kg dw		SC0001
Toluene	<0.061mg/kg dw		SC0001
Chlorobenzene	<0.061mg/kg dw		SC0001
Ethylbenzene	<0.061mg/kg dw		SC0001
Styrene	<0.061mg/kg dw		SC0001
m-Xylene and p-Xylene	<0.061mg/kg dw		SC0001
o-Xylene	<0.061mg/kg dw		SC0001

dw = Dry weight

DATE: 11/22/96

Upstate Laboratories, Inc.
Analysis Results
Report Number: 29996001
Client I.D.: DELTA ENVIRONMENTAL CONSULTANT E146-015-1.0012
Sampled by: Client

APPROVAL:
QC:
Lab I.D.: 10170

GP-2 (8-10) 1645H 10/22/96 C

ULI I.D.: 29996006 Matrix: Soil

PARAMETERS	RESULTS	KEY	FILE#
MBAS	<1.2mg/kgLAS dw		WB4969
Percent Moisture	12%		WB4993
Percent Solids	87%		WB4972

dw = Dry weight

DATE: 11/22/96

Upstate Laboratories, Inc. APPROVAL:
Analysis Results QC:
Report Number: 29996001 Lab I.D.: 10170
Client I.D.: DELTA ENVIRONMENTAL CONSULTANT E146-015-1.0012
Sampled by: Client GP-4 (2-3) 1715H 10/22/96 C

ULI I.D.: 29996007 Matrix: Soil

PARAMETERS	RESULTS	KEY	FILE#
Percent Solids	85%		WB5048
TCL Volatiles by EPA Method 8240			
Chloromethane	<0.30mg/kg dw		SC0001
Bromomethane	<0.30mg/kg dw		SC0001
Vinyl Chloride	<0.12mg/kg dw		SC0001
Chloroethane	<0.30mg/kg dw		SC0001
Methylene Chloride	<0.060mg/kg dw		SC0001
Acetone	<0.60mg/kg dw		SC0001
Carbon Disulfide	<0.060mg/kg dw		SC0001
1,1-Dichloroethene	<0.060mg/kg dw		SC0001
1,1-Dichloroethane	<0.060mg/kg dw		SC0001
trans-1,2-Dichloroethene	<0.060mg/kg dw		SC0001
cis-1,2-Dichloroethene	<0.060mg/kg dw		SC0001
Chloroform	<0.060mg/kg dw		SC0001
1,2-Dichloroethane	<0.060mg/kg dw		SC0001
2-Butanone	<0.30mg/kg dw		SC0001
1,1,1-Trichloroethane	<0.060mg/kg dw		SC0001
Carbon Tetrachloride	<0.060mg/kg dw		SC0001
Bromodichloromethane	<0.060mg/kg dw		SC0001
1,2-Dichloropropane	<0.060mg/kg dw		SC0001
cis-1,3-Dichloropropene	<0.060mg/kg dw		SC0001
Trichloroethene	<0.060mg/kg dw		SC0001
Dibromochloromethane	<0.060mg/kg dw		SC0001
1,1,2-Trichloroethane	<0.060mg/kg dw		SC0001
Benzene	<0.060mg/kg dw		SC0001
trans-1,3-Dichloropropene	<0.060mg/kg dw		SC0001
Bromoform	<0.060mg/kg dw		SC0001
4-Methyl-2-pentanone	<0.30mg/kg dw		SC0001
2-Hexanone	<0.30mg/kg dw		SC0001
Tetrachloroethene	<0.060mg/kg dw		SC0001
1,1,2,2-Tetrachloroethane	<0.060mg/kg dw		SC0001
Toluene	<0.060mg/kg dw		SC0001
Chlorobenzene	<0.060mg/kg dw		SC0001
Ethylbenzene	<0.060mg/kg dw		SC0001
Styrene	<0.060mg/kg dw		SC0001
m-Xylene and p-Xylene	<0.060mg/kg dw		SC0001
o-Xylene	<0.060mg/kg dw		SC0001

dw = Dry weight

DATE: 11/22/96

Upstate Laboratories, Inc.
Analysis Results
Report Number: 29996001
Client I.D.: DELTA ENVIRONMENTAL CONSULTANT E146-015-1.0012
Sampled by: Client

APPROVAL:
QC:
Lab I.D.: 10170

GP-4 (8-10) 1800H 10/22/96 C

ULI I.D.: 29996008 Matrix: Soil

PARAMETERS	RESULTS	KEY	FILE#
MBAS	<1.3mg/kgLAS dw		WB4969
Percent Moisture	18%		WB4993
Percent Solids	82%		WB4972

dw = Dry weight

DATE: 11/22/96

Upstate Laboratories, Inc.
Analysis Results
Report Number: 29996001
Client I.D.: DELTA ENVIRONMENTAL CONSULTANT E146-015-1.0012
Sampled by: Client

APPROVAL:
QC:
Lab I.D.: 10170
GP-4 (9-10) 1800H 10/22/96 C

ULI I.D.: 29996009 Matrix: Soil

PARAMETERS	RESULTS	KEY	FILE#
Percent Solids	82%		WB5048
TCL Volatiles by EPA Method 8240			
Chloromethane	<0.30mg/kg dw		SC0001
Bromomethane	<0.30mg/kg dw		SC0001
Vinyl Chloride	<0.12mg/kg dw		SC0001
Chloroethane	<0.30mg/kg dw		SC0001
Methylene Chloride	<0.060mg/kg dw		SC0001
Acetone	<0.60mg/kg dw		SC0001
Carbon Disulfide	<0.060mg/kg dw		SC0001
1,1-Dichloroethene	<0.060mg/kg dw		SC0001
1,1-Dichloroethane	<0.060mg/kg dw		SC0001
trans-1,2-Dichloroethene	<0.060mg/kg dw		SC0001
cis-1,2-Dichloroethene	<0.060mg/kg dw		SC0001
Chloroform	<0.060mg/kg dw		SC0001
1,2-Dichloroethane	<0.060mg/kg dw		SC0001
2-Butanone	<0.30mg/kg dw		SC0001
1,1,1-Trichloroethane	<0.060mg/kg dw		SC0001
Carbon Tetrachloride	<0.060mg/kg dw		SC0001
Bromodichloromethane	<0.060mg/kg dw		SC0001
1,2-Dichloropropane	<0.060mg/kg dw		SC0001
cis-1,3-Dichloropropene	<0.060mg/kg dw		SC0001
Trichloroethene	<0.060mg/kg dw		SC0001
Dibromochloromethane	<0.060mg/kg dw		SC0001
1,1,2-Trichloroethane	<0.060mg/kg dw		SC0001
Benzene	<0.060mg/kg dw		SC0001
trans-1,3-Dichloropropene	<0.060mg/kg dw		SC0001
Bromoform	<0.060mg/kg dw		SC0001
4-Methyl-2-pentanone	<0.30mg/kg dw		SC0001
2-Hexanone	<0.30mg/kg dw		SC0001
Tetrachloroethene	0.25mg/kg dw		SC0001
1,1,2,2-Tetrachloroethane	<0.060mg/kg dw		SC0001
Toluene	<0.060mg/kg dw		SC0001
Chlorobenzene	<0.060mg/kg dw		SC0001
Ethylbenzene	<0.060mg/kg dw		SC0001
Styrene	<0.060mg/kg dw		SC0001
m-Xylene and p-Xylene	<0.060mg/kg dw		SC0001
o-Xylene	<0.060mg/kg dw		SC0001

dw = Dry weight

DATE: 11/22/96

Upstate Laboratories, Inc. APPROVAL: [signature]
Analysis Results QC: [initials]
Report Number: 29996001 Lab I.D.: 10170
Client I.D.: DELTA ENVIRONMENTAL CONSULTANT E146-015-1.0012
Sampled by: Client GP-8 (2-3) 0745H 10/23/96 C

ULI I.D.: 29996010 Matrix: Soil

PARAMETERS	RESULTS	KEY	FILE#
Percent Solids	87%		WB5048
TCL Volatiles by EPA Method 8240			
Chloromethane	<0.29mg/kg dw		SC0001
Bromomethane	<0.29mg/kg dw		SC0001
Vinyl Chloride	<0.11mg/kg dw		SC0001
Chloroethane	<0.29mg/kg dw		SC0001
Methylene Chloride	<0.057mg/kg dw		SC0001
Acetone	<0.57mg/kg dw		SC0001
Carbon Disulfide	<0.057mg/kg dw		SC0001
1,1-Dichloroethene	<0.057mg/kg dw		SC0001
1,1-Dichloroethane	<0.057mg/kg dw		SC0001
trans-1,2-Dichloroethene	<0.057mg/kg dw		SC0001
cis-1,2-Dichloroethene	<0.057mg/kg dw		SC0001
Chloroform	<0.057mg/kg dw		SC0001
1,2-Dichloroethane	<0.057mg/kg dw		SC0001
2-Butanone	<0.29mg/kg dw		SC0001
1,1,1-Trichloroethane	<0.057mg/kg dw		SC0001
Carbon Tetrachloride	<0.057mg/kg dw		SC0001
Bromodichloromethane	<0.057mg/kg dw		SC0001
1,2-Dichloropropane	<0.057mg/kg dw		SC0001
cis-1,3-Dichloropropene	<0.057mg/kg dw		SC0001
Trichloroethene	<0.057mg/kg dw		SC0001
Dibromochloromethane	<0.057mg/kg dw		SC0001
1,1,2-Trichloroethane	<0.057mg/kg dw		SC0001
Benzene	<0.057mg/kg dw		SC0001
trans-1,3-Dichloropropene	<0.057mg/kg dw		SC0001
Bromoform	<0.057mg/kg dw		SC0001
4-Methyl-2-pentanone	<0.29mg/kg dw		SC0001
2-Hexanone	<0.29mg/kg dw		SC0001
Tetrachloroethene	<0.057mg/kg dw		SC0001
1,1,2,2-Tetrachloroethane	<0.057mg/kg dw		SC0001
Toluene	<0.057mg/kg dw		SC0001
Chlorobenzene	<0.057mg/kg dw		SC0001
Ethylbenzene	<0.057mg/kg dw		SC0001
Styrene	<0.057mg/kg dw		SC0001
m-Xylene and p-Xylene	<0.057mg/kg dw		SC0001
o-Xylene	<0.057mg/kg dw		SC0001

dw = Dry weight

DATE: 11/22/96

Upstate Laboratories, Inc.
Analysis Results
Report Number: 29996001
Client I.D.: DELTA ENVIRONMENTAL CONSULTANT E146-015-1.0012
Sampled by: Client

APPROVAL:
QC:
Lab I.D.: 10170

GP-8 (8-10) 0825H 10/23/96 C

ULI I.D.: 29996011 Matrix: Soil

PARAMETERS	RESULTS	KEY	FILE#
MBAS	<1.3mg/kgLAS dw		WB4969
Percent Moisture	19%		WB4993
Percent Solids	82%		WB4972

dw = Dry weight

DATE: 11/22/96

Upstate Laboratories, Inc.
Analysis Results
Report Number: 29996001
Client I.D.: DELTA ENVIRONMENTAL CONSULTANT E146-015-1.0012
Sampled by: Client

APPROVAL:
QC:
Lab I.D.: 10170

GP-8 (9-10) 0825H 10/23/96 C

ULI I.D.: 29996012 Matrix: Soil

PARAMETERS	RESULTS	KEY	FILE#
Percent Solids	85%		WB5048
TCL Volatiles by EPA Method 8240			
Chloromethane	<0.31mg/kg dw		SC0001
Bromomethane	<0.31mg/kg dw		SC0001
Vinyl Chloride	<0.12mg/kg dw		SC0001
Chloroethane	<0.31mg/kg dw		SC0001
Methylene Chloride	<0.062mg/kg dw		SC0001
Acetone	<0.62mg/kg dw		SC0001
Carbon Disulfide	<0.062mg/kg dw		SC0001
1,1-Dichloroethene	<0.062mg/kg dw		SC0001
1,1-Dichloroethane	<0.062mg/kg dw		SC0001
trans-1,2-Dichloroethene	<0.062mg/kg dw		SC0001
cis-1,2-Dichloroethene	<0.062mg/kg dw		SC0001
Chloroform	<0.062mg/kg dw		SC0001
1,2-Dichloroethane	<0.062mg/kg dw		SC0001
2-Butanone	<0.31mg/kg dw		SC0001
1,1,1-Trichloroethane	<0.062mg/kg dw		SC0001
Carbon Tetrachloride	<0.062mg/kg dw		SC0001
Bromodichloromethane	<0.062mg/kg dw		SC0001
1,2-Dichloropropane	<0.062mg/kg dw		SC0001
cis-1,3-Dichloropropene	<0.062mg/kg dw		SC0001
Trichloroethene	<0.062mg/kg dw		SC0001
Dibromochloromethane	<0.062mg/kg dw		SC0001
1,1,2-Trichloroethane	<0.062mg/kg dw		SC0001
Benzene	<0.062mg/kg dw		SC0001
trans-1,3-Dichloropropene	<0.062mg/kg dw		SC0001
Bromoform	<0.062mg/kg dw		SC0001
4-Methyl-2-pentanone	<0.31mg/kg dw		SC0001
2-Hexanone	<0.31mg/kg dw		SC0001
Tetrachloroethene	<0.062mg/kg dw		SC0001
1,1,2,2-Tetrachloroethane	<0.062mg/kg dw		SC0001
Toluene	<0.062mg/kg dw		SC0001
Chlorobenzene	<0.062mg/kg dw		SC0001
Ethylbenzene	<0.062mg/kg dw		SC0001
Styrene	<0.062mg/kg dw		SC0001
m-Xylene and p-Xylene	<0.062mg/kg dw		SC0001
o-Xylene	<0.062mg/kg dw		SC0001

dw = Dry weight

DATE: 11/22/96

Upstate Laboratories, Inc.
Analysis Results
Report Number: 29996001
Client I.D.: DELTA ENVIRONMENTAL CONSULTANT E146-015-1.0012
Sampled by: Client GP-9 (2-3) 0845H 10/23/96 C

APPROVAL:
QC:
Lab I.D.: 10170

ULI I.D.: 29996013 Matrix: Soil

PARAMETERS	RESULTS	KEY	FILE#
Percent Solids	81%		WB5048
TCL Volatiles by EPA Method 8240			
Chloromethane	<0.31mg/kg dw		SC0001
Bromomethane	<0.31mg/kg dw		SC0001
Vinyl Chloride	<0.12mg/kg dw		SC0001
Chloroethane	<0.31mg/kg dw		SC0001
Methylene Chloride	<0.062mg/kg dw		SC0001
Acetone	<0.62mg/kg dw		SC0001
Carbon Disulfide	<0.062mg/kg dw		SC0001
1,1-Dichloroethene	<0.062mg/kg dw		SC0001
1,1-Dichloroethane	<0.062mg/kg dw		SC0001
trans-1,2-Dichloroethene	<0.062mg/kg dw		SC0001
cis-1,2-Dichloroethene	<0.062mg/kg dw		SC0001
Chloroform	<0.062mg/kg dw		SC0001
1,2-Dichloroethane	<0.062mg/kg dw		SC0001
2-Butanone	<0.31mg/kg dw		SC0001
1,1,1-Trichloroethane	<0.062mg/kg dw		SC0001
Carbon Tetrachloride	<0.062mg/kg dw		SC0001
Bromodichloromethane	<0.062mg/kg dw		SC0001
1,2-Dichloropropane	<0.062mg/kg dw		SC0001
cis-1,3-Dichloropropene	<0.062mg/kg dw		SC0001
Trichloroethene	<0.062mg/kg dw		SC0001
Dibromochloromethane	<0.062mg/kg dw		SC0001
1,1,2-Trichloroethane	<0.062mg/kg dw		SC0001
Benzene	<0.062mg/kg dw		SC0001
trans-1,3-Dichloropropene	<0.062mg/kg dw		SC0001
Bromoform	<0.062mg/kg dw		SC0001
4-Methyl-2-pentanone	<0.31mg/kg dw		SC0001
2-Hexanone	<0.31mg/kg dw		SC0001
Tetrachloroethene	<0.062mg/kg dw		SC0001
1,1,2,2-Tetrachloroethane	<0.062mg/kg dw		SC0001
Toluene	<0.062mg/kg dw		SC0001
Chlorobenzene	<0.062mg/kg dw		SC0001
Ethylbenzene	<0.062mg/kg dw		SC0001
Styrene	<0.062mg/kg dw		SC0001
m-Xylene and p-Xylene	<0.062mg/kg dw		SC0001
o-Xylene	<0.062mg/kg dw		SC0001

dw = Dry weight

DATE: 11/22/96

Upstate Laboratories, Inc.
Analysis Results
Report Number: 29996001
Client I.D.: DELTA ENVIRONMENTAL CONSULTANT E146-015-1.0012
Sampled by: Client

APPROVAL:
QC:
Lab I.D.: 10170

GP-9 (2-4) 0845H 10/23/96 C

ULI I.D.: 29996014 Matrix: Soil

PARAMETERS	RESULTS	KEY	FILE#
MBAS	<1.2mg/kgLAS dw		WB4969
Percent Moisture	13%		WB4993
Percent Solids	87%		WB4972

dw = Dry weight

DATE: 11/22/96

Upstate Laboratories, Inc. APPROVAL:
Analysis Results QC:
Report Number: 29996001 Lab I.D.: 10170
Client I.D.: DELTA ENVIRONMENTAL CONSULTANT E146-015-1.0012
Sampled by: Client GP-9 (9-10) 0945H 10/23/96 C

ULI I.D.: 29996015 Matrix: Soil

PARAMETERS	RESULTS	KEY	FILE#
Percent Solids	82%		WB5048
TCL Volatiles by EPA Method 8240			
Chloromethane	<0.30mg/kg dw		SC0001
Bromomethane	<0.30mg/kg dw		SC0001
Vinyl Chloride	<0.12mg/kg dw		SC0001
Chloroethane	<0.30mg/kg dw		SC0001
Methylene Chloride	<0.061mg/kg dw		SC0001
Acetone	<0.61mg/kg dw		SC0001
Carbon Disulfide	<0.061mg/kg dw		SC0001
1,1-Dichloroethene	<0.061mg/kg dw		SC0001
1,1-Dichloroethane	<0.061mg/kg dw		SC0001
trans-1,2-Dichloroethene	<0.061mg/kg dw		SC0001
cis-1,2-Dichloroethene	<0.061mg/kg dw		SC0001
Chloroform	<0.061mg/kg dw		SC0001
1,2-Dichloroethane	<0.061mg/kg dw		SC0001
2-Butanone	<0.30mg/kg dw		SC0001
1,1,1-Trichloroethane	<0.061mg/kg dw		SC0001
Carbon Tetrachloride	<0.061mg/kg dw		SC0001
Bromodichloromethane	<0.061mg/kg dw		SC0001
1,2-Dichloropropane	<0.061mg/kg dw		SC0001
cis-1,3-Dichloropropene	<0.061mg/kg dw		SC0001
Trichloroethene	<0.061mg/kg dw		SC0001
Dibromochloromethane	<0.061mg/kg dw		SC0001
1,1,2-Trichloroethane	<0.061mg/kg dw		SC0001
Benzene	<0.061mg/kg dw		SC0001
trans-1,3-Dichloropropene	<0.061mg/kg dw		SC0001
Bromoform	<0.061mg/kg dw		SC0001
4-Methyl-2-pentanone	<0.30mg/kg dw		SC0001
2-Hexanone	<0.30mg/kg dw		SC0001
Tetrachloroethene	<0.061mg/kg dw		SC0001
1,1,2,2-Tetrachloroethane	<0.061mg/kg dw		SC0001
Toluene	<0.061mg/kg dw		SC0001
Chlorobenzene	<0.061mg/kg dw		SC0001
Ethylbenzene	<0.061mg/kg dw		SC0001
Styrene	<0.061mg/kg dw		SC0001
m-Xylene and p-Xylene	<0.061mg/kg dw		SC0001
o-Xylene	<0.061mg/kg dw		SC0001

dw = Dry weight

DATE: 11/22/96

Upstate Laboratories, Inc.
Analysis Results
Report Number: 29996001

APPROVAL:
QC:
Lab I.D.: 10170

Client I.D.: DELTA ENVIRONMENTAL CONSULTANT E146-015-1.0012
Sampled by: Client GP-6 (2-3) 1015H 10/23/96 C

ULI I.D.: 29996016 Matrix: Soil

PARAMETERS	RESULTS	KEY	FILE#
Percent Solids	83%		WB5048
TCL Volatiles by EPA Method 8240			
Chloromethane	<0.30mg/kg dw		SC0001
Bromomethane	<0.30mg/kg dw		SC0001
Vinyl Chloride	<0.12mg/kg dw		SC0001
Chloroethane	<0.30mg/kg dw		SC0001
Methylene Chloride	<0.060mg/kg dw		SC0001
Acetone	<0.60mg/kg dw		SC0001
Carbon Disulfide	<0.060mg/kg dw		SC0001
1,1-Dichloroethene	<0.060mg/kg dw		SC0001
1,1-Dichloroethane	<0.060mg/kg dw		SC0001
trans-1,2-Dichloroethene	<0.060mg/kg dw		SC0001
cis-1,2-Dichloroethene	<0.060mg/kg dw		SC0001
Chloroform	<0.060mg/kg dw		SC0001
1,2-Dichloroethane	<0.060mg/kg dw		SC0001
2-Butanone	<0.30mg/kg dw		SC0001
1,1,1-Trichloroethane	<0.060mg/kg dw		SC0001
Carbon Tetrachloride	<0.060mg/kg dw		SC0001
Bromodichloromethane	<0.060mg/kg dw		SC0001
1,2-Dichloropropane	<0.060mg/kg dw		SC0001
cis-1,3-Dichloropropene	<0.060mg/kg dw		SC0001
Trichloroethene	<0.060mg/kg dw		SC0001
Dibromochloromethane	<0.060mg/kg dw		SC0001
1,1,2-Trichloroethane	<0.060mg/kg dw		SC0001
Benzene	<0.060mg/kg dw		SC0001
trans-1,3-Dichloropropene	<0.060mg/kg dw		SC0001
Bromoform	<0.060mg/kg dw		SC0001
4-Methyl-2-pentanone	<0.30mg/kg dw		SC0001
2-Hexanone	<0.30mg/kg dw		SC0001
Tetrachloroethene	<0.060mg/kg dw		SC0001
1,1,2,2-Tetrachloroethane	<0.060mg/kg dw		SC0001
Toluene	<0.060mg/kg dw		SC0001
Chlorobenzene	<0.060mg/kg dw		SC0001
Ethylbenzene	<0.060mg/kg dw		SC0001
Styrene	<0.060mg/kg dw		SC0001
m-Xylene and p-Xylene	<0.060mg/kg dw		SC0001
o-Xylene	<0.060mg/kg dw		SC0001

dw = Dry weight

DATE: 11/22/96

Upstate Laboratories, Inc.
Analysis Results
Report Number: 29996001
Client I.D.: DELTA ENVIRONMENTAL CONSULTANT E146-015-1.0012
Sampled by: Client

APPROVAL:
QC:
Lab I.D.: 10170
GP-6 (9-10) 1115H 10/23/96 C

ULI I.D.: 29996017 Matrix: Soil

PARAMETERS	RESULTS	KEY	FILE#
Percent Solids	81%		WB5048
TCL Volatiles by EPA Method 8240			
Chloromethane	<0.30mg/kg dw		SC0001
Bromomethane	<0.30mg/kg dw		SC0001
Vinyl Chloride	<0.12mg/kg dw		SC0001
Chloroethane	<0.30mg/kg dw		SC0001
Methylene Chloride	<0.061mg/kg dw		SC0001
Acetone	<0.61mg/kg dw		SC0001
Carbon Disulfide	<0.061mg/kg dw		SC0001
1,1-Dichloroethene	<0.061mg/kg dw		SC0001
1,1-Dichloroethane	<0.061mg/kg dw		SC0001
trans-1,2-Dichloroethene	<0.061mg/kg dw		SC0001
cis-1,2-Dichloroethene	<0.061mg/kg dw		SC0001
Chloroform	<0.061mg/kg dw		SC0001
1,2-Dichloroethane	<0.061mg/kg dw		SC0001
2-Butanone	<0.30mg/kg dw		SC0001
1,1,1-Trichloroethane	<0.061mg/kg dw		SC0001
Carbon Tetrachloride	<0.061mg/kg dw		SC0001
Bromodichloromethane	<0.061mg/kg dw		SC0001
1,2-Dichloropropane	<0.061mg/kg dw		SC0001
cis-1,3-Dichloropropene	<0.061mg/kg dw		SC0001
Trichloroethene	<0.061mg/kg dw		SC0001
Dibromochloromethane	<0.061mg/kg dw		SC0001
1,1,2-Trichloroethane	<0.061mg/kg dw		SC0001
Benzene	<0.061mg/kg dw		SC0001
trans-1,3-Dichloropropene	<0.061mg/kg dw		SC0001
Bromoform	<0.061mg/kg dw		SC0001
4-Methyl-2-pentanone	<0.30mg/kg dw		SC0001
2-Hexanone	<0.30mg/kg dw		SC0001
Tetrachloroethene	<0.061mg/kg dw		SC0001
1,1,2,2-Tetrachloroethane	<0.061mg/kg dw		SC0001
Toluene	<0.061mg/kg dw		SC0001
Chlorobenzene	<0.061mg/kg dw		SC0001
Ethylbenzene	<0.061mg/kg dw		SC0001
Styrene	<0.061mg/kg dw		SC0001
m-Xylene and p-Xylene	<0.061mg/kg dw		SC0001
o-Xylene	<0.061mg/kg dw		SC0001

dw = Dry weight

DATE: 11/22/96

Upstate Laboratories, Inc.
Analysis Results
Report Number: 29996001
Client I.D.: DELTA ENVIRONMENTAL CONSULTANT E146-015-1.0012
Sampled by: Client

APPROVAL:
QC:
Lab I.D.: 10170

GP-6 (2-4) 1020H 10/23/96 C

ULI I.D.: 29996018   Matrix: Soil

PARAMETERS	RESULTS	KEY	FILE#
MBAS	<1.3mg/kgLAS dw		WB4969
Percent Moisture	19%		WB4993
Percent Solids	82%		WB4972

dw = Dry weight

DATE: 11/22/96

Upstate Laboratories, Inc. APPROVAL:
Analysis Results QC:
Report Number: 29996001 Lab I.D.: 10170
Client I.D.: DELTA ENVIRONMENTAL CONSULTANT E146-015-1.0012
Sampled by: Client GP-5 (2-3) 1300H 10/23/96 C

ULI I.D.: 29996019 Matrix: Soil

PARAMETERS	RESULTS	KEY	FILE#
Percent Solids	87%		WB5049
TCL Volatiles by EPA Method 8240			
Chloromethane	<0.57mg/kg dw		SC0001
Bromomethane	<0.57mg/kg dw		SC0001
Vinyl Chloride	<0.23mg/kg dw		SC0001
Chloroethane	<0.57mg/kg dw		SC0001
Methylene Chloride	<0.11mg/kg dw		SC0001
Acetone	<1.1mg/kg dw		SC0001
Carbon Disulfide	<0.11mg/kg dw		SC0001
1,1-Dichloroethene	<0.11mg/kg dw		SC0001
1,1-Dichloroethane	<0.11mg/kg dw		SC0001
trans-1,2-Dichloroethene	<0.11mg/kg dw		SC0001
cis-1,2-Dichloroethene	<0.11mg/kg dw		SC0001
Chloroform	<0.11mg/kg dw		SC0001
1,2-Dichloroethane	<0.11mg/kg dw		SC0001
2-Butanone	<0.57mg/kg dw		SC0001
1,1,1-Trichloroethane	<0.11mg/kg dw		SC0001
Carbon Tetrachloride	<0.11mg/kg dw		SC0001
Bromodichloromethane	<0.11mg/kg dw		SC0001
1,2-Dichloropropane	<0.11mg/kg dw		SC0001
cis-1,3-Dichloropropene	<0.11mg/kg dw		SC0001
Trichloroethene	<0.11mg/kg dw		SC0001
Dibromochloromethane	<0.11mg/kg dw		SC0001
1,1,2-Trichloroethane	<0.11mg/kg dw		SC0001
Benzene	<0.11mg/kg dw		SC0001
trans-1,3-Dichloropropene	<0.11mg/kg dw		SC0001
Bromoform	<0.11mg/kg dw		SC0001
4-Methyl-2-pentanone	<0.57mg/kg dw		SC0001
2-Hexanone	<0.57mg/kg dw		SC0001
Tetrachloroethene	<0.11mg/kg dw		SC0001
1,1,2,2-Tetrachloroethane	<0.11mg/kg dw		SC0001
Toluene	<0.11mg/kg dw		SC0001
Chlorobenzene	<0.11mg/kg dw		SC0001
Ethylbenzene	<0.11mg/kg dw		SC0001
Styrene	<0.11mg/kg dw		SC0001
m-Xylene and p-Xylene	<0.11mg/kg dw		SC0001
o-Xylene	<0.11mg/kg dw		SC0001

dw = Dry weight

DATE: 11/22/96

Upstate Laboratories, Inc.
Analysis Results
Report Number: 29996001
Client I.D.: DELTA ENVIRONMENTAL CONSULTANT E146-015-1.0012
Sampled by: Client

APPROVAL:
QC:
Lab I.D.: 10170

GP-5 (2-4) 1300H 10/23/96 C

ULI I.D.: 29996020 Matrix: Soil

PARAMETERS	RESULTS	KEY	FILE#
MBAS	<1.2mg/kg LASdw		WB4969
Percent Moisture	15%		WB4993
Percent Solids	85%		WB4972

dw = Dry weight

DATE: 11/22/96

Upstate Laboratories, Inc.
Analysis Results
Report Number: 29996001
Client I.D.: DELTA ENVIRONMENTAL CONSULTANT E146-015-1.0012
Sampled by: Client GP-10 (8-9) 1615H 10/23/96 C

APPROVAL:
QC:
Lab I.D.: 10170

ULI I.D.: 29996021 Matrix: Soil

PARAMETERS	RESULTS	KEY	FILE#
MBAS	<1.2mg/kgLAS dw		WB4969
Percent Moisture	16%		WB4993
Percent Solids	84%		WB4972
TCL Volatiles by EPA Method 8240			
Chloromethane	<0.30mg/kg dw		SC0001
Bromomethane	<0.30mg/kg dw		SC0001
Vinyl Chloride	<0.12mg/kg dw		SC0001
Chloroethane	<0.30mg/kg dw		SC0001
Methylene Chloride	<0.060mg/kg dw		SC0001
Acetone	<0.60mg/kg dw		SC0001
Carbon Disulfide	<0.060mg/kg dw		SC0001
1,1-Dichloroethene	<0.060mg/kg dw		SC0001
1,1-Dichloroethane	<0.060mg/kg dw		SC0001
trans-1,2-Dichloroethene	<0.060mg/kg dw		SC0001
cis-1,2-Dichloroethene	<0.060mg/kg dw		SC0001
Chloroform	<0.060mg/kg dw		SC0001
1,2-Dichloroethane	<0.060mg/kg dw		SC0001
2-Butanone	<0.30mg/kg dw		SC0001
1,1,1-Trichloroethane	<0.060mg/kg dw		SC0001
Carbon Tetrachloride	<0.060mg/kg dw		SC0001
Bromodichloromethane	<0.060mg/kg dw		SC0001
1,2-Dichloropropane	<0.060mg/kg dw		SC0001
cis-1,3-Dichloropropene	<0.060mg/kg dw		SC0001
Trichloroethene	<0.060mg/kg dw		SC0001
Dibromochloromethane	<0.060mg/kg dw		SC0001
1,1,2-Trichloroethane	<0.060mg/kg dw		SC0001
Benzene	<0.060mg/kg dw		SC0001
trans-1,3-Dichloropropene	<0.060mg/kg dw		SC0001
Bromoform	<0.060mg/kg dw		SC0001
4-Methyl-2-pentanone	<0.30mg/kg dw		SC0001
2-Hexanone	<0.30mg/kg dw		SC0001
Tetrachloroethene	<0.060mg/kg dw		SC0001
1,1,2,2-Tetrachloroethane	<0.060mg/kg dw		SC0001
Toluene	<0.060mg/kg dw		SC0001
Chlorobenzene	<0.060mg/kg dw		SC0001
Ethylbenzene	<0.060mg/kg dw		SC0001
Styrene	<0.060mg/kg dw		SC0001
m-Xylene and p-Xylene	<0.060mg/kg dw		SC0001
o-Xylene	<0.060mg/kg dw		SC0001

dw = Dry weight

DATE: 11/22/96

Upstate Laboratories, Inc.
Analysis Results
Report Number: 29996001
Client I.D.: DELTA ENVIRONMENTAL CONSULTANT E146-015-1.0012
Sampled by: Client

APPROVAL:
QC:
Lab I.D.: 10170

GP-3 (3-5) 1700H 10/23/96 C

ULI I.D.: 29996022 Matrix: Soil

PARAMETERS	RESULTS	KEY	FILE#
MBAS	<1.3mg/kgLAS dw		WB4969
Percent Moisture	17%		WB4993
Percent Solids	82%		WB4972

dw = Dry weight

DATE: 11/22/96

Upstate Laboratories, Inc.
Analysis Results
Report Number: 29996001
Client I.D.: DELTA ENVIRONMENTAL CONSULTANT E146-015-1.0012
Sampled by: Client

APPROVAL:
QC:
Lab I.D.: 10170

GP-3 (4-5) 1700H 10/23/96 C

ULI I.D.: 29996023 Matrix: Soil

PARAMETERS	RESULTS	KEY	FILE#
Percent Solids	83%		WB5049
TCL Volatiles by EPA Method 8240			
Chloromethane	<0.30mg/kg dw		SC0001
Bromomethane	<0.30mg/kg dw		SC0001
Vinyl Chloride	<0.12mg/kg dw		SC0001
Chloroethane	<0.30mg/kg dw		SC0001
Methylene Chloride	<0.060mg/kg dw		SC0001
Acetone	<0.60mg/kg dw		SC0001
Carbon Disulfide	<0.060mg/kg dw		SC0001
1,1-Dichloroethene	<0.060mg/kg dw		SC0001
1,1-Dichloroethane	<0.060mg/kg dw		SC0001
trans-1,2-Dichloroethene	<0.060mg/kg dw		SC0001
cis-1,2-Dichloroethene	<0.060mg/kg dw		SC0001
Chloroform	<0.060mg/kg dw		SC0001
1,2-Dichloroethane	<0.060mg/kg dw		SC0001
2-Butanone	<0.30mg/kg dw		SC0001
1,1,1-Trichloroethane	<0.060mg/kg dw		SC0001
Carbon Tetrachloride	<0.060mg/kg dw		SC0001
Bromodichloromethane	<0.060mg/kg dw		SC0001
1,2-Dichloropropane	<0.060mg/kg dw		SC0001
cis-1,3-Dichloropropene	<0.060mg/kg dw		SC0001
Trichloroethene	<0.060mg/kg dw		SC0001
Dibromochloromethane	<0.060mg/kg dw		SC0001
1,1,2-Trichloroethane	<0.060mg/kg dw		SC0001
Benzene	<0.060mg/kg dw		SC0001
trans-1,3-Dichloropropene	<0.060mg/kg dw		SC0001
Bromoform	<0.060mg/kg dw		SC0001
4-Methyl-2-pentanone	<0.30mg/kg dw		SC0001
2-Hexanone	<0.30mg/kg dw		SC0001
Tetrachloroethene	<0.060mg/kg dw		SC0001
1,1,2,2-Tetrachloroethane	<0.060mg/kg dw		SC0001
Toluene	<0.060mg/kg dw		SC0001
Chlorobenzene	<0.060mg/kg dw		SC0001
Ethylbenzene	<0.060mg/kg dw		SC0001
Styrene	<0.060mg/kg dw		SC0001
m-Xylene and p-Xylene	<0.060mg/kg dw		SC0001
o-Xylene	<0.060mg/kg dw		SC0001

dw = Dry weight

DATE: 11/22/96

Upstate Laboratories, Inc. APPROVAL:
Analysis Results QC:
Report Number: 29996001 Lab I.D.: 10170
Client I.D.: DELTA ENVIRONMENTAL CONSULTANT E146-015-1.0012
Sampled by: Client GP-2 (14-15.5) 10/23/96 C

ULI I.D.: 29996024 Matrix: Soil

PARAMETERS	RESULTS	KEY	FILE#
Percent Solids	82%		WB5049
TCL Volatiles by EPA Method 8240			
Chloromethane	<0.30mg/kg dw		SC0001
Bromomethane	<0.30mg/kg dw		SC0001
Vinyl Chloride	<0.12mg/kg dw		SC0001
Chloroethane	<0.30mg/kg dw		SC0001
Methylene Chloride	<0.060mg/kg dw		SC0001
Acetone	<0.60mg/kg dw		SC0001
Carbon Disulfide	<0.060mg/kg dw		SC0001
1,1-Dichloroethene	<0.060mg/kg dw		SC0001
1,1-Dichloroethane	0.11mg/kg dw		SC0001
trans-1,2-Dichloroethene	<0.060mg/kg dw		SC0001
cis-1,2-Dichloroethene	<0.060mg/kg dw		SC0001
Chloroform	<0.060mg/kg dw		SC0001
1,2-Dichloroethane	<0.060mg/kg dw		SC0001
2-Butanone	<0.30mg/kg dw		SC0001
1,1,1-Trichloroethane	<0.060mg/kg dw		SC0001
Carbon Tetrachloride	<0.060mg/kg dw		SC0001
Bromodichloromethane	<0.060mg/kg dw		SC0001
1,2-Dichloropropane	<0.060mg/kg dw		SC0001
cis-1,3-Dichloropropene	<0.060mg/kg dw		SC0001
Trichloroethene	0.06mg/kg dw		SC0001
Dibromochloromethane	<0.060mg/kg dw		SC0001
1,1,2-Trichloroethane	<0.060mg/kg dw		SC0001
Benzene	<0.060mg/kg dw		SC0001
trans-1,3-Dichloropropene	<0.060mg/kg dw		SC0001
Bromoform	<0.060mg/kg dw		SC0001
4-Methyl-2-pentanone	<0.30mg/kg dw		SC0001
2-Hexanone	<0.30mg/kg dw		SC0001
Tetrachloroethene	6.7mg/kg dw		SC0001
1,1,2,2-Tetrachloroethane	<0.060mg/kg dw		SC0001
Toluene	<0.060mg/kg dw		SC0001
Chlorobenzene	<0.060mg/kg dw		SC0001
Ethylbenzene	<0.060mg/kg dw		SC0001
Styrene	<0.060mg/kg dw		SC0001
m-Xylene and p-Xylene	<0.060mg/kg dw		SC0001
o-Xylene	<0.060mg/kg dw		SC0001

dw = Dry weight

Upstate Laboratories, Inc.
6034 Corporate Drive • E. Syracuse, NY 13057-1017
(315) 437 0255
Fax 437 1209

Chain Of Custody Record

11/8

Client: Delta Env Consult.		Client Project # / Project Name: E196-015-1, 0012			
Client Contact: Steve Zbur	Phone # 412 487 7100	Site Location (city/state): Geneva NY			

Sample Location:	Date	Time	Matrix	~~Grab or~~ Comp.	ULI Internal Use Only	No. of Containers	1) VOC 8240	2) MBAS	3) Bulk Density	4) TOC	5) Porosity	6) Moisture	7) (% Solids)	8)	9)	10)	Special Turnaround Time ____ (Lab Notification required) Remarks
GP-1 (4-5)	10-22-96	11:00	Soil	X	29996001	1 HD			X				~~(X)~~ HD				
GP-1 (4-5)	↓	11:00	↓	X		1				X			(X) HD				
GP-1 (5-6)		11:15		X	2	1					X		(X)				
GP-1 (9-10)		12:00		X	3	1				X			(X)				
GP-1 (9-10)		12:30		X		1			X								
GP-2 (1-2)		3:30		X	4	1	X						(X)				
GP-2 (9-10)		4:45		X	5	1	X						(X)				
GP-2 (9-10)		4:45		X	6	1		X				X	(X)				
GP-4 (2-3)		5:15		X	7	1	X						(X)				
GP-4 (9-10)	↓	6:00	↓	X	8	1		X				X	(X)				

parameter and method	sample bottle: type	size	pres.
1)			
2)			
3)			
4)			
5)			
6)			
7)			
8)			
9)			
10)			

Note: The numbered columns above cross-reference with the numbered columns in the upper right-hand corner.

Sampled by: (Please Print) Robert R Bottome
Company: Delta

ULI Internal Use Only
Delivery (check one):
☐ ULI Sampled
☒ Pickup ☐ Dropoff
☐ CC ____

Relinquished by: (Signature)	Date	Time	Received by: (Signature)
[signature]	10-24-96	10:00	[signature]
[signature]	10/24/96	4:15 pm	
Relinquished by: (Signature)	Date 10/24/96	Time 1630	Rec'd for Lab by: (Signature) Heather Done

Syracuse Rochester Buffalo Albany Binghamton Fair Lawn (NJ)

11/8

Upstate Laboratories, Inc.
6034 Corporate Drive • E. Syracuse, NY 13057-1017
(315) 437 0255 Fax 437 1209

Chain Of Custody Record

Client: Delta Env Consult

Client Project # / Project Name: E196-015-1.0012

Client Contact: Steve Zbur 412

Phone #: 487-7200

Site Location (city/state): Geneva NY

Special Turnaround Time____ (Lab Notification required)

Sample Location:	Date	Time	Matrix	~~Grab or~~ Comp.	ULI Internal Use Only	No. of Containers	1) Voc 8240	2) MBAS	3) moisture	4) (% Solids)	5)	6)	7)	8)	9)	10)	Remarks
GP-4 (9-10)	10-22-96	6:00	Soil	x	29996009	1	X			(X)	40						
GP-8 (2-3)	10-23-96	7:45		x	10	1	X			(X)							
GP-8 (8-10)		4:25		x	11	1		X	X	(X)							
GP-8 (9-10)		4:25		x	12	1	X			(X)							
GP-9 (2-3)		8:45		x	13	1	X			(X)							
GP-9 ~~[illegible]~~ (2-4)		8:45		x	14	1		X	X	(X)							
GP-9 (9-10)		9:45		x	15	1	X			(X)							
GP-6 (2-3)		10:15		x	16	1	X			(X)							
GP-6 (9-10)		11:15		x	17	1	X			(X)							
GP-6 (2-4)		10:20		x	18	1		X	X	(X)							

parameter and method	sample bottle: type	size	pres.
1)			
2)			
3)			
4)			
5)			
6)			
7)			
8)			
9)			
10)			

Note: The numbered columns above cross-reference with the numbered columns in the upper right-hand corner.

Sampled by: (Please Print) Robert R. Bottemann

Company: Delta

ULI Internal Use Only
Delivery (check one):
☐ ULI Sampled
☒ Pickup ☐ Dropoff
☐ CC ______

Relinquished by: (Signature)	Date	Time	Received by: (Signature)
R Rottm	10-24-96	10:00	[signature]
[signature]	10/24/96	415 pm	
Relinquished by: (Signature)	Date	Time	Rec'd for Lab by: (Signature)
	10/24/96	1630	Heather Done

Syracuse Rochester Buffalo Albany Binghamton Fair Lawn (NJ)

Upstate Laboratories, Inc.
6034 Corporate Drive • E. Syracuse, NY 13057-1017
(315) 437 0255 Fax 437 1209

Chain Of Custody Record

3 13

11/8

Client: Delta Env Consult
Client Project # / Project Name: E196-015-1.0012
Client Contact:
Phone #:
Site Location (city/state): Geneva NY

Sample Location:	Date	Time	Matrix	~~Grab or~~ Comp.	ULI Internal Use Only	No. of Containers	1) VOC 8240	2) MBAS	3) moisture	4) (% Solids) HO	5)	6)	7)	8)	9)	10)	Special Turnaround Time ____ (Lab Notification required) Remarks
GP-5 (2-3)	10-23-96	100	Soil	X	29996019	1	X			(X)	HD						
GP-5 (2-4)		100		X	20	1		X	X	(X)							
GP-10 (8-9)		4:15		X	21	1	X			(X)							
GP-10 (8-9)		4:15		X		1		X	X								
GP-3 (3-5)		5:00		X	22	1		X	X	(X)							
GP-3 (4-5)		5:00		X	23	1	X			(X)							
GP-2 (14-15.5)				X	24	1	X			(X)							

parameter and method	sample bottle: type	size	pres.
1)			
2)			
3)			
4)			
5)			
6)			
7)			
8)			
9)			
10)			

Note: The numbered columns above cross-reference with the numbered columns in the upper right-hand corner.

Sampled by: (Please Print) Robert R Bottkman
Company: Delta

ULI Internal Use Only
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Relinquished by: (Signature)	Date	Time	Received by: (Signature)
R Hoffman	10/24/96	1000	[signature]
[signature]	10/24/96	415 PM	

Relinquished by: (Signature)	Date	Time	Rec'd for Lab by: (Signature)
	10/24/96	1630	Heather Dom

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Upstate Laboratories inc.

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November 22, 1996

Mr. Bob Botterman
Delta Environmental Consultants
4068 Mt. Royal Blvd.
Suite 225 - Gamma
Allison Park, PA 15101

Re: Analysis Report #29996116 - 96-015/HB Fuller

Dear Mr. Botterman:

Please find enclosed the results for your samples which were picked up by ULI personnel on October 24, 1996.

We have included the Chain of Custody Record as part of your report. You may need to reference this form for a more detailed explanation of your sample. Samples will be disposed of approximately one month from final report date.

Should you have any questions, please feel free to give us a call.

Thank you for your patronage.

Sincerely,

UPSTATE LABORATORIES, INC.

Anthony J. Scala
Director

AJS/jk

Enclosures: report, invoice

cc/encs: N. Scala, ULI
file

DATE: 11/22/96

Upstate Laboratories, Inc.
Analysis Results
Report Number: 29996116
Client I.D.: DELTA ENVIRONMENTAL CONSULTANT 96-015/HB FULLER
Sampled by: Client

APPROVAL:
QC:
Lab I.D.: 10170

MW-1 1400H 10/22/96

ULI I.D.: 29996116 Matrix: Water

PARAMETERS	RESULTS	KEY	FILE#
BOD5	<12mg/l		WB4962
MBAS	0.17mg/lLAS		WB4969
TRC	0.04mg/lCl2		WB4955
Total Alkalinity	450mg/lCaCO3		WB5014
Chloride	10mg/l		WB5185
COD	95mg/l		WB5020
Free Residual Chlorine	0.05mg/lCl2		WB4956
Nitrate-Nitrite Nitrogen	<0.2mg/l		WB4970
Ammonia-Nitrogen	1.9mg/l		WB5083
Sulfide	<0.1mg/l		WB4991
Sulfate	95mg/l		WB5034
Total Dissolved Solids	670mg/l		WB4997
TOC	26mg/l		WB5011
Total Iron	9.9mg/l		MA7079
Total Sodium	29mg/l		MA7139
TCL Volatiles by EPA Method 8240			
Chloromethane	<5ug/l		SC0001
Bromomethane	<5ug/l		SC0001
Vinyl Chloride	<3ug/l		SC0001
Chloroethane	<5ug/l		SC0001
Methylene Chloride	<3ug/l		SC0001
Acetone	<5ug/l		SC0001
Carbon Disulfide	<3ug/l		SC0001
1,1-Dichloroethene	<3ug/l		SC0001
1,1-Dichloroethane	<3ug/l		SC0001
trans-1,2-Dichloroethene	<3ug/l		SC0001
cis-1,2-Dichloroethene	14ug/l		SC0001
Chloroform	<3ug/l		SC0001
1,2-Dichloroethane	<3ug/l		SC0001
2-Butanone	<5ug/l		SC0001
1,1,1-Trichloroethane	<3ug/l		SC0001
Carbon Tetrachloride	<3ug/l		SC0001
Bromodichloromethane	<3ug/l		SC0001
1,2-Dichloropropane	<3ug/l		SC0001
cis-1,3-Dichloropropene	<3ug/l		SC0001
Trichloroethene	<3ug/l		SC0001
Dibromochloromethane	<3ug/l		SC0001
1,1,2-Trichloroethane	<3ug/l		SC0001
Benzene	<3ug/l		SC0001
trans-1,3-Dichloropropene	<3ug/l		SC0001

DATE: 11/22/96

Upstate Laboratories, Inc.
Analysis Results
Report Number: 29996116
Client I.D.: DELTA ENVIRONMENTAL CONSULTANT 96-015/HB FULLER
Sampled by: Client

APPROVAL:
QC:
Lab I.D.: 10170

MW-1 1400H 10/22/96

ULI I.D.: 29996116 Matrix: Water

PARAMETERS	RESULTS	KEY	FILE#
Bromoform	<3ug/l		SC0001
4-Methyl-2-pentanone	<5ug/l		SC0001
2-Hexanone	<5ug/l		SC0001
Tetrachloroethene	4ug/l		SC0001
1,1,2,2-Tetrachloroethane	<3ug/l		SC0001
Toluene	<3ug/l		SC0001
Chlorobenzene	<3ug/l		SC0001
Ethylbenzene	6ug/l		SC0001
Styrene	<3ug/l		SC0001
m-Xylene and p-Xylene	4ug/l		SC0001
o-Xylene	<3ug/l		SC0001

DATE: 11/22/96

Upstate Laboratories, Inc.
Analysis Results
Report Number: 29996116
Client I.D.: DELTA ENVIRONMENTAL CONSULTANT 96-015/HB FULLER
Sampled by: Client

APPROVAL:
QC:
Lab I.D.: 10170

MW-2 1743H 10/22/96

ULI I.D.: 29996117 Matrix: Water

PARAMETERS	RESULTS	KEY	FILE#
BOD5	40mg/l		WB4962
MBAS	5.0mg/lLAS		WB4969
TRC	0.03mg/lCl2		WB4955
Total Alkalinity	2500mg/lCaCO3		WB5097
Chloride	430mg/l		WB4983
COD	410mg/l		WB5020
Free Residual Chlorine	0.02mg/lCl2		WB4956
Nitrate-Nitrite Nitrogen	<0.2mg/l		WB4970
Ammonia-Nitrogen	1.7mg/l		WB5090
Sulfide	<0.1mg/l		WB4991
Sulfate	280mg/l		WB5034
Total Dissolved Solids	4200mg/l		WB4997
TOC	160mg/l		WB5011
Total Iron	4.2mg/l		MA7079
Total Sodium	1300mg/l		MA7099
TCL Volatiles by EPA Method 8240			
Chloromethane	<10ug/l	05	SC0001
Bromomethane	<10ug/l	05	SC0001
Vinyl Chloride	130ug/l		SC0001
Chloroethane	<10ug/l	05	SC0001
Methylene Chloride	<10ug/l	05	SC0001
Acetone	310ug/l		SC0001
Carbon Disulfide	<10ug/l	05	SC0001
1,1-Dichloroethene	<10ug/l	05	SC0001
1,1-Dichloroethane	56ug/l		SC0001
trans-1,2-Dichloroethene	<10ug/l	05	SC0001
cis-1,2-Dichloroethene	260ug/l		SC0001
Chloroform	12ug/l		SC0001
1,2-Dichloroethane	<10ug/l	05	SC0001
2-Butanone	31ug/l		SC0001
1,1,1-Trichloroethane	<10ug/l	05	SC0001
Carbon Tetrachloride	<10ug/l	05	SC0001
Bromodichloromethane	<10ug/l	05	SC0001
1,2-Dichloropropane	<10ug/l	05	SC0001
cis-1,3-Dichloropropene	<10ug/l	05	SC0001
Trichloroethene	69ug/l		SC0001
Dibromochloromethane	<10ug/l	05	SC0001
1,1,2-Trichloroethane	<10ug/l	05	SC0001
Benzene	<10ug/l	05	SC0001
trans-1,3-Dichloropropene	<10ug/l	05	SC0001

DATE: 11/22/96

Upstate Laboratories, Inc.
Analysis Results
Report Number: 29996116
Client I.D.: DELTA ENVIRONMENTAL CONSULTANT 96-015/HB FULLER
Sampled by: Client

APPROVAL:
QC:
Lab I.D.: 10170

MW-2 1743H 10/22/96

ULI I.D.: 29996117 Matrix: Water

PARAMETERS	RESULTS	KEY	FILE#
Bromoform	<10ug/l	05	SC0001
4-Methyl-2-pentanone	57ug/l		SC0001
2-Hexanone	<10ug/l	05	SC0001
Tetrachloroethene	<10ug/l	05	SC0001
1,1,2,2-Tetrachloroethane	<10ug/l	05	SC0001
Toluene	<10ug/l	05	SC0001
Chlorobenzene	<10ug/l	05	SC0001
Ethylbenzene	<10ug/l	05	SC0001
Styrene	<10ug/l	05	SC0001
m-Xylene and p-Xylene	<10ug/l	05	SC0001
o-Xylene	<10ug/l	05	SC0001

DATE: 11/22/96

Upstate Laboratories, Inc. APPROVAL:
Analysis Results QC:
Report Number: 29996116 Lab I.D.: 10170
Client I.D.: DELTA ENVIRONMENTAL CONSULTANT 96-015/HB FULLER
Sampled by: Client MW-3 1553H 10/22/96

ULI I.D.: 29996118 Matrix: Water

PARAMETERS	RESULTS	KEY	FILE#
BOD5	170mg/l		WB4962
MBAS	5.0mg/lLAS		WB4969
TRC	0.02mg/lCl2		WB4955
Total Alkalinity	3000mg/lCaCO3		WB5097
Chloride	350mg/l		WB4983
COD	600mg/l		WB5020
Free Residual Chlorine	<0.02mg/lCl2		WB4956
Nitrate-Nitrite Nitrogen	<0.2mg/l		WB4970
Ammonia-Nitrogen	8.3mg/l		WB5083
Sulfide	0.5mg/l		WB4991
Sulfate	200mg/l		WB5034
Total Dissolved Solids	4800mg/l		WB4997
TOC	280mg/l		WB5011
Total Iron	4.5mg/l		MA7079
Total Sodium	1400mg/l		MA7099
TCL Volatiles by EPA Method 8240			
Chloromethane	<10ug/l	05	SC0001
Bromomethane	<10ug/l	05	SC0001
Vinyl Chloride	<10ug/l	05	SC0001
Chloroethane	<10ug/l	05	SC0001
Methylene Chloride	11ug/l		SC0001
Acetone	860ug/l		SC0001
Carbon Disulfide	<10ug/l	05	SC0001
1,1-Dichloroethene	<10ug/l	05	SC0001
1,1-Dichloroethane	11ug/l		SC0001
trans-1,2-Dichloroethene	<10ug/l	05	SC0001
cis-1,2-Dichloroethene	<10ug/l	05	SC0001
Chloroform	11ug/l		SC0001
1,2-Dichloroethane	<10ug/l	05	SC0001
2-Butanone	49ug/l		SC0001
1,1,1-Trichloroethane	<10ug/l	05	SC0001
Carbon Tetrachloride	<10ug/l	05	SC0001
Bromodichloromethane	<10ug/l	05	SC0001
1,2-Dichloropropane	<10ug/l	05	SC0001
cis-1,3-Dichloropropene	<10ug/l	05	SC0001
Trichloroethene	<10ug/l	05	SC0001
Dibromochloromethane	<10ug/l	05	SC0001
1,1,2-Trichloroethane	<10ug/l	05	SC0001
Benzene	<10ug/l	05	SC0001
trans-1,3-Dichloropropene	<10ug/l	05	SC0001

DATE: 11/22/96

Upstate Laboratories, Inc. APPROVAL:
Analysis Results QC:
Report Number: 29996116 Lab I.D.: 10170
Client I.D.: DELTA ENVIRONMENTAL CONSULTANT 96-015/HB FULLER
Sampled by: Client MW-3 1553H 10/22/96

ULI I.D.: 29996118 Matrix: Water

PARAMETERS	RESULTS	KEY	FILE#
Bromoform	<10ug/l	05	SC0001
4-Methyl-2-pentanone	33ug/l		SC0001
2-Hexanone	<10ug/l	05	SC0001
Tetrachloroethene	<10ug/l	05	SC0001
1,1,2,2-Tetrachloroethane	<10ug/l	05	SC0001
Toluene	<10ug/l	05	SC0001
Chlorobenzene	<10ug/l	05	SC0001
Ethylbenzene	<10ug/l	05	SC0001
Styrene	<10ug/l	05	SC0001
m-Xylene and p-Xylene	<10ug/l	05	SC0001
o-Xylene	<10ug/l	05	SC0001

DATE: 11/22/96

Upstate Laboratories, Inc. APPROVAL: [signature]
Analysis Results QC: [signature]
Report Number: 29996116 Lab I.D.: 10170
Client I.D.: DELTA ENVIRONMENTAL CONSULTANT 96-015/HB FULLER
Sampled by: Client MW-4 1233H 10/22/96

ULI I.D.: 29996119 Matrix: Water

PARAMETERS	RESULTS	KEY	FILE#
BOD5	<8mg/l		WB4962
MBAS	4.4mg/lLAS		WB4969
TRC	0.05mg/lCl2		WB4955
Total Alkalinity	330mg/lCaCO3		WB5014
Chloride	10mg/l		WB4983
COD	46mg/l		WB5020
Free Residual Chlorine	<0.02mg/lCl2		WB4956
Nitrate-Nitrite Nitrogen	0.4mg/l		WB4970
Ammonia-Nitrogen	0.8mg/l		WB5090
Sulfide	<0.1mg/l		WB4991
Sulfate	63mg/l		WB5034
Total Dissolved Solids	580mg/l		WB4997
TOC	11mg/l		WB5011
Total Iron	0.07mg/l		MA7079
Total Sodium	1500mg/l		MA7099
TCL Volatiles by EPA Method 8240			
Chloromethane	<5ug/l		SC0001
Bromomethane	<5ug/l		SC0001
Vinyl Chloride	<3ug/l		SC0001
Chloroethane	<5ug/l		SC0001
Methylene Chloride	<3ug/l		SC0001
Acetone	50ug/l		SC0001
Carbon Disulfide	<3ug/l		SC0001
1,1-Dichloroethene	<3ug/l		SC0001
1,1-Dichloroethane	<3ug/l		SC0001
trans-1,2-Dichloroethene	<3ug/l		SC0001
cis-1,2-Dichloroethene	<3ug/l		SC0001
Chloroform	4ug/l		SC0001
1,2-Dichloroethane	<3ug/l		SC0001
2-Butanone	11ug/l		SC0001
1,1,1-Trichloroethane	<3ug/l		SC0001
Carbon Tetrachloride	<3ug/l		SC0001
Bromodichloromethane	<3ug/l		SC0001
1,2-Dichloropropane	<3ug/l		SC0001
cis-1,3-Dichloropropene	<3ug/l		SC0001
Trichloroethene	<3ug/l		SC0001
Dibromochloromethane	<3ug/l		SC0001
1,1,2-Trichloroethane	<3ug/l		SC0001
Benzene	<3ug/l		SC0001
trans-1,3-Dichloropropene	<3ug/l		SC0001

DATE: 11/22/96

Upstate Laboratories, Inc. APPROVAL:
Analysis Results QC:
Report Number: 29996116 Lab I.D.: 10170
Client I.D.: DELTA ENVIRONMENTAL CONSULTANT 96-015/HB FULLER
Sampled by: Client MW-4 1233H 10/22/96

ULI I.D.: 29996119 Matrix: Water

PARAMETERS	RESULTS	KEY	FILE#
Bromoform	<3ug/l		SC0001
4-Methyl-2-pentanone	57ug/l		SC0001
2-Hexanone	<5ug/l		SC0001
Tetrachloroethene	<3ug/l		SC0001
1,1,2,2-Tetrachloroethane	<3ug/l		SC0001
Toluene	<3ug/l		SC0001
Chlorobenzene	<3ug/l		SC0001
Ethylbenzene	<3ug/l		SC0001
Styrene	<3ug/l		SC0001
m-Xylene and p-Xylene	<3ug/l		SC0001
o-Xylene	<3ug/l		SC0001

DATE: 11/22/96

Upstate Laboratories, Inc.
Analysis Results
Report Number: 29996116
Client I.D.: DELTA ENVIRONMENTAL CONSULTANT 96-015/HB FULLER
Sampled by: Client

APPROVAL:
QC:
Lab I.D.: 10170

MW-5 1031H 10/22/96

ULI I.D.: 29996120 Matrix: Water

	PARAMETERS	RESULTS	KEY	FILE#
	BOD5	<4mg/l		WB4962
	MBAS	<0.05mg/lLAS		WB4969
	TRC	0.03mg/lCl2		WB4955
	Total Alkalinity	560mg/lCaCO3		WB5097
	Chloride	290mg/l		WB4983
	COD	<20mg/l		WB5020
	Free Residual Chlorine	<0.02mg/lCl2		WB4956
	Nitrate-Nitrite Nitrogen	<0.2mg/l		WB4970
	Ammonia-Nitrogen	<0.5mg/l		WB5083
	Sulfide	<0.1mg/l		WB4991
	Sulfate	150mg/l		WB5034
	Total Dissolved Solids	1300mg/l		WB4997
	TOC	5mg/l		WB5011
Total	Iron	<0.03mg/l		MA7079
Total	Sodium	240mg/l		MA7139

TCL Volatiles by EPA Method 8240

Chloromethane	<5ug/l	SC0001
Bromomethane	<5ug/l	SC0001
Vinyl Chloride	<3ug/l	SC0001
Chloroethane	<5ug/l	SC0001
Methylene Chloride	<3ug/l	SC0001
Acetone	<5ug/l	SC0001
Carbon Disulfide	<3ug/l	SC0001
1,1-Dichloroethene	<3ug/l	SC0001
1,1-Dichloroethane	<3ug/l	SC0001
trans-1,2-Dichloroethene	<3ug/l	SC0001
cis-1,2-Dichloroethene	<3ug/l	SC0001
Chloroform	<3ug/l	SC0001
1,2-Dichloroethane	<3ug/l	SC0001
2-Butanone	<5ug/l	SC0001
1,1,1-Trichloroethane	6ug/l	SC0001
Carbon Tetrachloride	<3ug/l	SC0001
Bromodichloromethane	<3ug/l	SC0001
1,2-Dichloropropane	<3ug/l	SC0001
cis-1,3-Dichloropropene	<3ug/l	SC0001
Trichloroethene	<3ug/l	SC0001
Dibromochloromethane	<3ug/l	SC0001
1,1,2-Trichloroethane	<3ug/l	SC0001
Benzene	<3ug/l	SC0001
trans-1,3-Dichloropropene	<3ug/l	SC0001

DATE: 11/22/96

Upstate Laboratories, Inc. APPROVAL:
Analysis Results QC:
Report Number: 29996116 Lab I.D.: 10170
Client I.D.: DELTA ENVIRONMENTAL CONSULTANT 96-015/HB FULLER
Sampled by: Client MW-5 1031H 10/22/96

ULI I.D.: 29996120 Matrix: Water

PARAMETERS	RESULTS	KEY	FILE#
Bromoform	<3ug/l		SC0001
4-Methyl-2-pentanone	13ug/l		SC0001
2-Hexanone	<5ug/l		SC0001
Tetrachloroethene	<3ug/l		SC0001
1,1,2,2-Tetrachloroethane	<3ug/l		SC0001
Toluene	<3ug/l		SC0001
Chlorobenzene	<3ug/l		SC0001
Ethylbenzene	<3ug/l		SC0001
Styrene	<3ug/l		SC0001
m-Xylene and p-Xylene	<3ug/l		SC0001
o-Xylene	<3ug/l		SC0001

DATE: 11/22/96

Upstate Laboratories, Inc.
Analysis Results
Report Number: 29996116
Client I.D.: DELTA ENVIRONMENTAL CONSULTANT 96-015/HB FULLER
Sampled by: Client

APPROVAL:
QC:
Lab I.D.: 10170

GP-2 1000H 10/23/96

ULI I.D.: 29996121 Matrix: Water

PARAMETERS	RESULTS	KEY	FILE#
BOD5	71mg/l		WB4962
MBAS	4.5mg/lLAS		WB4969
TRC	<0.02mg/lCl2		WB4955
Total Alkalinity	1700mg/lCaCO3		WB5097
Chloride	89mg/l		WB4983
COD	320mg/l		WB5020
Free Residual Chlorine	<0.02mg/lCl2		WB4956
Nitrate-Nitrite Nitrogen	2.5mg/l		WB4970
Ammonia-Nitrogen	5.5mg/l		WB5083
Sulfide	<0.1mg/l		WB4991
Sulfate	160mg/l		WB5034
Total Dissolved Solids	2100mg/l		WB4997
TOC	91mg/l		WB5011
Total Iron	5.6mg/l		MA7079
Total Sodium	920mg/l		MA7099

TCL Volatiles by EPA Method 8240

Chloromethane	<50ug/l	05	SC0001
Bromomethane	<50ug/l	05	SC0001
Vinyl Chloride	<10ug/l	05	SC0001
Chloroethane	<50ug/l	05	SC0001
Methylene Chloride	<10ug/l	05	SC0001
Acetone	60ug/l		SC0001
Carbon Disulfide	<10ug/l	05	SC0001
1,1-Dichloroethene	<10ug/l	05	SC0001
1,1-Dichloroethane	<10ug/l	05	SC0001
trans-1,2-Dichloroethene	<10ug/l	05	SC0001
cis-1,2-Dichloroethene	<10ug/l	05	SC0001
Chloroform	<10ug/l	05	SC0001
1,2-Dichloroethane	<10ug/l	05	SC0001
2-Butanone	<50ug/l	05	SC0001
1,1,1-Trichloroethane	<10ug/l	05	SC0001
Carbon Tetrachloride	<10ug/l	05	SC0001
Bromodichloromethane	<10ug/l	05	SC0001
1,2-Dichloropropane	<10ug/l	05	SC0001
cis-1,3-Dichloropropene	<10ug/l	05	SC0001
Trichloroethene	<10ug/l	05	SC0001
Dibromochloromethane	<10ug/l	05	SC0001
1,1,2-Trichloroethane	<10ug/l	05	SC0001
Benzene	<10ug/l	05	SC0001
trans-1,3-Dichloropropene	<10ug/l	05	SC0001

DATE: 11/22/96

Upstate Laboratories, Inc.
Analysis Results
Report Number: 29996116
Client I.D.: DELTA ENVIRONMENTAL CONSULTANT 96-015/HB FULLER
Sampled by: Client

APPROVAL:
QC:
Lab I.D.: 10170

GP-2 1000H 10/23/96

ULI I.D.: 29996121   Matrix: Water

PARAMETERS	RESULTS	KEY	FILE#
Bromoform	<10ug/l	05	SC0001
4-Methyl-2-pentanone	250ug/l		SC0001
2-Hexanone	<50ug/l	05	SC0001
Tetrachloroethene	<10ug/l	05	SC0001
1,1,2,2-Tetrachloroethane	<10ug/l	05	SC0001
Toluene	<10ug/l	05	SC0001
Chlorobenzene	<10ug/l	05	SC0001
Ethylbenzene	<10ug/l	05	SC0001
Styrene	<10ug/l	05	SC0001
m-Xylene and p-Xylene	<10ug/l	05	SC0001
o-Xylene	<10ug/l	05	SC0001

DATE: 11/22/96

Upstate Laboratories, Inc. APPROVAL:
Analysis Results QC:
Report Number: 29996116 Lab I.D.: 10170
Client I.D.: DELTA ENVIRONMENTAL CONSULTANT 96-015/HB FULLER
Sampled by: Client GP-4 1200H 10/23/96

ULI I.D.: 29996122 Matrix: Water

	PARAMETERS	RESULTS	KEY	FILE#
	BOD5	52mg/l		WB4962
	MBAS	4.0mg/lLAS		WB4969
	TRC	0.04mg/lCl2		WB4955
	Total Alkalinity	3300mg/lCaCO3		WB5097
	Chloride	400mg/l		WB4983
	COD	74mg/l		WB5020
	Free Residual Chlorine	0.02mg/lCl2		WB4956
	Nitrate-Nitrite Nitrogen	0.3mg/l		WB4970
	Ammonia-Nitrogen	7.7mg/l		WB5090
	Sulfide	<0.1mg/l		WB4991
	Sulfate	250mg/l		WB5034
	Total Dissolved Solids	4600mg/l		WB4997
	TOC	140mg/l		WB5011
Total	Iron	3.2mg/l		MA7079
Total	Sodium	1600mg/l		MA7099
	TCL Volatiles by EPA Method 8240			
	Chloromethane	<50ug/l	05	SC0001
	Bromomethane	<50ug/l	05	SC0001
	Vinyl Chloride	<10ug/l	05	SC0001
	Chloroethane	<50ug/l	05	SC0001
	Methylene Chloride	<10ug/l	05	SC0001
	Acetone	60ug/l		SC0001
	Carbon Disulfide	<10ug/l	05	SC0001
	1,1-Dichloroethene	<10ug/l	05	SC0001
	1,1-Dichloroethane	<10ug/l	05	SC0001
	trans-1,2-Dichloroethene	<10ug/l	05	SC0001
	cis-1,2-Dichloroethene	<10ug/l	05	SC0001
	Chloroform	<10ug/l	05	SC0001
	1,2-Dichloroethane	<10ug/l	05	SC0001
	2-Butanone	<50ug/l	05	SC0001
	1,1,1-Trichloroethane	<10ug/l	05	SC0001
	Carbon Tetrachloride	<10ug/l	05	SC0001
	Bromodichloromethane	<10ug/l	05	SC0001
	1,2-Dichloropropane	<10ug/l	05	SC0001
	cis-1,3-Dichloropropene	<10ug/l	05	SC0001
	Trichloroethene	<10ug/l	05	SC0001
	Dibromochloromethane	<10ug/l	05	SC0001
	1,1,2-Trichloroethane	<10ug/l	05	SC0001
	Benzene	<10ug/l	05	SC0001
	trans-1,3-Dichloropropene	<10ug/l	05	SC0001

DATE: 11/22/96

Upstate Laboratories, Inc.
Analysis Results
Report Number: 29996116
Client I.D.: DELTA ENVIRONMENTAL CONSULTANT 96-015/HB FULLER
Sampled by: Client

APPROVAL:
QC:
Lab I.D.: 10170

GP-4 1200H 10/23/96

ULI I.D.: 29996122 Matrix: Water

PARAMETERS	RESULTS	KEY	FILE#
Bromoform	<10ug/l	05	SC0001
4-Methyl-2-pentanone	70ug/l		SC0001
2-Hexanone	<50ug/l	05	SC0001
Tetrachloroethene	<10ug/l	05	SC0001
1,1,2,2-Tetrachloroethane	<10ug/l	05	SC0001
Toluene	<10ug/l	05	SC0001
Chlorobenzene	<10ug/l	05	SC0001
Ethylbenzene	<10ug/l	05	SC0001
Styrene	<10ug/l	05	SC0001
m-Xylene and p-Xylene	<10ug/l	05	SC0001
o-Xylene	<10ug/l	05	SC0001

DATE: 11/22/96

Upstate Laboratories, Inc.
Analysis Results
Report Number: 29996116
Client I.D.: DELTA ENVIRONMENTAL CONSULTANT 96-015/HB FULLER
Sampled by: Client

APPROVAL:
QC:
Lab I.D.: 10170

GP-6 0930H 10/24/96

ULI I.D.: 29996123 Matrix: Water

PARAMETERS	RESULTS	KEY	FILE#
BOD5	1400mg/l		WB4962
MBAS	3.3mg/lLAS		WB4969
TRC	<0.1mg/lCl2	01	WB4955
Total Alkalinity	9200mg/lCaCO3		WB5124
Chloride	1100mg/l		WB4983
COD	6800mg/l		WB5122
Free Residual Chlorine	<0.1mg/lCl2	01	WB4956
Nitrate-Nitrite Nitrogen	12mg/l		WB4970
Ammonia-Nitrogen	51mg/l		WB5083
Sulfide	0.1mg/l		WB4991
Sulfate	1500mg/l		WB5034
Total Dissolved Solids	19,000mg/l		WB4997
TOC	1600mg/l		WB5011
Total Iron	36mg/l		MA7079
Total Sodium	5700mg/l		MA7139

TCL Volatiles by EPA Method 8240

PARAMETERS	RESULTS	KEY	FILE#
Chloromethane	<500ug/l	05	SC0001
Bromomethane	<500ug/l	05	SC0001
Vinyl Chloride	<100ug/l	05	SC0001
Chloroethane	<500ug/l	05	SC0001
Methylene Chloride	<100ug/l	05	SC0001
Acetone	750ug/l		SC0001
Carbon Disulfide	<100ug/l	05	SC0001
1,1-Dichloroethene	<100ug/l	05	SC0001
1,1-Dichloroethane	<100ug/l	05	SC0001
trans-1,2-Dichloroethene	<100ug/l	05	SC0001
cis-1,2-Dichloroethene	<100ug/l	05	SC0001
Chloroform	<100ug/l	05	SC0001
1,2-Dichloroethane	<100ug/l	05	SC0001
2-Butanone	<500ug/l	05	SC0001
1,1,1-Trichloroethane	<100ug/l	05	SC0001
Carbon Tetrachloride	<100ug/l	05	SC0001
Bromodichloromethane	<100ug/l	05	SC0001
1,2-Dichloropropane	<100ug/l	05	SC0001
cis-1,3-Dichloropropene	<100ug/l	05	SC0001
Trichloroethene	<100ug/l	05	SC0001
Dibromochloromethane	<100ug/l	05	SC0001
1,1,2-Trichloroethane	<100ug/l	05	SC0001
Benzene	<100ug/l	05	SC0001
trans-1,3-Dichloropropene	<100ug/l	05	SC0001

DATE: 11/22/96

Upstate Laboratories, Inc.
Analysis Results
Report Number: 29996116
Client I.D.: DELTA ENVIRONMENTAL CONSULTANT 96-015/HB FULLER
Sampled by: Client

APPROVAL:
QC:
Lab I.D.: 10170

GP-6 0930H 10/24/96

ULI I.D.: 29996123 Matrix: Water

PARAMETERS	RESULTS	KEY	FILE#
Bromoform	<100ug/l	05	SC0001
4-Methyl-2-pentanone	<500ug/l	05	SC0001
2-Hexanone	<500ug/l	05	SC0001
Tetrachloroethene	<100ug/l	05	SC0001
1,1,2,2-Tetrachloroethane	<100ug/l	05	SC0001
Toluene	<100ug/l	05	SC0001
Chlorobenzene	<100ug/l	05	SC0001
Ethylbenzene	<100ug/l	05	SC0001
Styrene	<100ug/l	05	SC0001
m-Xylene and p-Xylene	<100ug/l	05	SC0001
o-Xylene	<100ug/l	05	SC0001

DATE: 11/22/96

Upstate Laboratories, Inc.
Analysis Results
Report Number: 29996116
Client I.D.: DELTA ENVIRONMENTAL CONSULTANT 96-015/HB FULLER
Sampled by: Client

APPROVAL:
QC:
Lab I.D.: 10170

GP-8 1359H 10/23/96

ULI I.D.: 29996124　　Matrix: Water

	PARAMETERS	RESULTS	KEY	FILE#
	BOD5	42mg/l		WB4962
	MBAS	0.96mg/lLAS		WB4969
	TRC	0.02mg/lCl2		WB4955
	Total Alkalinity	2300mg/lCaCO3		WB5097
	Chloride	630mg/l		WB4983
	COD	240mg/l		WB5092
	Free Residual Chlorine	<0.02mg/lCl2		WB4956
	Nitrate-Nitrite Nitrogen	<0.2mg/l		WB4970
	Ammonia-Nitrogen	8.3mg/l		WB5083
	Sulfide	<0.1mg/l		WB4991
	Sulfate	310mg/l		WB5034
	Total Dissolved Solids	4200mg/l		WB4997
	TOC	90mg/l		WB5011
Total	Iron	3.4mg/l		MA7079
Total	Sodium	1200mg/l		MA7099

TCL Volatiles by EPA Method 8240

TCL Volatiles by EPA Method 8240	RESULTS	FILE#
Chloromethane	<5ug/l	SC0001
Bromomethane	<5ug/l	SC0001
Vinyl Chloride	<3ug/l	SC0001
Chloroethane	<5ug/l	SC0001
Methylene Chloride	3ug/l	SC0001
Acetone	130ug/l	SC0001
Carbon Disulfide	<3ug/l	SC0001
1,1-Dichloroethene	<3ug/l	SC0001
1,1-Dichloroethane	5ug/l	SC0001
trans-1,2-Dichloroethene	<3ug/l	SC0001
cis-1,2-Dichloroethene	<3ug/l	SC0001
Chloroform	3ug/l	SC0001
1,2-Dichloroethane	<3ug/l	SC0001
2-Butanone	<5ug/l	SC0001
1,1,1-Trichloroethane	<3ug/l	SC0001
Carbon Tetrachloride	<3ug/l	SC0001
Bromodichloromethane	<3ug/l	SC0001
1,2-Dichloropropane	<3ug/l	SC0001
cis-1,3-Dichloropropene	<3ug/l	SC0001
Trichloroethene	<3ug/l	SC0001
Dibromochloromethane	<3ug/l	SC0001
1,1,2-Trichloroethane	<3ug/l	SC0001
Benzene	<3ug/l	SC0001
trans-1,3-Dichloropropene	<3ug/l	SC0001

DATE: 11/22/96

Upstate Laboratories, Inc.
Analysis Results
Report Number: 29996116
Client I.D.: DELTA ENVIRONMENTAL CONSULTANT 96-015/HB FULLER
Sampled by: Client

APPROVAL:
QC:
Lab I.D.: 10170

GP-8 1359H 10/23/96

ULI I.D.: 29996124   Matrix: Water

PARAMETERS	RESULTS	KEY	FILE#
Bromoform	<3ug/l		SC0001
4-Methyl-2-pentanone	<5ug/l		SC0001
2-Hexanone	<5ug/l		SC0001
Tetrachloroethene	<3ug/l		SC0001
1,1,2,2-Tetrachloroethane	<3ug/l		SC0001
Toluene	<3ug/l		SC0001
Chlorobenzene	<3ug/l		SC0001
Ethylbenzene	<3ug/l		SC0001
Styrene	<3ug/l		SC0001
m-Xylene and p-Xylene	<3ug/l		SC0001
o-Xylene	<3ug/l		SC0001

DATE: 11/22/96

Upstate Laboratories, Inc.
Analysis Results
Report Number: 29996116

APPROVAL:
QC:
Lab I.D.: 10170

Client I.D.: DELTA ENVIRONMENTAL CONSULTANT 96-015/HB FULLER
Sampled by: Client GP-9 1930H 10/23/96

ULI I.D.: 29996125 Matrix: Water

PARAMETERS	RESULTS	KEY	FILE#
BOD5	160mg/l		WB4962
MBAS	5.0mg/lLAS		WB4969
TRC	0.04mg/lCl2		WB4955
Total Alkalinity	2400mg/lCaCO3		WB5097
Chloride	270mg/l		WB4983
COD	470mg/l		WB5092
Free Residual Chlorine	0.03mg/lCl2		WB4956
Nitrate-Nitrite Nitrogen	<0.2mg/l		WB4970
Ammonia-Nitrogen	17mg/l		WB5090
Sulfide	<0.1mg/l		WB4991
Sulfate	9mg/l		WB5034
Total Dissolved Solids	5300mg/l		WB4997
TOC	190mg/l		WB5011
Total Iron	3.3mg/l		MA7079
Total Sodium	1000mg/l		MA7099

TCL Volatiles by EPA Method 8240

Chloromethane	<100ug/l	05	SC0001
Bromomethane	<100ug/l	05	SC0001
Vinyl Chloride	<20ug/l	05	SC0001
Chloroethane	<100ug/l	05	SC0001
Methylene Chloride	<20ug/l	05	SC0001
Acetone	560ug/l		SC0001
Carbon Disulfide	<20ug/l	05	SC0001
1,1-Dichloroethene	<20ug/l	05	SC0001
1,1-Dichloroethane	<20ug/l	05	SC0001
trans-1,2-Dichloroethene	<20ug/l	05	SC0001
cis-1,2-Dichloroethene	<20ug/l	05	SC0001
Chloroform	<20ug/l	05	SC0001
1,2-Dichloroethane	<20ug/l	05	SC0001
2-Butanone	<100ug/l	05	SC0001
1,1,1-Trichloroethane	<20ug/l	05	SC0001
Carbon Tetrachloride	<20ug/l	05	SC0001
Bromodichloromethane	<20ug/l	05	SC0001
1,2-Dichloropropane	<20ug/l	05	SC0001
cis-1,3-Dichloropropene	<20ug/l	05	SC0001
Trichloroethene	<20ug/l	05	SC0001
Dibromochloromethane	<20ug/l	05	SC0001
1,1,2-Trichloroethane	<20ug/l	05	SC0001
Benzene	<20ug/l	05	SC0001
trans-1,3-Dichloropropene	<20ug/l	05	SC0001

DATE: 11/22/96

Upstate Laboratories, Inc.
Analysis Results
Report Number: 29996116
Client I.D.: DELTA ENVIRONMENTAL CONSULTANT 96-015/HB FULLER
Sampled by: Client

APPROVAL:
QC:
Lab I.D.: 10170

GP-9 1930H 10/23/96

ULI I.D.: 29996125 Matrix: Water

PARAMETERS	RESULTS	KEY	FILE#
Bromoform	<20ug/l	05	SC0001
4-Methyl-2-pentanone	<100ug/l	05	SC0001
2-Hexanone	<100ug/l	05	SC0001
Tetrachloroethene	<20ug/l	05	SC0001
1,1,2,2-Tetrachloroethane	<20ug/l	05	SC0001
Toluene	<20ug/l	05	SC0001
Chlorobenzene	<20ug/l	05	SC0001
Ethylbenzene	<20ug/l	05	SC0001
Styrene	<20ug/l	05	SC0001
m-Xylene and p-Xylene	<20ug/l	05	SC0001
o-Xylene	<20ug/l	05	SC0001

DATE: 11/22/96

Upstate Laboratories, Inc.
Analysis Results
Report Number: 29996116
Client I.D.: DELTA ENVIRONMENTAL CONSULTANT 96-015/HB FULLER
Sampled by: Client

APPROVAL:
QC:
Lab I.D.: 10170

FIELD 10/24/96

ULI I.D.: 29996126   Matrix: Water

PARAMETERS	RESULTS	KEY	FILE#
TCL Volatiles by EPA Method 8240			
Chloromethane	<5ug/l		SC0001
Bromomethane	<5ug/l		SC0001
Vinyl Chloride	<3ug/l		SC0001
Chloroethane	<5ug/l		SC0001
Methylene Chloride	<3ug/l		SC0001
Acetone	<5ug/l		SC0001
Carbon Disulfide	<3ug/l		SC0001
1,1-Dichloroethene	<3ug/l		SC0001
1,1-Dichloroethane	<3ug/l		SC0001
trans-1,2-Dichloroethene	<3ug/l		SC0001
cis-1,2-Dichloroethene	<3ug/l		SC0001
Chloroform	<3ug/l		SC0001
1,2-Dichloroethane	<3ug/l		SC0001
2-Butanone	<5ug/l		SC0001
1,1,1-Trichloroethane	<3ug/l		SC0001
Carbon Tetrachloride	<3ug/l		SC0001
Bromodichloromethane	<3ug/l		SC0001
1,2-Dichloropropane	<3ug/l		SC0001
cis-1,3-Dichloropropene	<3ug/l		SC0001
Trichloroethene	<3ug/l		SC0001
Dibromochloromethane	<3ug/l		SC0001
1,1,2-Trichloroethane	<3ug/l		SC0001
Benzene	<3ug/l		SC0001
trans-1,3-Dichloropropene	<3ug/l		SC0001
Bromoform	<3ug/l		SC0001
4-Methyl-2-pentanone	<5ug/l		SC0001
2-Hexanone	<5ug/l		SC0001
Tetrachloroethene	<3ug/l		SC0001
1,1,2,2-Tetrachloroethane	<3ug/l		SC0001
Toluene	<3ug/l		SC0001
Chlorobenzene	<3ug/l		SC0001
Ethylbenzene	<3ug/l		SC0001
Styrene	<3ug/l		SC0001
m-Xylene and p-Xylene	<3ug/l		SC0001
o-Xylene	<3ug/l		SC0001

DATE: 11/22/96

Upstate Laboratories, Inc. APPROVAL:
Analysis Results QC:
Report Number: 29996116 Lab I.D.: 10170
Client I.D.: DELTA ENVIRONMENTAL CONSULTANT 96-015/HB FULLER
Sampled by: Client ULI TRIP BLANK 10/24/96

ULI I.D.: 29996127 Matrix: Water

PARAMETERS	RESULTS	KEY	FILE#
TCL Volatiles by EPA Method 8240			
Chloromethane	<5ug/l		SC0001
Bromomethane	<5ug/l		SC0001
Vinyl Chloride	<3ug/l		SC0001
Chloroethane	<5ug/l		SC0001
Methylene Chloride	<3ug/l		SC0001
Acetone	<5ug/l		SC0001
Carbon Disulfide	<3ug/l		SC0001
1,1-Dichloroethene	<3ug/l		SC0001
1,1-Dichloroethane	<3ug/l		SC0001
trans-1,2-Dichloroethene	<3ug/l		SC0001
cis-1,2-Dichloroethene	<3ug/l		SC0001
Chloroform	<3ug/l		SC0001
1,2-Dichloroethane	<3ug/l		SC0001
2-Butanone	<5ug/l		SC0001
1,1,1-Trichloroethane	<3ug/l		SC0001
Carbon Tetrachloride	<3ug/l		SC0001
Bromodichloromethane	<3ug/l		SC0001
1,2-Dichloropropane	<3ug/l		SC0001
cis-1,3-Dichloropropene	<3ug/l		SC0001
Trichloroethene	<3ug/l		SC0001
Dibromochloromethane	<3ug/l		SC0001
1,1,2-Trichloroethane	<3ug/l		SC0001
Benzene	<3ug/l		SC0001
trans-1,3-Dichloropropene	<3ug/l		SC0001
Bromoform	<3ug/l		SC0001
4-Methyl-2-pentanone	<5ug/l		SC0001
2-Hexanone	<5ug/l		SC0001
Tetrachloroethene	<3ug/l		SC0001
1,1,2,2-Tetrachloroethane	<3ug/l		SC0001
Toluene	<3ug/l		SC0001
Chlorobenzene	<3ug/l		SC0001
Ethylbenzene	<3ug/l		SC0001
Styrene	<3ug/l		SC0001
m-Xylene and p-Xylene	<3ug/l		SC0001
o-Xylene	<3ug/l		SC0001

KEY PAGE

1 MATRIX INTERFERENCE PRECLUDES LOWER DETECTION LIMITS
2 MATRIX INTERFERENCE
3 PRESENT IN BLANK
4 ANALYSIS NOT PERFORMED BECAUSE OF INSUFFICIENT SAMPLE
5 THE PRESENCE OF OTHER TARGET ANALYTE(S) PRECLUDES LOWER DETECTION LIMITS
6 BLANK CORRECTED
7 HEAD SPACE PRESENT IN SAMPLE
8 QUANTITATION LIMIT IS GREATER THAN THE CALCULATED REGULATORY LEVEL. THE QUANTITATION LIMIT THEREFORE BECOMES THE REGULATORY LEVEL.
9 THE OIL WAS TREATED AS A SOLID AND LEACHED WITH EXTRACTION FLUID
10 ADL(AVERAGE DETECTION LIMITS)
11 PQL(PRACTICAL QUANTITATION LIMITS)
12 SAMPLE ANALYZED OVER HOLDING TIME
13 DISSOLVED VALUE MAY BE HIGHER THAN TOTAL DUE TO CONTAMINATION FROM THE FILTERING PROCEDURE
14 SAMPLED BY ULI
15 DISSOLVED VALUE MAY BE HIGHER THAN TOTAL; HOWEVER, THE VALUES ARE WITHIN EXPERIMENTAL ERROR
16 AN INHIBITORY FACTOR WAS OBSERVED IN THIS ANALYSIS
17 PARAMETER NOT ANALYZED WITHIN 15 MINUTES OF SAMPLING
18 DEPENDING UPON THE INTENDED USE OF THIS TEST RESULT, CONFIRMATION BY GC/MS OR DUAL COLUMN CHROMATOGRAPHY MAY BE REQUIRED
19 CALCULATION BASED ON DRY WEIGHT
20 INDICATES AN ESTIMATED VALUE, DETECTED BUT BELOW THE PRACTICAL QUANTITATION LIMITS
21 UG/KG AS REC.D / UG/KG DRY WT
22 MG/KG AS REC.D / MG/KG DRY WT
23 INSUFFICIENT SAMPLE PRECLUDES LOWER DETECTION LIMITS
24 SAMPLE DILUTED/BLANK CORRECTED
25 ND(NON-DETECTED)
26 MATRIX INTERFERENCE PRECLUDES LOWER DETECTION LIMITS/BLANK CORRECTED
27 SPIKE RECOVERY ABNORMALLY HIGH/LOW DUE TO MATRIX INTERFERENCE
28 POST-DIGESTION SPIKE FOR FURNACE AA ANALYSIS IS OUTSIDE OF THE CONTROL LIMITS (85-115%); HOWEVER, THE SAMPLE CONCENTRATION IS BELOW THE PQL
29 ANALYZED BY METHOD OF STANDARD ADDITIONS
30 METHOD PERFORMANCE STUDY HAS NOT BEEN COMPLETED/ND(NON-DETECTED)
31 FIELD MEASURED PARAMETER TAKEN BY CLIENT
32 TARGET ANALYTE IS BIODEGRADED AND/OR ENVIRONMENTALLY WEATHERED
33 NON-POTABLE WATER SOURCE
34 THE QUALITY CONTROL RESULTS FOR THIS ANALYSIS INDICATE A POSITIVE BIAS OF 1-5 MG/L. THE POSITIVE BIAS FALLS BELOW THE PUBLISHED EPA REGULATORY DETECTION LIMIT OF 5 MG/L BUT ABOVE 1 MG/L.
35 THE HYDROCARBONS DETECTED IN THE SAMPLE DID NOT CROSS-MATCH WITH COMMON PETROLEUM DISTILLATES
36 MATRIX INTERFERENCE CAUSING SPIKES TO RESULT IN LESS THAN 50.0% RECOVERY
37 MILLIGRAMS PER LITER (MG/L) / POUNDS (LBS) PER DAY
38 MILLIGRAMS PER LITER (MG/L) OF RESIDUAL CHLORINE (CL2) / POUNDS (LBS) PER DAY OF CL2
39 MICROGRAMS PER LITER (UG/L) / POUNDS (LBS) PER DAY
40 MILLIGRAMS PER LITER (MG/L) LINEAR ALKYL SULFONATE (LAS) / POUNDS (LBS) PER DAY LAS
41 RESULTS ARE REPORTED ON AN AS REC.D BASIS
42 THE SAMPLE WAS ANALYZED ON A TOTAL BASIS; THE TEST RESULT CAN BE COMPARED TO THE TCLP REGULATORY CRITERIA BY DIVIDING THE TEST RESULT BY 20, CREATING A THEORETICAL TCLP VALUE
43 METAL BY CONCENTRATION PROCEDURE
44 POSSIBLE CONTAMINATION FROM FIELD/LABORATORY

Upstate Laboratories, Inc.

6034 Corporate Drive • E. Syracuse, NY 13057-1017
(315) 437 0255   Fax 437 1209

Chain Of Custody Record

Lee Cutler
11/8

Client:	Client Project # / Project Name
DElta Environmental	96-015 / HB Fuller

Client Contact:	Phone #	Site Location (city/state)
Steve Zbur	4124877700 fax 4879785	Geneva, NY

Sample Location:	Date	Time	Matrix	Grab or Comp.	ULI Internal Use Only	No. of Containers	1)	2)	3)	4)	5)	6)	7)	8)	9)	10)	Remarks
MW-1	10/22/96	14:00	water		~~29996025~~ 116	9 HD	I	I	I	I	I	I	I	2			only enough
MW-2	↓	17:43	↓		~~26~~ 117	9	I	I	I	I	I	I	I	2			sample from GP-9 &
MW-3	↓	15:53	↓		~~27~~ 118	9	I	I	I	I	I	I	I	2			GP-6 for one ½ gallon
MW-4	↓	12:33	↓		~~28~~ 119	9	I	I	I	I	I	I	I	2			container for MBAS + ✱1
MW-5	↓	10:31	↓		~~29~~ 120	9	I	I	I	I	I	I	I	2			
GP-2	10/23/96	10:00	↓		~~30~~ 121	9	I	I	I	I	I	I	I	2			formaction
GP-4	↓	12:00	↓		~~31~~ 122	9	I	I	I	I	I	I	I	2			(both MBAS & formaction ✱1
GP-6	10/24/96	9:30	↓		~~32~~ 123	8	I	(x)	I	I	I	I	I	2			can be taken from large ½
GP-8	10/23/96	13:59	↓		~~33~~ 124	9	I	I	I	I	I	I	I	2			gal. container follow chain only)
GP-9	↓	19:30	↓		~~34~~ 125	8	(x)	I	I	I	I	I	I	2			MBAS sample ½ full—well dry no bottle enough

Parameter and method	sample bottle: type	size	pres.
1) BOD5, TDS, SO4, Cl⁻, TLCl⁻, Chlorine (TRC) + FRC)			
2) MBAS			
3) NO3⁻ NO2⁻, NH3, COD			
4) T-Fe, Na			
5) alkalinity			
6) TOC			
7) Sulfide			
8) VOA (8240) ck			
9)			
10)			

Note: The numbered columns above cross-reference with the numbered columns in the upper right-hand corner.

Sampled by: (Please Print) Richard P Mazurkiewicz

Company: DELTA

ULI Internal Use Only
Delivery (check one):
☐ ULI Sampled
☐ Pickup ☐ Dropoff
☐ CC ______

Relinquished by: (Signature)	Date	Time	Received by: (Signature)
[signature]	10/24/96	11:00	[signature]
[signature]	10/24/96	4:15 pm	
Relinquished by: (Signature)	Date 10/24/96	Time 1630	Rec'd for Lab by: (Signature) Heather Dore

Syracuse   Rochester   Buffalo   Albany   Binghamton   Fair Lawn (NJ)

Upstate Laboratories, Inc.
6034 Corporate Drive • E. Syracuse, NY 13057-1017
(315) 437 0255 Fax 437 1209

Chain Of Custody Record

11|8

Client: Delta Env.

Client Project # / Project Name: 96-015/HB Fuller

Client Contact:

Phone #:

Site Location (city/state):

Special Turnaround Time______ (Lab Notification required)

Sample Location:	Date	Time	Matrix	Grab or Comp.	ULI Internal Use Only	No. of Containers	1)	2)	3)	4)	5)	6)	7)	8)	9)	10)	Remarks
Field	(10/24/96)		(W)		29996126	2	X										
ULI TRIP BLANK	↓		↓		127	1	X										

parameter and method	sample bottle: type	size	pres.
1) 8240			
2)			
3)			
4)			
5)			
6)			
7)			
8)			
9)			
10)			

Note: The numbered columns above cross-reference with the numbered columns in the upper right-hand corner.

Sampled by: (Please Print)

Company:

ULI Internal Use Only
Delivery (check one):
☐ ULI Sampled
☒ Pickup ☐ Dropoff
☐ CC ______

Relinquished by: (Signature)	Date	Time	Received by: (Signature)
	10/24/96	2 30 pm	[signature]
[signature]	10/24/96	430 pm	

Relinquished by: (Signature)	Date	Time	Rec'd for Lab by: (Signature)
	10/24/96	1630	CKinney

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AUG 15 1997

Upstate Laboratories inc.

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New Jersey (201) 703-1324

August 12, 1997

Mr. Bob Botterman
Delta Environmental Consultants
4068 Mt. Royal Blvd.
Suite 225 - Gamma
Allison Park, PA 15101

Re: Analysis Report #20297001 - S096015

Dear Mr. Botterman:

Please find enclosed the results for your samples which were collected by ULI personnel on July 18 and 21, 1997.

We have included the Chain of Custody Record as part of your report. You may need to reference this form for a more detailed explanation of your sample. Samples will be disposed of approximately one month from final report date.

Should you have any questions, please feel free to give us a call.

Thank you for your patronage.

Sincerely,

UPSTATE LABORATORIES, INC.

Anthony J. Scala

Anthony J. Scala
Director

AJS/jk

Enclosures: report, field data, invoice

cc/encs: N. Scala, ULI
file

Note: Faxed results were given to your office on 8/8/97. AJS

Disclaimer: The test results and procedures utilized, and laboratory interpretations of data obtained by ULI as contained in this report are believed by ULI to be accurate and reliable for sample(s) tested. In accepting this report, the customer agrees that the full extent of any and all liability for actual and consequential damages of ULI for the services performed shall be equal to the fee charged to the customer for the services as liquidated damages.

DATE: 08/12/97

Upstate Laboratories, Inc. APPROVAL: ajs
Analysis Results QC: PF
Report Number: 20297001 Lab I.D.: 10170
Client I.D.: DELTA ENVIRONMENTAL CONSULTANT S096015
Sampled by: ULI MW-1 1145H 07/18/97 G

ULI I.D.: 20297001 Matrix: Water

PARAMETERS	RESULTS	KEY	FILE#
MBAS	<0.05mg/lLAS		WB8168
TCL Volatiles by EPA Method 8240			
Chloromethane	<3ug/l		VM1544
Bromomethane	<3ug/l		VM1544
Vinyl Chloride	<2ug/l		VM1544
Chloroethane	<3ug/l		VM1544
Methylene Chloride	<3ug/l		VM1544
Acetone	<10ug/l		VM1544
Carbon Disulfide	<3ug/l		VM1544
1,1-Dichloroethene	<3ug/l		VM1544
1,1-Dichloroethane	<3ug/l		VM1544
trans-1,2-Dichloroethene	<3ug/l		VM1544
cis-1,2-Dichloroethene	9ug/l		VM1544
Chloroform	<3ug/l		VM1544
1,2-Dichloroethane	<3ug/l		VM1544
2-Butanone	<10ug/l		VM1544
1,1,1-Trichloroethane	<3ug/l		VM1544
Carbon Tetrachloride	<3ug/l		VM1544
Bromodichloromethane	<3ug/l		VM1544
1,2-Dichloropropane	<3ug/l		VM1544
cis-1,3-Dichloropropene	<3ug/l		VM1544
Trichloroethene	<3ug/l		VM1544
Dibromochloromethane	<3ug/l		VM1544
1,1,2-Trichloroethane	<3ug/l		VM1544
Benzene	<3ug/l		VM1544
trans-1,3-Dichloropropene	<3ug/l		VM1544
Bromoform	<3ug/l		VM1544
4-Methyl-2-pentanone	<10ug/l		VM1544
2-Hexanone	<10ug/l		VM1544
Tetrachloroethene	3ug/l		VM1544
1,1,2,2-Tetrachloroethane	<3ug/l		VM1544
Toluene	<3ug/l		VM1544
Chlorobenzene	<3ug/l		VM1544
Ethylbenzene	42ug/l		VM1544
Styrene	<3ug/l		VM1544
m-Xylene and p-Xylene	<3ug/l		VM1544
o-Xylene	<3ug/l		VM1544

DATE: 08/12/97

Upstate Laboratories, Inc.
Analysis Results
Report Number: 20297001
Client I.D.: DELTA ENVIRONMENTAL CONSULTANT S096015
Sampled by: ULI

APPROVAL: QJS
QC: PR
Lab I.D.: 10170
MW-6 1445H 07/18/97 G

ULI I.D.: 20297002 Matrix: Water

PARAMETERS	RESULTS	KEY	FILE#
MBAS	<0.05mg/lLAS		WB8168
TCL Volatiles by EPA Method 8240			
Chloromethane	<3ug/l		VM1544
Bromomethane	<3ug/l		VM1544
Vinyl Chloride	<2ug/l		VM1544
Chloroethane	<3ug/l		VM1544
Methylene Chloride	<3ug/l		VM1544
Acetone	<10ug/l		VM1544
Carbon Disulfide	<3ug/l		VM1544
1,1-Dichloroethene	<3ug/l		VM1544
1,1-Dichloroethane	<3ug/l		VM1544
trans-1,2-Dichloroethene	<3ug/l		VM1544
cis-1,2-Dichloroethene	<3ug/l		VM1544
Chloroform	<3ug/l		VM1544
1,2-Dichloroethane	<3ug/l		VM1544
2-Butanone	<10ug/l		VM1544
1,1,1-Trichloroethane	<3ug/l		VM1544
Carbon Tetrachloride	<3ug/l		VM1544
Bromodichloromethane	<3ug/l		VM1544
1,2-Dichloropropane	<3ug/l		VM1544
cis-1,3-Dichloropropene	<3ug/l		VM1544
Trichloroethene	<3ug/l		VM1544
Dibromochloromethane	<3ug/l		VM1544
1,1,2-Trichloroethane	<3ug/l		VM1544
Benzene	<3ug/l		VM1544
trans-1,3-Dichloropropene	<3ug/l		VM1544
Bromoform	<3ug/l		VM1544
4-Methyl-2-pentanone	<10ug/l		VM1544
2-Hexanone	<10ug/l		VM1544
Tetrachloroethene	<3ug/l		VM1544
1,1,2,2-Tetrachloroethane	<3ug/l		VM1544
Toluene	<3ug/l		VM1544
Chlorobenzene	<3ug/l		VM1544
Ethylbenzene	<3ug/l		VM1544
Styrene	<3ug/l		VM1544
m-Xylene and p-Xylene	<3ug/l		VM1544
o-Xylene	<3ug/l		VM1544

DATE: 08/12/97

Upstate Laboratories, Inc.
Analysis Results
Report Number: 20297001
Client I.D.: DELTA ENVIRONMENTAL CONSULTANT S096015
Sampled by: ULI

APPROVAL: QJS
QC: PF
Lab I.D.: 10170

MW-7 1045H 07/18/97 G

ULI I.D.: 20297003 Matrix: Water

PARAMETERS	RESULTS	KEY	FILE#
MBAS	<0.05mg/lLAS		WB8168
TCL Volatiles by EPA Method 8240			
Chloromethane	<3ug/l		VM1544
Bromomethane	<3ug/l		VM1544
Vinyl Chloride	<2ug/l		VM1544
Chloroethane	<3ug/l		VM1544
Methylene Chloride	<3ug/l		VM1544
Acetone	<10ug/l		VM1544
Carbon Disulfide	<3ug/l		VM1544
1,1-Dichloroethene	<3ug/l		VM1544
1,1-Dichloroethane	<3ug/l		VM1544
trans-1,2-Dichloroethene	<3ug/l		VM1544
cis-1,2-Dichloroethene	<3ug/l		VM1544
Chloroform	<3ug/l		VM1544
1,2-Dichloroethane	<3ug/l		VM1544
2-Butanone	<10ug/l		VM1544
1,1,1-Trichloroethane	<3ug/l		VM1544
Carbon Tetrachloride	<3ug/l		VM1544
Bromodichloromethane	<3ug/l		VM1544
1,2-Dichloropropane	<3ug/l		VM1544
cis-1,3-Dichloropropene	<3ug/l		VM1544
Trichloroethene	<3ug/l		VM1544
Dibromochloromethane	<3ug/l		VM1544
1,1,2-Trichloroethane	<3ug/l		VM1544
Benzene	<3ug/l		VM1544
trans-1,3-Dichloropropene	<3ug/l		VM1544
Bromoform	<3ug/l		VM1544
4-Methyl-2-pentanone	<10ug/l		VM1544
2-Hexanone	<10ug/l		VM1544
Tetrachloroethene	7ug/l		VM1544
1,1,2,2-Tetrachloroethane	<3ug/l		VM1544
Toluene	<3ug/l		VM1544
Chlorobenzene	<3ug/l		VM1544
Ethylbenzene	<3ug/l		VM1544
Styrene	<3ug/l		VM1544
m-Xylene and p-Xylene	<3ug/l		VM1544
o-Xylene	<3ug/l		VM1544

DATE: 08/12/97

Upstate Laboratories, Inc. APPROVAL: QJS
Analysis Results QC: PF
Report Number: 20297001 Lab I.D.: 10170
Client I.D.: DELTA ENVIRONMENTAL CONSULTANT S096015
Sampled by: ULI MW-201 1230H 07/18/97 G

ULI I.D.: 20297004 Matrix: Water

PARAMETERS	RESULTS	KEY	FILE#
MBAS	0.12mg/lLAS		WB8168
TCL Volatiles by EPA Method 8240			
Chloromethane	<3ug/l		VM1544
Bromomethane	<3ug/l		VM1544
Vinyl Chloride	<2ug/l		VM1544
Chloroethane	<3ug/l		VM1544
Methylene Chloride	<3ug/l		VM1544
Acetone	<10ug/l		VM1544
Carbon Disulfide	<3ug/l		VM1544
1,1-Dichloroethene	<3ug/l		VM1544
1,1-Dichloroethane	<3ug/l		VM1544
trans-1,2-Dichloroethene	<3ug/l		VM1544
cis-1,2-Dichloroethene	<3ug/l		VM1544
Chloroform	<3ug/l		VM1544
1,2-Dichloroethane	<3ug/l		VM1544
2-Butanone	<10ug/l		VM1544
1,1,1-Trichloroethane	<3ug/l		VM1544
Carbon Tetrachloride	<3ug/l		VM1544
Bromodichloromethane	<3ug/l		VM1544
1,2-Dichloropropane	<3ug/l		VM1544
cis-1,3-Dichloropropene	<3ug/l		VM1544
Trichloroethene	<3ug/l		VM1544
Dibromochloromethane	<3ug/l		VM1544
1,1,2-Trichloroethane	<3ug/l		VM1544
Benzene	<3ug/l		VM1544
trans-1,3-Dichloropropene	<3ug/l		VM1544
Bromoform	<3ug/l		VM1544
4-Methyl-2-pentanone	<10ug/l		VM1544
2-Hexanone	<10ug/l		VM1544
Tetrachloroethene	<3ug/l		VM1544
1,1,2,2-Tetrachloroethane	<3ug/l		VM1544
Toluene	<3ug/l		VM1544
Chlorobenzene	<3ug/l		VM1544
Ethylbenzene	<3ug/l		VM1544
Styrene	<3ug/l		VM1544
m-Xylene and p-Xylene	<3ug/l		VM1544
o-Xylene	<3ug/l		VM1544

DATE: 08/12/97

Upstate Laboratories, Inc. APPROVAL: GJS
Analysis Results QC: PE
Report Number: 20297001 Lab I.D.: 10170
Client I.D.: DELTA ENVIRONMENTAL CONSULTANT S096015
Sampled by: ULI MW-2 1310H 07/21/97 G

ULI I.D.: 20397005 Matrix: Water

PARAMETERS	RESULTS	KEY	FILE#
Field Alkalinity	1020mg/lCaCO3		FIELD
Field Dissolved Oxygen	3.86mg/l		FIELD
Field Eh	230mV		FIELD
Field Iron	3.2mg/l		FIELD
Field pH	8.2SU		FIELD
Field Specific Conductivity	480umhos/cm		FIELD
Field TRC	<0.1mg/lCl2		FIELD
Static Water Level	9.08'		FIELD
Temperature	14degC		FIELD
MBAS	0.62mg/lLAS		WB8200
TCL Volatiles by EPA Method 8240			
Chloromethane	<3ug/l		VM1548
Bromomethane	<3ug/l		VM1548
Vinyl Chloride	11ug/l		VM1548
Chloroethane	<3ug/l		VM1548
Methylene Chloride	<3ug/l		VM1548
Acetone	<10ug/l		VM1548
Carbon Disulfide	<3ug/l		VM1548
1,1-Dichloroethene	<3ug/l		VM1548
1,1-Dichloroethane	8ug/l		VM1548
trans-1,2-Dichloroethene	<3ug/l		VM1548
cis-1,2-Dichloroethene	15ug/l		VM1548
Chloroform	<3ug/l		VM1548
1,2-Dichloroethane	<3ug/l		VM1548
2-Butanone	<10ug/l		VM1548
1,1,1-Trichloroethane	<3ug/l		VM1548
Carbon Tetrachloride	<3ug/l		VM1548
Bromodichloromethane	<3ug/l		VM1548
1,2-Dichloropropane	<3ug/l		VM1548
cis-1,3-Dichloropropene	<3ug/l		VM1548
Trichloroethene	16ug/l		VM1548
Dibromochloromethane	<3ug/l		VM1548
1,1,2-Trichloroethane	<3ug/l		VM1548
Benzene	<3ug/l		VM1548
trans-1,3-Dichloropropene	<3ug/l		VM1548
Bromoform	<3ug/l		VM1548
4-Methyl-2-pentanone	<10ug/l		VM1548
2-Hexanone	<10ug/l		VM1548
Tetrachloroethene	<3ug/l		VM1548

DATE: 08/12/97

Upstate Laboratories, Inc.
Analysis Results
Report Number: 20297001
Client I.D.: DELTA ENVIRONMENTAL CONSULTANT S096015
Sampled by: ULI

APPROVAL: ajs
QC: PE
Lab I.D.: 10170

MW-2 1310H 07/21/97 G

ULI I.D.: 20397005 Matrix: Water

PARAMETERS	RESULTS	KEY	FILE#
1,1,2,2-Tetrachloroethane	<3ug/l		VM1548
Toluene	<3ug/l		VM1548
Chlorobenzene	<3ug/l		VM1548
Ethylbenzene	<3ug/l		VM1548
Styrene	<3ug/l		VM1548
m-Xylene and p-Xylene	<3ug/l		VM1548
o-Xylene	<3ug/l		VM1548

DATE: 08/12/97

Upstate Laboratories, Inc.
Analysis Results
Report Number: 20297001
Client I.D.: DELTA ENVIRONMENTAL CONSULTANT S096015
Sampled by: ULI

APPROVAL: QJS
QC: PE
Lab I.D.: 10170

MW-8 1235H 07/21/97 G

ULI I.D.: 20397006 Matrix: Water

PARAMETERS	RESULTS	KEY	FILE#
Field Alkalinity	160mg/lCaCO3		FIELD
Field Dissolved Oxygen	6.59mg/l		FIELD
Field Eh	410mV		FIELD
Field Iron	0mg/l		FIELD
Field pH	7.3SU		FIELD
Field Specific Conductivity	520umhos/cm		FIELD
Field TRC	<0.1mg/lCl2		FIELD
Static Water Level	9.43'		FIELD
Temperature	13degC		FIELD
MBAS	<0.05mg/lLAS		WB8200
TCL Volatiles by EPA Method 8240			
Chloromethane	4ug/l		VM1548
Bromomethane	<3ug/l		VM1548
Vinyl Chloride	<2ug/l		VM1548
Chloroethane	<3ug/l		VM1548
Methylene Chloride	<3ug/l		VM1548
Acetone	<10ug/l		VM1548
Carbon Disulfide	<3ug/l		VM1548
1,1-Dichloroethene	<3ug/l		VM1548
1,1-Dichloroethane	<3ug/l		VM1548
trans-1,2-Dichloroethene	<3ug/l		VM1548
cis-1,2-Dichloroethene	<3ug/l		VM1548
Chloroform	<3ug/l		VM1548
1,2-Dichloroethane	<3ug/l		VM1548
2-Butanone	<10ug/l		VM1548
1,1,1-Trichloroethane	<3ug/l		VM1548
Carbon Tetrachloride	<3ug/l		VM1548
Bromodichloromethane	<3ug/l		VM1548
1,2-Dichloropropane	<3ug/l		VM1548
cis-1,3-Dichloropropene	<3ug/l		VM1548
Trichloroethene	<3ug/l		VM1548
Dibromochloromethane	<3ug/l		VM1548
1,1,2-Trichloroethane	<3ug/l		VM1548
Benzene	<3ug/l		VM1548
trans-1,3-Dichloropropene	<3ug/l		VM1548
Bromoform	<3ug/l		VM1548
4-Methyl-2-pentanone	<10ug/l		VM1548
2-Hexanone	<10ug/l		VM1548
Tetrachloroethene	<3ug/l		VM1548

DATE: 08/12/97

Upstate Laboratories, Inc.
Analysis Results
Report Number: 20297001
Client I.D.: DELTA ENVIRONMENTAL CONSULTANT S096015
Sampled by: ULI

APPROVAL: QJS
QC: PF
Lab I.D.: 10170

MW-8 1235H 07/21/97 G

ULI I.D.: 20397006 Matrix: Water

PARAMETERS	RESULTS	KEY	FILE#
1,1,2,2-Tetrachloroethane	<3ug/l		VM1548
Toluene	<3ug/l		VM1548
Chlorobenzene	<3ug/l		VM1548
Ethylbenzene	<3ug/l		VM1548
Styrene	<3ug/l		VM1548
m-Xylene and p-Xylene	<3ug/l		VM1548
o-Xylene	<3ug/l		VM1548

DATE: 08/12/97

Upstate Laboratories, Inc. APPROVAL: QS
Analysis Results QC: PF
Report Number: 20297001 Lab I.D.: 10170
Client I.D.: DELTA ENVIRONMENTAL CONSULTANT S096015
Sampled by: ULI MW-202 1340H 07/21/97 G

ULI I.D.: 20397007 Matrix: Water

PARAMETERS	RESULTS	KEY	FILE#
Field Alkalinity	192mg/lCaCO3		FIELD
Field Dissolved Oxygen	3.72mg/l		FIELD
Field Eh	125mV		FIELD
Field Iron	0.3mg/l		FIELD
Field pH	8.0SU		FIELD
Field Specific Conductivity	620umhos/cm		FIELD
Field TRC	<0.1mg/lCl2		FIELD
Static Water Level	14.43'		FIELD
Temperature	15degC		FIELD
MBAS	<0.05mg/lLAS		WB8200
TCL Volatiles by EPA Method 8240			
Chloromethane	<3ug/l		VM1548
Bromomethane	<3ug/l		VM1548
Vinyl Chloride	<2ug/l		VM1548
Chloroethane	<3ug/l		VM1548
Methylene Chloride	<3ug/l		VM1548
Acetone	<10ug/l		VM1548
Carbon Disulfide	<3ug/l		VM1548
1,1-Dichloroethene	<3ug/l		VM1548
1,1-Dichloroethane	<3ug/l		VM1548
trans-1,2-Dichloroethene	<3ug/l		VM1548
cis-1,2-Dichloroethene	<3ug/l		VM1548
Chloroform	<3ug/l		VM1548
1,2-Dichloroethane	<3ug/l		VM1548
2-Butanone	<10ug/l		VM1548
1,1,1-Trichloroethane	<3ug/l		VM1548
Carbon Tetrachloride	<3ug/l		VM1548
Bromodichloromethane	<3ug/l		VM1548
1,2-Dichloropropane	<3ug/l		VM1548
cis-1,3-Dichloropropene	<3ug/l		VM1548
Trichloroethene	<3ug/l		VM1548
Dibromochloromethane	<3ug/l		VM1548
1,1,2-Trichloroethane	<3ug/l		VM1548
Benzene	<3ug/l		VM1548
trans-1,3-Dichloropropene	<3ug/l		VM1548
Bromoform	<3ug/l		VM1548
4-Methyl-2-pentanone	<10ug/l		VM1548
2-Hexanone	<10ug/l		VM1548
Tetrachloroethene	<3ug/l		VM1548

DATE: 08/12/97

Upstate Laboratories, Inc.
Analysis Results
Report Number: 20297001
Client I.D.: DELTA ENVIRONMENTAL CONSULTANT S096015
Sampled by: ULI

APPROVAL: QJS
QC: PF
Lab I.D.: 10170

MW-202 1340H 07/21/97 G

ULI I.D.: 20397007 Matrix: Water

PARAMETERS	RESULTS	KEY	FILE#
1,1,2,2-Tetrachloroethane	<3ug/l		VM1548
Toluene	<3ug/l		VM1548
Chlorobenzene	<3ug/l		VM1548
Ethylbenzene	<3ug/l		VM1548
Styrene	<3ug/l		VM1548
m-Xylene and p-Xylene	<3ug/l		VM1548
o-Xylene	<3ug/l		VM1548

DATE: 08/12/97

Upstate Laboratories, Inc.
Analysis Results
Report Number: 20297001
Client I.D.: DELTA ENVIRONMENTAL CONSULTANT S096015
Sampled by: ULI

APPROVAL: AJS
QC: PF
Lab I.D.: 10170

MW-203 1300H 07/21/97 G

ULI I.D.: 20397008 Matrix: Water

PARAMETERS	RESULTS	KEY	FILE#
MBAS	<0.05mg/lLAS		WB8200
TCL Volatiles by EPA Method 8240			
Chloromethane	<3ug/l		VM1548
Bromomethane	<3ug/l		VM1548
Vinyl Chloride	<2ug/l		VM1548
Chloroethane	<3ug/l		VM1548
Methylene Chloride	<3ug/l		VM1548
Acetone	11ug/l		VM1548
Carbon Disulfide	<3ug/l		VM1548
1,1-Dichloroethene	<3ug/l		VM1548
1,1-Dichloroethane	<3ug/l		VM1548
trans-1,2-Dichloroethene	<3ug/l		VM1548
cis-1,2-Dichloroethene	<3ug/l		VM1548
Chloroform	<3ug/l		VM1548
1,2-Dichloroethane	<3ug/l		VM1548
2-Butanone	<10ug/l		VM1548
1,1,1-Trichloroethane	<3ug/l		VM1548
Carbon Tetrachloride	<3ug/l		VM1548
Bromodichloromethane	<3ug/l		VM1548
1,2-Dichloropropane	<3ug/l		VM1548
cis-1,3-Dichloropropene	<3ug/l		VM1548
Trichloroethene	<3ug/l		VM1548
Dibromochloromethane	<3ug/l		VM1548
1,1,2-Trichloroethane	<3ug/l		VM1548
Benzene	<3ug/l		VM1548
trans-1,3-Dichloropropene	<3ug/l		VM1548
Bromoform	<3ug/l		VM1548
4-Methyl-2-pentanone	<10ug/l		VM1548
2-Hexanone	<10ug/l		VM1548
Tetrachloroethene	<3ug/l		VM1548
1,1,2,2-Tetrachloroethane	<3ug/l		VM1548
Toluene	<3ug/l		VM1548
Chlorobenzene	<3ug/l		VM1548
Ethylbenzene	<3ug/l		VM1548
Styrene	<3ug/l		VM1548
m-Xylene and p-Xylene	<3ug/l		VM1548
o-Xylene	<3ug/l		VM1548

Groundwater Field Log

File: TS-30-01
Revised: 11/95

Client: DeltA EnviRonmental
Project: S0960015
Well ID: mw-2
ULI ID No. (entered by lab)

Condition of Well: Good
Method of Evacuation: TEFlon Bailer
Method of Sampling: TEFlon Bailer
Locked: yes no
Lock ID: —

<---a--->

top

water level

silt

c. d. e. f

a.	Diameter	2"	inches
b.	Well Depth Measured	14.66	feet
c.	Depth to Water	9.08	feet
d.	Length of Water Column (calculated)	5.58	feet
	Conversion Factor	x.16	-
	Well Volume (calculated)	.89	gallons
	No. of Volumes to be Evacuated	x 3	-
	Total Volume to be Evacuated	2.68	gallons
	Actual Volume Evacuated	Dry @ 2.50	gallons
e.	Installed Well Depth (if known)	N/A	feet
f.	Depth of Silt (calculated)		feet

Field Measurements:	Initial Evacuation	Final Sampling	Units
date	7-21-97	7-21-97	-
time	11 42 Am	1 10 pm	-
EH	N/A	230	mV
temperature		14°C	define
pH		8.2	std. units
specific conductivity		480	umhos/cm
~~turbidity~~ D.O.		3.86	NTU
appearance	Lt. BROWN	BROWN	-

% Recharge:

Initial Depth to Water	9.08	feet
Recharge Depth to Water	12.36	feet
2nd water column height / 1st water column height	41	%

Elevation:

Elevation (Top of Casing) N/A feet
G.W. Elevation = feet
(G.W. Elevation = Top of Casing Elevation − Depth to Water)

Weather: Lt. Rain - 65°F
Observations: PURGED WATER WAS SOAPY AND oily
Iron - 3.2 / TRC - 0 / Alk - 1020

Sampler: Kevin Cahl
Signature:

Groundwater Field Log

Client: DELTA ENVIRONMENTAL

Project: S096015

Well ID: MW-8

ULI ID No. (entered by lab) ______

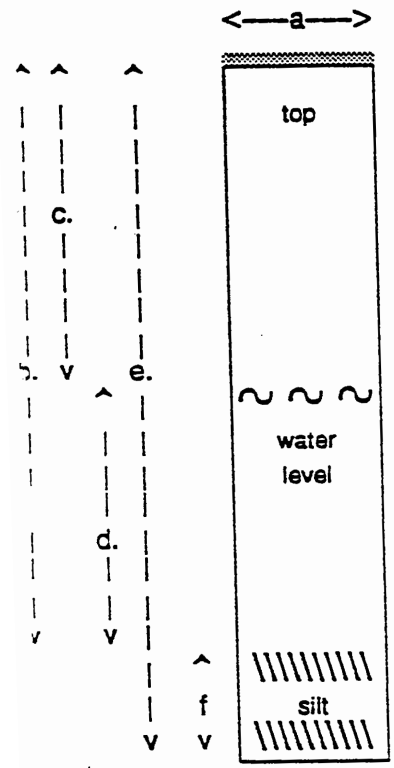
Condition of Well: GOOD

Locked: yes no

Method of Evacuation: TEFLON BAILER

Lock ID: —

Method of Sampling: TEFLON BAILER



a.	Diameter	2"	inches
b.	Well Depth Measured	16.46	feet
c.	Depth to Water	9.43	feet
d.	Length of Water Column (calculated)	7.03	feet
	Conversion Factor	x .16	-
	Well Volume (calculated)	1.12	gallons
	No. of Volumes to be Evacuated	x 3	-
	Total Volume to be Evacuated	3.37	gallons
	Actual Volume Evacuated	dry @ 3.50	gallons
e.	Installed Well Depth (if known)	N/A	feet
f.	Depth of Silt (calculated)	N/A	feet

Field Measurements:

	Initial Evacuation	Final Sampling	Units
date	7-21-97	7-21-97	-
time	11^20 Am	12^35 Pm	-
EH	N/A	410	mV
temperature	N/A	13°C	define
pH	N/A	7.3	std. units
specific conductivity	N/A	520	umhos/cm
~~turbidity~~ D.O.–	N/A	6.59	NTU
appearance	Clear	BROWN	-

% Recharge:

Initial Depth to Water	9.43	feet
Recharge Depth to Water	14.29	feet
2nd water column height / 1st water column height	30	%

Elevation:

Elevation (Top of Casing)	N/A	feet
G.W. Elevation =	N/A	feet

(G.W. Elevation = Top of Casing Elevation – Depth to Water)

Weather: Lt. Rain · 65°F

Observations: IRON-0 / TRC-0 / ALK.-160

Sampler: KEVIN CAHL

Signature: Kevin Cahl

File: TS-30-01

Groundwater Field Log

Revised: 11/95

Client: Delta Environmental

Project: S096015

Well ID: MW-202

ULI ID No. (entered by lab) ______

Condition of Well: Good

Locked: yes no

Method of Evacuation: Teflon Bailer

Lock ID: —

Method of Sampling: Teflon Bailer

a.	Diameter	2"	inches
b.	Well Depth Measured	23.36	feet
c.	Depth to Water	14.43	feet
d.	Length of Water Column (calculated)	8.93	feet
	Conversion Factor	X.16	-
	Well Volume (calculated)	1.43	gallons
	No. of Volumes to be Evacuated	X 3	-
	Total Volume to be Evacuated	4.29	gallons
	Actual Volume Evacuated	Dry @ 2.00	gallons
e.	Installed Well Depth (if known)	N/A	feet
f.	Depth of Silt (calculated)	N/A	feet

Field Measurements:

	Initial Evacuation	Final Sampling	Units
date	7-21-97	7-21-97	-
time	11 45 Am	1 40 pm	-
EH	N/A	125	mV
temperature		15°C	define
pH		8.0	std. units
specific conductivity		620	umhos/cm
~~turbidity~~ D.O. -		3.72	NTU
appearance	Cloudy	Brown	-

% Recharge:

Initial Depth to Water	14.43	feet
Recharge Depth to Water	21.68	feet
2nd water column height / 1st water column height	18	%

Elevation:

Elevation (Top of Casing)	N/A	feet
G.W. Elevation =		feet

(G.W. Elevation = Top of Casing Elevation − Depth to Water)

Weather: Lt. Rain - 65°F

Observations: Iron - .3 / TRC - 0 / Alk - 192

Sampler: Kevin Cahill

Signature: Kevin Cahill

Groundwater Field Log

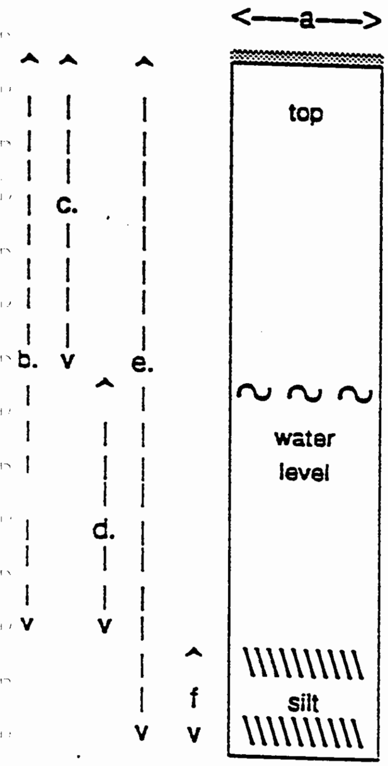
File: TS-30-01
Revised: 11/95

Client: Delta Environmental
Project: S096015
Well ID: MW-203

ULI ID No. (entered by lab)

Condition of Well: GOOD
Method of Evacuation: —
Method of Sampling: TEFLON BAILER

Locked: yes no
Lock ID: —



a.	Diameter	2"	inches
b.	Well Depth Measured	24.00	feet
c.	Depth to Water	22.53	feet
d.	Length of Water Column (calculated)	1.47	feet
	Conversion Factor	x.16	-
	Well Volume (calculated)	.24	gallons
	No. of Volumes to be Evacuated	x 3	-
	Total Volume to be Evacuated	.71	gallons
	Actual Volume Evacuated	N	gallons
e.	Installed Well Depth (if known)		feet
f.	Depth of Silt (calculated)	A	feet

Field Measurements:

	Initial Evacuation	Final Sampling	Units
date	N	7-21-97	-
time		1:09pm	-
EH			mV
temperature		N	define
pH			std. units
specific conductivity		A	umhos/cm
~~turbidity~~ D.O. -			NTU
appearance	A	BROWN	-

% Recharge:

Initial Depth to Water	N	feet
Recharge Depth to Water		feet
2nd water column height / 1st water column height	A	%

Elevation:

Elevation (Top of Casing) N feet
G.W. Elevation = A feet
(G.W. Elevation = Top of Casing Elevation – Depth to Water)

Weather: Lt. RAIN - 65°F

Observations: INSUFFICIENT WATER to PURGE, only SAMPLED. Unable to get Full Sample set AND DO READINGS.

Sampler: KEVIN CAHC

Signature: Kevin Cahill

ps e l bo or , I :.
6034 Corporate Drive • E. Syracuse, NY 13057-1017
(315) 437 0255 Fax 437 1209

Chain Of Custody Record

8|4

Client: Delta Environmental
Client Project # / Project Name: S096015
Client Contact: BOB BOTTERMAN
Phone #: (412) 487-7700
Site Location (city/state): GENEVA, NY

Special Turnaround Time______ (Lab Notification required)

Sample Location:	Date	Time	Matrix	Grab or Comp.	ULI Internal Use Only	No. of Containers	1)	2)	3)	4)	5)	6)	7)	8)	9)	10)	Remarks
mw-1	7/8-97	11 45 Am	H2O	Grab	20297001	3	X	X	X								
mw-6	↓	2 45 pm	↓	↓	2	3	X	X	X								
mw-7	↓	10 45 Am	↓	↓	3	3	X	X	X								
mw-201	7-18-97	12 30 p	H2O	Grab	4	3	X	X	X ok								

parameter and method	sample bottle: type	size	pres.
1) MBAS	Plastic	½ gal.	NONE
2) EPA 8240	Glass	40ml	1:1 HCl
3) ~~FIELD PH, TEMP, EH, COND, TRC, DO, SWL, ALK, IRON~~ ok 8-12-97			
4)			
5)			
6)			
7)			
8)			
9)			
10)			

Note: The numbered columns above cross-reference with the numbered columns in the upper right-hand corner.

Sampled by: (Please Print) KEVIN CARR
Company: U.C.I.

ULI Internal Use Only
Delivery (check one):
☑ ULI Sampled
☐ Pickup ☐ Dropoff
☐ CC ______

Relinquished by: (Signature)	Date	Time	Received by: (Signature)
Relinquished by: (Signature)	Date	Time	Received by: (Signature)
Relinquished by: (Signature)	Date	Time	Received by: (Signature)
Relinquished by: (Signature)	Date	Time	Rec'd for Lab by: (Signature)
Kevin Carr	7/18/97	5 20 pm	H. Dore

Syracuse Rochester Buffalo Albany Binghamton Fair Lawn (NJ)

Upstate Laboratories, Inc.
6034 Corporate Drive • E. Syracuse, NY 13057-1017
(315) 437 0255 Fax 437 1209

Chain Of Custody Record

8/5

Client:		Client Project # / Project Name				No. of Containers	1)	2)	3)	4)	5)	6)	7)	8)	9)	10)	Special Turnaround Time ______ (Lab Notification required) Remarks
Delta Environmental		S0960015															
Client Contact:	Phone #	Site Location (city/state)															
Sample Location:	**Date**	**Time**	**Matrix**	**Grab or Comp.**	**ULI Internal Use Only**												
mw-2	7-21-97	1:10 pm	H_2O	GRAB	20397005	3	X	X	X	X							
mw-8	↓	12:35 pm	↓	↓	6	3	X	X	X	X							
mw-202	↓	1:40 pm	↓	↓	7	3	X	X	X	X							
mw-203	7-21-97	1:00 pm	H_2O	GRAB	8	3	X	X	~~X~~	X	95						

parameter and method	sample bottle: type	size	pres.
1) EPA 8240	glass	40 ml	1:1 HCl
2) MBAS	plastic	1/2 gal	NONE
3) SWC	—		
4) Field pH, Cond, Temp, Eh, TRC, Iron, Alk, D.O.	—		
5)			
6)			
7)			
8)			
9)			
10)			

Note: The numbered columns above cross-reference with the numbered columns in the upper right-hand corner.

Sampled by: (Please Print) KEVIN CAHL

Company: U.L.I.

ULI Internal Use Only
Delivery (check one):
☒ ULI Sampled
☐ Pickup ☐ Dropoff
☐ CC ______

Relinquished by: (Signature)	Date	Time	Received by: (Signature)
Relinquished by: (Signature)	Date	Time	Received by: (Signature)
Relinquished by: (Signature)	Date	Time	Received by: (Signature)
Relinquished by: (Signature)	Date	Time	Rec'd for Lab by: (Signature)
[signature]	7/21/97	4:05 pm	[signature]

Upstate Laboratories inc.

Shipping: 6034 Corporate Dr. • E. Syracuse, NY 13057-1017 • (315) 437-0255 • Fax (315) 437-1209
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New Jersey (201) 703-1324

MAR 10 1998

March 6, 1998

Mr. Steve Zbur
Unit Manager
Delta Environmental Consultants
4068 Mt. Royal Blvd.
Suite 225 - Gamma
Allison Park, PA 15101

Re: Analysis Report #04998182 - HB Fuller (Geneva)

Dear Mr. Zbur:

Please find enclosed the results for your samples which were collected by ULI personnel on February 18, 1998.

We have included the Chain of Custody Record as part of your report. You may need to reference this form for a more detailed explanation of your sample. Samples will be disposed of approximately one month from final report date.

Should you have any questions, please feel free to give us a call.

Thank you for your patronage.

Sincerely,

UPSTATE LABORATORIES, INC.

Anthony J. Scala
Director

AJS/lw

Enclosures: report, field data, invoice

cc/encs: N. Scala, ULI
file

Disclaimer: The test results and procedures utilized, and laboratory interpretations of data obtained by ULI as contained in this report are believed by ULI to be accurate and reliable for sample(s) tested. In accepting this report, the customer agrees that the full extent of any and all liability for actual and consequential damages of ULI for the services performed shall be equal to the fee charged to the customer for the services as liquidated damages.

DATE: 03/06/98

Upstate Laboratories, Inc.
Analysis Results
Report Number: 04998182
Client I.D.: DELTA ENVIRONMENTAL CONSULTANT HB FULLER (GENEVA)
Sampled by: ULI

APPROVAL:
QC:
Lab I.D.: 10170

MW-5 1304H 02/18/98 G

ULI I.D.: 04998182   Matrix: Water

PARAMETERS	RESULTS	KEY	FILE#
Field Dissolved Oxygen	3.4mg/l		FIELD
Field Eh	12.9mV		FIELD
Field pH	6.48SU		FIELD
Field Specific Conductivity	1200umhos/cm		FIELD
Temperature	10.1degC		FIELD
MBAS	<0.05mg/lLAS		WC0625
TCL Volatiles by EPA Method 8260			
Chloromethane	<3ug/l		VM1789
Bromomethane	<3ug/l		VM1789
Vinyl Chloride	<2ug/l		VM1789
Chloroethane	<3ug/l		VM1789
Methylene Chloride	<3ug/l		VM1789
Acetone	<10ug/l		VM1789
Carbon Disulfide	<3ug/l		VM1789
1,1-Dichloroethene	<3ug/l		VM1789
1,1-Dichloroethane	<3ug/l		VM1789
trans-1,2-Dichloroethene	<3ug/l		VM1789
cis-1,2-Dichloroethene	<3ug/l		VM1789
Chloroform	<3ug/l		VM1789
1,2-Dichloroethane	<3ug/l		VM1789
2-Butanone	<10ug/l		VM1789
1,1,1-Trichloroethane	<3ug/l		VM1789
Carbon Tetrachloride	<3ug/l		VM1789
Bromodichloromethane	<3ug/l		VM1789
1,2-Dichloropropane	<3ug/l		VM1789
cis-1,3-Dichloropropene	<3ug/l		VM1789
Trichloroethene	<3ug/l		VM1789
Dibromochloromethane	<3ug/l		VM1789
1,1,2-Trichloroethane	<3ug/l		VM1789
Benzene	<3ug/l		VM1789
trans-1,3-Dichloropropene	<3ug/l		VM1789
Bromoform	<3ug/l		VM1789
4-Methyl-2-pentanone	<10ug/l		VM1789
2-Hexanone	<10ug/l		VM1789
Tetrachloroethene	<3ug/l		VM1789
1,1,2,2-Tetrachloroethane	<3ug/l		VM1789
Toluene	<3ug/l		VM1789
Chlorobenzene	<3ug/l		VM1789
Ethylbenzene	<3ug/l		VM1789

DATE: 03/06/98

Upstate Laboratories, Inc.
Analysis Results
Report Number: 04998182
Client I.D.: DELTA ENVIRONMENTAL CONSULTANT HB FULLER (GENEVA)
Sampled by: ULI

APPROVAL:
QC:
Lab I.D.: 10170

MW-5 1304H 02/18/98 G

ULI I.D.: 04998182 Matrix: Water

PARAMETERS	RESULTS	KEY	FILE#
Styrene	<3ug/l		VM1789
m-Xylene and p-Xylene	<3ug/l		VM1789
o-Xylene	<3ug/l		VM1789

DATE: 03/06/98

Upstate Laboratories, Inc. APPROVAL: QC:
Analysis Results
Report Number: 04998182 Lab I.D.: 10170
Client I.D.: DELTA ENVIRONMENTAL CONSULTANT HB FULLER (GENEVA)
Sampled by: ULI MW-6 1425H 02/18/98

ULI I.D.: 04998183 Matrix: Water

PARAMETERS	RESULTS	KEY	FILE#
Field Dissolved Oxygen	2.8mg/l		FIELD
Field Eh	2.2mV		FIELD
Field pH	6.65SU		FIELD
Field Specific Conductivity	860umhos/cm		FIELD
Temperature	8.5degC		FIELD
MBAS	<0.05mg/lLAS		WC0625
TCL Volatiles by EPA Method 8260			
Chloromethane	<3ug/l		VM1789
Bromomethane	<3ug/l		VM1789
Vinyl Chloride	<2ug/l		VM1789
Chloroethane	<3ug/l		VM1789
Methylene Chloride	<3ug/l		VM1789
Acetone	<10ug/l		VM1789
Carbon Disulfide	<3ug/l		VM1789
1,1-Dichloroethene	<3ug/l		VM1789
1,1-Dichloroethane	<3ug/l		VM1789
trans-1,2-Dichloroethene	<3ug/l		VM1789
cis-1,2-Dichloroethene	<3ug/l		VM1789
Chloroform	<3ug/l		VM1789
1,2-Dichloroethane	<3ug/l		VM1789
2-Butanone	<10ug/l		VM1789
1,1,1-Trichloroethane	<3ug/l		VM1789
Carbon Tetrachloride	<3ug/l		VM1789
Bromodichloromethane	<3ug/l		VM1789
1,2-Dichloropropane	<3ug/l		VM1789
cis-1,3-Dichloropropene	<3ug/l		VM1789
Trichloroethene	<3ug/l		VM1789
Dibromochloromethane	<3ug/l		VM1789
1,1,2-Trichloroethane	<3ug/l		VM1789
Benzene	<3ug/l		VM1789
trans-1,3-Dichloropropene	<3ug/l		VM1789
Bromoform	<3ug/l		VM1789
4-Methyl-2-pentanone	<10ug/l		VM1789
2-Hexanone	<10ug/l		VM1789
Tetrachloroethene	<3ug/l		VM1789
1,1,2,2-Tetrachloroethane	<3ug/l		VM1789
Toluene	<3ug/l		VM1789
Chlorobenzene	<3ug/l		VM1789
Ethylbenzene	<3ug/l		VM1789

DATE: 03/06/98

Upstate Laboratories, Inc.
Analysis Results
Report Number: 04998182
Client I.D.: DELTA ENVIRONMENTAL CONSULTANT HB FULLER (GENEVA)
Sampled by: ULI

APPROVAL:
QC:
Lab I.D.: 10170

MW-6 1425H 02/18/98

ULI I.D.: 04998183

Matrix: Water

PARAMETERS	RESULTS	KEY	FILE#
Styrene	<3ug/l		VM1789
m-Xylene and p-Xylene	<3ug/l		VM1789
o-Xylene	<3ug/l		VM1789

DATE: 03/06/98

Upstate Laboratories, Inc.
Analysis Results
Report Number: 04998182
Client I.D.: DELTA ENVIRONMENTAL CONSULTANT HB FULLER (GENEVA)
Sampled by: ULI

APPROVAL:
QC:
Lab I.D.: 10170

MW-7 1059H 02/18/98

ULI I.D.: 04998184 Matrix: Water

PARAMETERS	RESULTS	KEY	FILE#
Field Dissolved Oxygen	6.6mg/l		FIELD
Field Eh	2.2mV		FIELD
Field pH	6.87SU		FIELD
Field Specific Conductivity	440umhos/cm		FIELD
Temperature	8.2degC		FIELD
MBAS	<0.05mg/lLAS		WC0625
TCL Volatiles by EPA Method 8260			
Chloromethane	<3ug/l		VM1789
Bromomethane	<3ug/l		VM1789
Vinyl Chloride	<2ug/l		VM1789
Chloroethane	<3ug/l		VM1789
Methylene Chloride	<3ug/l		VM1789
Acetone	<10ug/l		VM1789
Carbon Disulfide	<3ug/l		VM1789
1,1-Dichloroethene	<3ug/l		VM1789
1,1-Dichloroethane	<3ug/l		VM1789
trans-1,2-Dichloroethene	<3ug/l		VM1789
cis-1,2-Dichloroethene	<3ug/l		VM1789
Chloroform	<3ug/l		VM1789
1,2-Dichloroethane	<3ug/l		VM1789
2-Butanone	<10ug/l		VM1789
1,1,1-Trichloroethane	<3ug/l		VM1789
Carbon Tetrachloride	<3ug/l		VM1789
Bromodichloromethane	<3ug/l		VM1789
1,2-Dichloropropane	<3ug/l		VM1789
cis-1,3-Dichloropropene	<3ug/l		VM1789
Trichloroethene	<3ug/l		VM1789
Dibromochloromethane	<3ug/l		VM1789
1,1,2-Trichloroethane	<3ug/l		VM1789
Benzene	<3ug/l		VM1789
trans-1,3-Dichloropropene	<3ug/l		VM1789
Bromoform	<3ug/l		VM1789
4-Methyl-2-pentanone	<10ug/l		VM1789
2-Hexanone	<10ug/l		VM1789
Tetrachloroethene	6ug/l		VM1789
1,1,2,2-Tetrachloroethane	<3ug/l		VM1789
Toluene	<3ug/l		VM1789
Chlorobenzene	<3ug/l		VM1789
Ethylbenzene	<3ug/l		VM1789

DATE: 03/06/98

Upstate Laboratories, Inc.
Analysis Results
Report Number: 04998182
Client I.D.: DELTA ENVIRONMENTAL CONSULTANT HB FULLER (GENEVA)
Sampled by: ULI

APPROVAL:
QC:
Lab I.D.: 10170

MW-7 1059H 02/18/98

ULI I.D.: 04998184 Matrix: Water

PARAMETERS	RESULTS	KEY	FILE#
Styrene	<3ug/l		VM1789
m-Xylene and p-Xylene	<3ug/l		VM1789
o-Xylene	<3ug/l		VM1789

DATE: 03/06/98

Upstate Laboratories, Inc.
Analysis Results
Report Number: 04998182
Client I.D.: DELTA ENVIRONMENTAL CONSULTANT HB FULLER (GENEVA)
Sampled by: ULI

APPROVAL:
QC:
Lab I.D.: 10170
MW-2 0947H 02/18/98

ULI I.D.: 04998185 Matrix: Water

PARAMETERS	RESULTS	KEY	FILE#
Field Dissolved Oxygen	5.8mg/l		FIELD
Field Eh	-40.2mV		FIELD
Field pH	7.66SU		FIELD
Field Specific Conductivity	4200umhos/cm		FIELD
Temperature	9.6degC		FIELD
MBAS	0.28mg/lLAS		WC0625
TCL Volatiles by EPA Method 8260			
Chloromethane	<6ug/l	05	VM1789
Bromomethane	<6ug/l	05	VM1789
Vinyl Chloride	250ug/l		VM1789
Chloroethane	<6ug/l	05	VM1789
Methylene Chloride	<6ug/l	05	VM1789
Acetone	50ug/l		VM1789
Carbon Disulfide	<6ug/l	05	VM1789
1,1-Dichloroethene	<6ug/l	05	VM1789
1,1-Dichloroethane	140ug/l		VM1789
trans-1,2-Dichloroethene	<6ug/l	05	VM1789
cis-1,2-Dichloroethene	210ug/l		VM1789
Chloroform	<6ug/l	05	VM1789
1,2-Dichloroethane	<6ug/l	05	VM1789
2-Butanone	<20ug/l	05	VM1789
1,1,1-Trichloroethane	6ug/l		VM1789
Carbon Tetrachloride	<6ug/l	05	VM1789
Bromodichloromethane	<6ug/l	05	VM1789
1,2-Dichloropropane	<6ug/l	05	VM1789
cis-1,3-Dichloropropene	<6ug/l	05	VM1789
Trichloroethene	240ug/l		VM1789
Dibromochloromethane	<6ug/l	05	VM1789
1,1,2-Trichloroethane	<6ug/l	05	VM1789
Benzene	<6ug/l	05	VM1789
trans-1,3-Dichloropropene	<6ug/l	05	VM1789
Bromoform	<6ug/l	05	VM1789
4-Methyl-2-pentanone	<20ug/l	05	VM1789
2-Hexanone	<20ug/l	05	VM1789
Tetrachloroethene	51ug/l		VM1789
1,1,2,2-Tetrachloroethane	<6ug/l	05	VM1789
Toluene	<6ug/l	05	VM1789
Chlorobenzene	<6ug/l	05	VM1789
Ethylbenzene	<6ug/l	05	VM1789

DATE: 03/06/98

Upstate Laboratories, Inc.
Analysis Results
Report Number: 04998182
Client I.D.: DELTA ENVIRONMENTAL CONSULTANT HB FULLER (GENEVA)
Sampled by: ULI

APPROVAL:
QC:
Lab I.D.: 10170

MW-2 0947H 02/18/98

ULI I.D.: 04998185

Matrix: Water

PARAMETERS	RESULTS	KEY	FILE#
Styrene	<6ug/l	05	VM1789
m-Xylene and p-Xylene	<6ug/l	05	VM1789
o-Xylene	<6ug/l	05	VM1789

DATE: 03/06/98

Upstate Laboratories, Inc. APPROVAL:
Analysis Results QC:
Report Number: 04998182 Lab I.D.: 10170
Client I.D.: DELTA ENVIRONMENTAL CONSULTANT HB FULLER (GENEVA)
Sampled by: ULI MW-202 0932H 02/18/98

ULI I.D.: 04998186 Matrix: Water

PARAMETERS	RESULTS	KEY	FILE#
Field Dissolved Oxygen	6.8mg/l		FIELD
Field Eh	-41.9mV		FIELD
Field pH	7.7SU		FIELD
Field Specific Conductivity	800umhos/cm		FIELD
Temperature	11.7degC		FIELD
MBAS	<0.05mg/lLAS		WC0625
TCL Volatiles by EPA Method 8260			
Chloromethane	<3ug/l		VM1790
Bromomethane	<3ug/l		VM1790
Vinyl Chloride	<2ug/l		VM1790
Chloroethane	<3ug/l		VM1790
Methylene Chloride	<3ug/l		VM1790
Acetone	<10ug/l		VM1790
Carbon Disulfide	<3ug/l		VM1790
1,1-Dichloroethene	<3ug/l		VM1790
1,1-Dichloroethane	<3ug/l		VM1790
trans-1,2-Dichloroethene	<3ug/l		VM1790
cis-1,2-Dichloroethene	<3ug/l		VM1790
Chloroform	<3ug/l		VM1790
1,2-Dichloroethane	<3ug/l		VM1790
2-Butanone	<10ug/l		VM1790
1,1,1-Trichloroethane	<3ug/l		VM1790
Carbon Tetrachloride	<3ug/l		VM1790
Bromodichloromethane	<3ug/l		VM1790
1,2-Dichloropropane	<3ug/l		VM1790
cis-1,3-Dichloropropene	<3ug/l		VM1790
Trichloroethene	<3ug/l		VM1790
Dibromochloromethane	<3ug/l		VM1790
1,1,2-Trichloroethane	<3ug/l		VM1790
Benzene	<3ug/l		VM1790
trans-1,3-Dichloropropene	<3ug/l		VM1790
Bromoform	<3ug/l		VM1790
4-Methyl-2-pentanone	<10ug/l		VM1790
2-Hexanone	<10ug/l		VM1790
Tetrachloroethene	<3ug/l		VM1790
1,1,2,2-Tetrachloroethane	<3ug/l		VM1790
Toluene	<3ug/l		VM1790
Chlorobenzene	<3ug/l		VM1790
Ethylbenzene	<3ug/l		VM1790

DATE: 03/06/98

Upstate Laboratories, Inc.
Analysis Results
Report Number: 04998182
Client I.D.: DELTA ENVIRONMENTAL CONSULTANT HB FULLER (GENEVA)
Sampled by: ULI

APPROVAL:
QC:
Lab I.D.: 10170
MW-202 0932H 02/18/98

ULI I.D.: 04998186 Matrix: Water

PARAMETERS	RESULTS	KEY	FILE#
Styrene	<3ug/l		VM1790
m-Xylene and p-Xylene	<3ug/l		VM1790
o-Xylene	<3ug/l		VM1790

DATE: 03/06/98

Upstate Laboratories, Inc. APPROVAL:
Analysis Results QC:
Report Number: 04998182 Lab I.D.: 10170
Client I.D.: DELTA ENVIRONMENTAL CONSULTANT HB FULLER (GENEVA)
Sampled by: ULI MW-10 1512H 02/18/98

ULI I.D.: 04998187 Matrix: Water

PARAMETERS	RESULTS	KEY	FILE#
TCL Volatiles by EPA Method 8260			
Chloromethane	<3ug/l		VM1790
Bromomethane	<3ug/l		VM1790
Vinyl Chloride	<2ug/l		VM1790
Chloroethane	<3ug/l		VM1790
Methylene Chloride	<3ug/l		VM1790
Acetone	<10ug/l		VM1790
Carbon Disulfide	<3ug/l		VM1790
1,1-Dichloroethene	<3ug/l		VM1790
1,1-Dichloroethane	<3ug/l		VM1790
trans-1,2-Dichloroethene	<3ug/l		VM1790
cis-1,2-Dichloroethene	<3ug/l		VM1790
Chloroform	<3ug/l		VM1790
1,2-Dichloroethane	<3ug/l		VM1790
2-Butanone	<10ug/l		VM1790
1,1,1-Trichloroethane	<3ug/l		VM1790
Carbon Tetrachloride	<3ug/l		VM1790
Bromodichloromethane	<3ug/l		VM1790
1,2-Dichloropropane	<3ug/l		VM1790
cis-1,3-Dichloropropene	<3ug/l		VM1790
Trichloroethene	<3ug/l		VM1790
Dibromochloromethane	<3ug/l		VM1790
1,1,2-Trichloroethane	<3ug/l		VM1790
Benzene	<3ug/l		VM1790
trans-1,3-Dichloropropene	<3ug/l		VM1790
Bromoform	<3ug/l		VM1790
4-Methyl-2-pentanone	<10ug/l		VM1790
2-Hexanone	<10ug/l		VM1790
Tetrachloroethene	<3ug/l		VM1790
1,1,2,2-Tetrachloroethane	<3ug/l		VM1790
Toluene	<3ug/l		VM1790
Chlorobenzene	<3ug/l		VM1790
Ethylbenzene	<3ug/l		VM1790
Styrene	<3ug/l		VM1790
m-Xylene and p-Xylene	<3ug/l		VM1790
o-Xylene	<3ug/l		VM1790

DATE: 03/06/98

Upstate Laboratories, Inc.
Analysis Results
Report Number: 04998182
Client I.D.: DELTA ENVIRONMENTAL CONSULTANT HB FULLER (GENEVA)
Sampled by: ULI

APPROVAL:
QC:
Lab I.D.: 10170

MW-11 1401H 02/18/98

ULI I.D.: 04998188 Matrix: Water

PARAMETERS	RESULTS	KEY	FILE#
Field Dissolved Oxygen	2.2mg/l		FIELD
Field Eh	-17.9mV		FIELD
Field pH	7.04SU		FIELD
Field Specific Conductivity	900umhos/cm		FIELD
Temperature	7.7degC		FIELD
MBAS	<0.05mg/l		WC0625
TCL Volatiles by EPA Method 8260			
Chloromethane	<3ug/l		VM1790
Bromomethane	<3ug/l		VM1790
Vinyl Chloride	<2ug/l		VM1790
Chloroethane	<3ug/l		VM1790
Methylene Chloride	<3ug/l		VM1790
Acetone	<10ug/l		VM1790
Carbon Disulfide	<3ug/l		VM1790
1,1-Dichloroethene	16ug/l		VM1790
1,1-Dichloroethane	33ug/l		VM1790
trans-1,2-Dichloroethene	<3ug/l		VM1790
cis-1,2-Dichloroethene	6ug/l		VM1790
Chloroform	<3ug/l		VM1790
1,2-Dichloroethane	<3ug/l		VM1790
2-Butanone	<10ug/l		VM1790
1,1,1-Trichloroethane	<3ug/l		VM1790
Carbon Tetrachloride	<3ug/l		VM1790
Bromodichloromethane	<3ug/l		VM1790
1,2-Dichloropropane	<3ug/l		VM1790
cis-1,3-Dichloropropene	<3ug/l		VM1790
Trichloroethene	4ug/l		VM1790
Dibromochloromethane	<3ug/l		VM1790
1,1,2-Trichloroethane	<3ug/l		VM1790
Benzene	<3ug/l		VM1790
trans-1,3-Dichloropropene	<3ug/l		VM1790
Bromoform	<3ug/l		VM1790
4-Methyl-2-pentanone	<10ug/l		VM1790
2-Hexanone	<10ug/l		VM1790
Tetrachloroethene	<3ug/l		VM1790
1,1,2,2-Tetrachloroethane	<3ug/l		VM1790
Toluene	<3ug/l		VM1790
Chlorobenzene	<3ug/l		VM1790
Ethylbenzene	<3ug/l		VM1790

DATE: 03/06/98

Upstate Laboratories, Inc.
Analysis Results
Report Number: 04998182
Client I.D.: DELTA ENVIRONMENTAL CONSULTANT HB FULLER (GENEVA)
Sampled by: ULI

APPROVAL:
QC:
Lab I.D.: 10170

MW-11 1401H 02/18/98

ULI I.D.: 04998188 Matrix: Water

PARAMETERS	RESULTS	KEY	FILE#
Styrene	<3ug/l		VM1790
m-Xylene and p-Xylene	<3ug/l		VM1790
o-Xylene	<3ug/l		VM1790

DATE: 03/06/98

Upstate Laboratories, Inc.
Analysis Results
Report Number: 04998182
Client I.D.: DELTA ENVIRONMENTAL CONSULTANT HB FULLER (GENEVA)
Sampled by: ULI

APPROVAL:
QC:
Lab I.D.: 10170
MW-1 1207H 02/18/98

ULI I.D.: 04998189 Matrix: Water

PARAMETERS	RESULTS	KEY	FILE#
Field Dissolved Oxygen	5.6mg/l		FIELD
Field Eh	9.5mV		FIELD
Field pH	6.74SU		FIELD
Field Specific Conductivity	620umhos/cm		FIELD
Temperature	8.0degC		FIELD
MBAS	0.09mg/lLAs		WC0625
TCL Volatiles by EPA Method 8260			
Chloromethane	<3ug/l		VM1790
Bromomethane	<3ug/l		VM1790
Vinyl Chloride	<2ug/l		VM1790
Chloroethane	<3ug/l		VM1790
Methylene Chloride	<3ug/l		VM1790
Acetone	<10ug/l		VM1790
Carbon Disulfide	<3ug/l		VM1790
1,1-Dichloroethene	<3ug/l		VM1790
1,1-Dichloroethane	<3ug/l		VM1790
trans-1,2-Dichloroethene	<3ug/l		VM1790
cis-1,2-Dichloroethene	<3ug/l		VM1790
Chloroform	<3ug/l		VM1790
1,2-Dichloroethane	<3ug/l		VM1790
2-Butanone	<10ug/l		VM1790
1,1,1-Trichloroethane	<3ug/l		VM1790
Carbon Tetrachloride	<3ug/l		VM1790
Bromodichloromethane	<3ug/l		VM1790
1,2-Dichloropropane	<3ug/l		VM1790
cis-1,3-Dichloropropene	<3ug/l		VM1790
Trichloroethene	<3ug/l		VM1790
Dibromochloromethane	<3ug/l		VM1790
1,1,2-Trichloroethane	<3ug/l		VM1790
Benzene	<3ug/l		VM1790
trans-1,3-Dichloropropene	<3ug/l		VM1790
Bromoform	<3ug/l		VM1790
4-Methyl-2-pentanone	<10ug/l		VM1790
2-Hexanone	<10ug/l		VM1790
Tetrachloroethene	12ug/l		VM1790
1,1,2,2-Tetrachloroethane	<3ug/l		VM1790
Toluene	<3ug/l		VM1790
Chlorobenzene	<3ug/l		VM1790
Ethylbenzene	<3ug/l		VM1790

DATE: 03/06/98

Upstate Laboratories, Inc.
Analysis Results
Report Number: 04998182
Client I.D.: DELTA ENVIRONMENTAL CONSULTANT HB FULLER (GENEVA)
Sampled by: ULI

APPROVAL:
QC:
Lab I.D.: 10170

MW-1 1207H 02/18/98

ULI I.D.: 04998189 Matrix: Water

PARAMETERS	RESULTS	KEY	FILE#
Styrene	<3ug/l		VM1790
m-Xylene and p-Xylene	<3ug/l		VM1790
o-Xylene	<3ug/l		VM1790

DATE: 03/06/98

Upstate Laboratories, Inc. APPROVAL:
Analysis Results QC:
Report Number: 04998182 Lab I.D.: 10170
Client I.D.: DELTA ENVIRONMENTAL CONSULTANT HB FULLER (GENEVA)
Sampled by: ULI MW-4 1242H 02/18/98

ULI I.D.: 04998190 Matrix: Water

PARAMETERS	RESULTS	KEY	FILE#
Field Dissolved Oxygen	5.0mg/l		FIELD
Field Eh	-83.4mV		FIELD
Field pH	8.20SU		FIELD
Field Specific Conductivity	400umhos/cm		FIELD
Temperature	9.3degC		FIELD
MBAS	<0.05mg/l		WC0625
TCL Volatiles by EPA Method 8260			
Chloromethane	<3ug/l		VM1790
Bromomethane	<3ug/l		VM1790
Vinyl Chloride	<2ug/l		VM1790
Chloroethane	<3ug/l		VM1790
Methylene Chloride	<3ug/l		VM1790
Acetone	<10ug/l		VM1790
Carbon Disulfide	<3ug/l		VM1790
1,1-Dichloroethene	<3ug/l		VM1790
1,1-Dichloroethane	<3ug/l		VM1790
trans-1,2-Dichloroethene	<3ug/l		VM1790
cis-1,2-Dichloroethene	<3ug/l		VM1790
Chloroform	<3ug/l		VM1790
1,2-Dichloroethane	<3ug/l		VM1790
2-Butanone	<10ug/l		VM1790
1,1,1-Trichloroethane	<3ug/l		VM1790
Carbon Tetrachloride	<3ug/l		VM1790
Bromodichloromethane	<3ug/l		VM1790
1,2-Dichloropropane	<3ug/l		VM1790
cis-1,3-Dichloropropene	<3ug/l		VM1790
Trichloroethene	<3ug/l		VM1790
Dibromochloromethane	<3ug/l		VM1790
1,1,2-Trichloroethane	<3ug/l		VM1790
Benzene	<3ug/l		VM1790
trans-1,3-Dichloropropene	<3ug/l		VM1790
Bromoform	<3ug/l		VM1790
4-Methyl-2-pentanone	<10ug/l		VM1790
2-Hexanone	<10ug/l		VM1790
Tetrachloroethene	<3ug/l		VM1790
1,1,2,2-Tetrachloroethane	<3ug/l		VM1790
Toluene	<3ug/l		VM1790
Chlorobenzene	<3ug/l		VM1790
Ethylbenzene	<3ug/l		VM1790

DATE: 03/06/98

Upstate Laboratories, Inc.
Analysis Results
Report Number: 04998182
Client I.D.: DELTA ENVIRONMENTAL CONSULTANT HB FULLER (GENEVA)
Sampled by: ULI

APPROVAL:
QC:
Lab I.D.: 10170

MW-4 1242H 02/18/98

ULI I.D.: 04998190 Matrix: Water

PARAMETERS	RESULTS	KEY	FILE#
Styrene	<3ug/l		VM1790
m-Xylene and p-Xylene	<3ug/l		VM1790
o-Xylene	<3ug/l		VM1790

DATE: 03/06/98

Upstate Laboratories, Inc.
Analysis Results
Report Number: 04998182

APPROVAL:
QC:
Lab I.D.: 10170

Client I.D.: DELTA ENVIRONMENTAL CONSULTANT HB FULLER (GENEVA)
Sampled by: ULI
MW-3 1230H 02/18/98

ULI I.D.: 04998191 Matrix: Water

PARAMETERS	RESULTS	KEY	FILE#
Field Dissolved Oxygen	4.0mg/l		FIELD
Field Eh	-118.6mV		FIELD
Field pH	8.85SU		FIELD
Field Specific Conductivity	3000umhos/cm		FIELD
Temperature	9.7degC		FIELD
MBAS	0.60mg/lLAS		WC0625
TCL Volatiles by EPA Method 8260			
Chloromethane	<3ug/l		VM1790
Bromomethane	<3ug/l		VM1790
Vinyl Chloride	5ug/l		VM1790
Chloroethane	<3ug/l		VM1790
Methylene Chloride	6ug/l		VM1790
Acetone	110ug/l		VM1790
Carbon Disulfide	6ug/l		VM1790
1,1-Dichloroethene	<3ug/l		VM1790
1,1-Dichloroethane	10ug/l		VM1790
trans-1,2-Dichloroethene	<3ug/l		VM1790
cis-1,2-Dichloroethene	13ug/l		VM1790
Chloroform	5ug/l		VM1790
1,2-Dichloroethane	<3ug/l		VM1790
2-Butanone	<10ug/l		VM1790
1,1,1-Trichloroethane	<3ug/l		VM1790
Carbon Tetrachloride	<3ug/l		VM1790
Bromodichloromethane	<3ug/l		VM1790
1,2-Dichloropropane	<3ug/l		VM1790
cis-1,3-Dichloropropene	<3ug/l		VM1790
Trichloroethene	14ug/l		VM1790
Dibromochloromethane	<3ug/l		VM1790
1,1,2-Trichloroethane	<3ug/l		VM1790
Benzene	<3ug/l		VM1790
trans-1,3-Dichloropropene	<3ug/l		VM1790
Bromoform	<3ug/l		VM1790
4-Methyl-2-pentanone	<10ug/l		VM1790
2-Hexanone	<10ug/l		VM1790
Tetrachloroethene	15ug/l		VM1790
1,1,2,2-Tetrachloroethane	<3ug/l		VM1790
Toluene	<3ug/l		VM1790
Chlorobenzene	<3ug/l		VM1790
Ethylbenzene	<3ug/l		VM1790

DATE: 03/06/98

Upstate Laboratories, Inc.
Analysis Results
Report Number: 04998182
Client I.D.: DELTA ENVIRONMENTAL CONSULTANT HB FULLER (GENEVA)
Sampled by: ULI

APPROVAL:
QC:
Lab I.D.: 10170

MW-3 1230H 02/18/98

ULI I.D.: 04998191 Matrix: Water

PARAMETERS	RESULTS	KEY	FILE#
Styrene	<3ug/l		VM1790
m-Xylene and p-Xylene	<3ug/l		VM1790
o-Xylene	<3ug/l		VM1790

DATE: 03/06/98

Upstate Laboratories, Inc.
Analysis Results
Report Number: 04998182
Client I.D.: DELTA ENVIRONMENTAL CONSULTANT HB FULLER (GENEVA)
Sampled by: ULI

APPROVAL:
QC:
Lab I.D.: 10170

MW-201 1212H 02/18/98

ULI I.D.: 04998192 Matrix: Water

PARAMETERS	RESULTS	KEY	FILE#
Field Dissolved Oxygen	5.2mg/l		FIELD
Field Eh	-7.2mV		FIELD
Field pH	7.05SU		FIELD
Field Specific Conductivity	1000umhos/cm		FIELD
Temperature	10.7degC		FIELD
MBAS	<0.05mg/lLAS		WC0625
TCL Volatiles by EPA Method 8260			
Chloromethane	<3ug/l		VM1791
Bromomethane	<3ug/l		VM1791
Vinyl Chloride	<2ug/l		VM1791
Chloroethane	<3ug/l		VM1791
Methylene Chloride	<3ug/l		VM1791
Acetone	<10ug/l		VM1791
Carbon Disulfide	25ug/l		VM1791
1,1-Dichloroethene	<3ug/l		VM1791
1,1-Dichloroethane	<3ug/l		VM1791
trans-1,2-Dichloroethene	<3ug/l		VM1791
cis-1,2-Dichloroethene	<3ug/l		VM1791
Chloroform	<3ug/l		VM1791
1,2-Dichloroethane	<3ug/l		VM1791
2-Butanone	<10ug/l		VM1791
1,1,1-Trichloroethane	<3ug/l		VM1791
Carbon Tetrachloride	<3ug/l		VM1791
Bromodichloromethane	<3ug/l		VM1791
1,2-Dichloropropane	<3ug/l		VM1791
cis-1,3-Dichloropropene	<3ug/l		VM1791
Trichloroethene	<3ug/l		VM1791
Dibromochloromethane	<3ug/l		VM1791
1,1,2-Trichloroethane	<3ug/l		VM1791
Benzene	<3ug/l		VM1791
trans-1,3-Dichloropropene	<3ug/l		VM1791
Bromoform	<3ug/l		VM1791
4-Methyl-2-pentanone	<10ug/l		VM1791
2-Hexanone	<10ug/l		VM1791
Tetrachloroethene	4ug/l		VM1791
1,1,2,2-Tetrachloroethane	<3ug/l		VM1791
Toluene	<3ug/l		VM1791
Chlorobenzene	<3ug/l		VM1791
Ethylbenzene	<3ug/l		VM1791

DATE: 03/06/98

Upstate Laboratories, Inc.
Analysis Results
Report Number: 04998182
Client I.D.: DELTA ENVIRONMENTAL CONSULTANT HB FULLER (GENEVA)
Sampled by: ULI

APPROVAL:
QC:
Lab I.D.: 10170

MW-201 1212H 02/18/98

ULI I.D.: 04998192 Matrix: Water

PARAMETERS	RESULTS	KEY	FILE#
Styrene	<3ug/l		VM1791
m-Xylene and p-Xylene	<3ug/l		VM1791
o-Xylene	<3ug/l		VM1791

DATE: 03/06/98

Upstate Laboratories, Inc.
Analysis Results
Report Number: 04998182
Client I.D.: DELTA ENVIRONMENTAL CONSULTANT HB FULLER (GENEVA)
Sampled by: ULI

APPROVAL:
QC:
Lab I.D.: 10170
MW-9 1145H 02/18/98

ULI I.D.: 04998193 Matrix: Water

PARAMETERS	RESULTS	KEY	FILE#
Field Dissolved Oxygen	4.0mg/l		FIELD
Field Eh	8.2mV		FIELD
Field pH	6.72SU		FIELD
Field Specific Conductivity	2200umhos/cm		FIELD
Temperature	8.8degC		FIELD
MBAS	0.62mg/lLAS		WC0625
TCL Volatiles by EPA Method 8260			
Chloromethane	<30ug/l	05	VM1791
Bromomethane	<30ug/l	05	VM1791
Vinyl Chloride	50ug/l		VM1791
Chloroethane	<30ug/l	05	VM1791
Methylene Chloride	<30ug/l	05	VM1791
Acetone	<100ug/l	05	VM1791
Carbon Disulfide	<30ug/l	05	VM1791
1,1-Dichloroethene	64ug/l		VM1791
1,1-Dichloroethane	81ug/l		VM1791
trans-1,2-Dichloroethene	<30ug/l	05	VM1791
cis-1,2-Dichloroethene	220ug/l		VM1791
Chloroform	<30ug/l	05	VM1791
1,2-Dichloroethane	<30ug/l	05	VM1791
2-Butanone	<100ug/l	05	VM1791
1,1,1-Trichloroethane	400ug/l		VM1791
Carbon Tetrachloride	<30ug/l	05	VM1791
Bromodichloromethane	<30ug/l	05	VM1791
1,2-Dichloropropane	<30ug/l	05	VM1791
cis-1,3-Dichloropropene	<30ug/l	05	VM1791
Trichloroethene	280ug/l		VM1791
Dibromochloromethane	<30ug/l	05	VM1791
1,1,2-Trichloroethane	<30ug/l	05	VM1791
Benzene	<30ug/l	05	VM1791
trans-1,3-Dichloropropene	<30ug/l	05	VM1791
Bromoform	<30ug/l	05	VM1791
4-Methyl-2-pentanone	<100ug/l	05	VM1791
2-Hexanone	<100ug/l	05	VM1791
Tetrachloroethene	520ug/l		VM1791
1,1,2,2-Tetrachloroethane	<30ug/l	05	VM1791
Toluene	<30ug/l	05	VM1791
Chlorobenzene	<30ug/l	05	VM1791
Ethylbenzene	<30ug/l	05	VM1791

DATE: 03/06/98

Upstate Laboratories, Inc.
Analysis Results
Report Number: 04998182
Client I.D.: DELTA ENVIRONMENTAL CONSULTANT HB FULLER (GENEVA)
Sampled by: ULI

APPROVAL:
QC:
Lab I.D.: 10170

MW-9 1145H 02/18/98

ULI I.D.: 04998193 Matrix: Water

PARAMETERS	RESULTS	KEY	FILE#
Styrene	<30ug/l	05	VM1791
m-Xylene and p-Xylene	<30ug/l	05	VM1791
o-Xylene	<30ug/l	05	VM1791

DATE: 03/06/98

Upstate Laboratories, Inc.
Analysis Results
Report Number: 04998182
Client I.D.: DELTA ENVIRONMENTAL CONSULTANT HB FULLER (GENEVA)
Sampled by: ULI

APPROVAL:
QC:
Lab I.D.: 10170
MW-8 1438H 02/18/98

ULI I.D.: 04998194 Matrix: Water

PARAMETERS	RESULTS	KEY	FILE#
Field Dissolved Oxygen	5.8mg/l		FIELD
Field Eh	-4.2mV		FIELD
Field pH	6.77SU		FIELD
Field Specific Conductivity	960umhos/cm		FIELD
Temperature	6.2degC		FIELD
MBAS	<0.05mg/lLAS		WC0625
TCL Volatiles by EPA Method 8260			
Chloromethane	<3ug/l		VM1790
Bromomethane	<3ug/l		VM1790
Vinyl Chloride	<2ug/l		VM1790
Chloroethane	<3ug/l		VM1790
Methylene Chloride	<3ug/l		VM1790
Acetone	<10ug/l		VM1790
Carbon Disulfide	<3ug/l		VM1790
1,1-Dichloroethene	<3ug/l		VM1790
1,1-Dichloroethane	<3ug/l		VM1790
trans-1,2-Dichloroethene	<3ug/l		VM1790
cis-1,2-Dichloroethene	<3ug/l		VM1790
Chloroform	<3ug/l		VM1790
1,2-Dichloroethane	<3ug/l		VM1790
2-Butanone	<10ug/l		VM1790
1,1,1-Trichloroethane	<3ug/l		VM1790
Carbon Tetrachloride	<3ug/l		VM1790
Bromodichloromethane	<3ug/l		VM1790
1,2-Dichloropropane	<3ug/l		VM1790
cis-1,3-Dichloropropene	<3ug/l		VM1790
Trichloroethene	<3ug/l		VM1790
Dibromochloromethane	<3ug/l		VM1790
1,1,2-Trichloroethane	<3ug/l		VM1790
Benzene	<3ug/l		VM1790
trans-1,3-Dichloropropene	<3ug/l		VM1790
Bromoform	<3ug/l		VM1790
4-Methyl-2-pentanone	<10ug/l		VM1790
2-Hexanone	<10ug/l		VM1790
Tetrachloroethene	<3ug/l		VM1790
1,1,2,2-Tetrachloroethane	<3ug/l		VM1790
Toluene	<3ug/l		VM1790
Chlorobenzene	<3ug/l		VM1790
Ethylbenzene	<3ug/l		VM1790

DATE: 03/06/98

Upstate Laboratories, Inc.
Analysis Results
Report Number: 04998182
Client I.D.: DELTA ENVIRONMENTAL CONSULTANT HB FULLER (GENEVA)
Sampled by: ULI

APPROVAL:
QC:
Lab I.D.: 10170

MW-8 1438H 02/18/98

ULI I.D.: 04998194 Matrix: Water

PARAMETERS	RESULTS	KEY	FILE#
Styrene	<3ug/l		VM1790
m-Xylene and p-Xylene	<3ug/l		VM1790
o-Xylene	<3ug/l		VM1790

DATE: 03/06/98

Upstate Laboratories, Inc.
Analysis Results
Report Number: 04998182
Client I.D.: DELTA ENVIRONMENTAL CONSULTANT HB FULLER (GENEVA)
Sampled by: ULI

APPROVAL:
QC:
Lab I.D.: 10170
MW-203 1440H 02/18/98

ULI I.D.: 04998195 Matrix: Water

PARAMETERS	RESULTS	KEY	FILE#
Field Dissolved Oxygen	5.1mg/l		FIELD
Field Eh	-68.6mV		FIELD
Field pH	7.80SU		FIELD
Field Specific Conductivity	760umhos/cm		FIELD
Temperature	8.3degC		FIELD
MBAS	<0.05mg/lLAS		WC0625
TCL Volatiles by EPA Method 8260			
Chloromethane	<3ug/l		VM1791
Bromomethane	<3ug/l		VM1791
Vinyl Chloride	<2ug/l		VM1791
Chloroethane	<3ug/l		VM1791
Methylene Chloride	<3ug/l		VM1791
Acetone	12ug/l		VM1791
Carbon Disulfide	<3ug/l		VM1791
1,1-Dichloroethene	<3ug/l		VM1791
1,1-Dichloroethane	<3ug/l		VM1791
trans-1,2-Dichloroethene	<3ug/l		VM1791
cis-1,2-Dichloroethene	<3ug/l		VM1791
Chloroform	<3ug/l		VM1791
1,2-Dichloroethane	<3ug/l		VM1791
2-Butanone	<10ug/l		VM1791
1,1,1-Trichloroethane	<3ug/l		VM1791
Carbon Tetrachloride	<3ug/l		VM1791
Bromodichloromethane	<3ug/l		VM1791
1,2-Dichloropropane	<3ug/l		VM1791
cis-1,3-Dichloropropene	<3ug/l		VM1791
Trichloroethene	<3ug/l		VM1791
Dibromochloromethane	<3ug/l		VM1791
1,1,2-Trichloroethane	<3ug/l		VM1791
Benzene	<3ug/l		VM1791
trans-1,3-Dichloropropene	<3ug/l		VM1791
Bromoform	<3ug/l		VM1791
4-Methyl-2-pentanone	<10ug/l		VM1791
2-Hexanone	<10ug/l		VM1791
Tetrachloroethene	<3ug/l		VM1791
1,1,2,2-Tetrachloroethane	<3ug/l		VM1791
Toluene	<3ug/l		VM1791
Chlorobenzene	<3ug/l		VM1791
Ethylbenzene	<3ug/l		VM1791

DATE: 03/06/98

Upstate Laboratories, Inc.
Analysis Results
Report Number: 04998182
Client I.D.: DELTA ENVIRONMENTAL CONSULTANT HB FULLER (GENEVA)
Sampled by: ULI

APPROVAL:
QC:
Lab I.D.: 10170

MW-203 1440H 02/18/98

ULI I.D.: 04998195 Matrix: Water

PARAMETERS	RESULTS	KEY	FILE#
Styrene	<3ug/l		VM1791
m-Xylene and p-Xylene	<3ug/l		VM1791
o-Xylene	<3ug/l		VM1791

DATE: 03/06/98

Upstate Laboratories, Inc.
Analysis Results
Report Number: 04998182
Client I.D.: DELTA ENVIRONMENTAL CONSULTANT HB FULLER (GENEVA)
Sampled by: ULI

APPROVAL:
QC:
Lab I.D.: 10170

S-1 1455H 02/18/98

ULI I.D.: 04998196 Matrix: Water

PARAMETERS	RESULTS	KEY	FILE#
Field Dissolved Oxygen	8.8mg/l		FIELD
Field Eh	-27.7mV		FIELD
Field pH	7.23SU		FIELD
Field Specific Conductivity	300umhos/cm		FIELD
Temperature	3.4degC		FIELD
MBAS	<0.05mg/lLAS		WC0625
TCL Volatiles by EPA Method 8260			
Chloromethane	<3ug/l		VM1791
Bromomethane	<3ug/l		VM1791
Vinyl Chloride	<2ug/l		VM1791
Chloroethane	<3ug/l		VM1791
Methylene Chloride	<3ug/l		VM1791
Acetone	<10ug/l		VM1791
Carbon Disulfide	<3ug/l		VM1791
1,1-Dichloroethene	<3ug/l		VM1791
1,1-Dichloroethane	<3ug/l		VM1791
trans-1,2-Dichloroethene	<3ug/l		VM1791
cis-1,2-Dichloroethene	<3ug/l		VM1791
Chloroform	<3ug/l		VM1791
1,2-Dichloroethane	<3ug/l		VM1791
2-Butanone	<10ug/l		VM1791
1,1,1-Trichloroethane	<3ug/l		VM1791
Carbon Tetrachloride	<3ug/l		VM1791
Bromodichloromethane	<3ug/l		VM1791
1,2-Dichloropropane	<3ug/l		VM1791
cis-1,3-Dichloropropene	<3ug/l		VM1791
Trichloroethene	<3ug/l		VM1791
Dibromochloromethane	<3ug/l		VM1791
1,1,2-Trichloroethane	<3ug/l		VM1791
Benzene	<3ug/l		VM1791
trans-1,3-Dichloropropene	<3ug/l		VM1791
Bromoform	<3ug/l		VM1791
4-Methyl-2-pentanone	<10ug/l		VM1791
2-Hexanone	<10ug/l		VM1791
Tetrachloroethene	<3ug/l		VM1791
1,1,2,2-Tetrachloroethane	<3ug/l		VM1791
Toluene	<3ug/l		VM1791
Chlorobenzene	<3ug/l		VM1791
Ethylbenzene	<3ug/l		VM1791

DATE: 03/06/98

Upstate Laboratories, Inc.
Analysis Results
Report Number: 04998182
Client I.D.: DELTA ENVIRONMENTAL CONSULTANT HB FULLER (GENEVA)
Sampled by: ULI

APPROVAL:
QC:
Lab I.D.: 10170

S-1 1455H 02/18/98

ULI I.D.: 04998196

Matrix: Water

PARAMETERS	RESULTS	KEY	FILE#
Styrene	<3ug/l		VM1791
m-Xylene and p-Xylene	<3ug/l		VM1791
o-Xylene	<3ug/l		VM1791

DATE: 03/06/98

Upstate Laboratories, Inc. APPROVAL:
Analysis Results QC:
Report Number: 04998182 Lab I.D.: 10170
Client I.D.: DELTA ENVIRONMENTAL CONSULTANT HB FULLER (GENEVA)
Sampled by: ULI S-2 1505H 02/18/98

ULI I.D.: 04998197 Matrix: Water

PARAMETERS	RESULTS	KEY	FILE#
Field Dissolved Oxygen	8.6mg/l		FIELD
Field Eh	-28.9mV		FIELD
Field pH	7.22SU		FIELD
Field Specific Conductivity	300umhos/cm		FIELD
Temperature	3.3decC		FIELD
MBAS	<0.05mg/lLAS		WC0625
TCL Volatiles by EPA Method 8260			
Chloromethane	<3ug/l		VM1791
Bromomethane	<3ug/l		VM1791
Vinyl Chloride	<2ug/l		VM1791
Chloroethane	<3ug/l		VM1791
Methylene Chloride	<3ug/l		VM1791
Acetone	<10ug/l		VM1791
Carbon Disulfide	<3ug/l		VM1791
1,1-Dichloroethene	<3ug/l		VM1791
1,1-Dichloroethane	<3ug/l		VM1791
trans-1,2-Dichloroethene	<3ug/l		VM1791
cis-1,2-Dichloroethene	<3ug/l		VM1791
Chloroform	<3ug/l		VM1791
1,2-Dichloroethane	<3ug/l		VM1791
2-Butanone	<10ug/l		VM1791
1,1,1-Trichloroethane	<3ug/l		VM1791
Carbon Tetrachloride	<3ug/l		VM1791
Bromodichloromethane	<3ug/l		VM1791
1,2-Dichloropropane	<3ug/l		VM1791
cis-1,3-Dichloropropene	<3ug/l		VM1791
Trichloroethene	<3ug/l		VM1791
Dibromochloromethane	<3ug/l		VM1791
1,1,2-Trichloroethane	<3ug/l		VM1791
Benzene	<3ug/l		VM1791
trans-1,3-Dichloropropene	<3ug/l		VM1791
Bromoform	<3ug/l		VM1791
4-Methyl-2-pentanone	<10ug/l		VM1791
2-Hexanone	<10ug/l		VM1791
Tetrachloroethene	<3ug/l		VM1791
1,1,2,2-Tetrachloroethane	<3ug/l		VM1791
Toluene	<3ug/l		VM1791
Chlorobenzene	<3ug/l		VM1791
Ethylbenzene	<3ug/l		VM1791

DATE: 03/06/98

Upstate Laboratories, Inc.
Analysis Results
Report Number: 04998182
Client I.D.: DELTA ENVIRONMENTAL CONSULTANT HB FULLER (GENEVA)
Sampled by: ULI

APPROVAL:
QC:
Lab I.D.: 10170

S-2 1505H 02/18/98

ULI I.D.: 04998197   Matrix: Water

PARAMETERS	RESULTS	KEY	FILE#
Styrene	<3ug/l		VM1791
m-Xylene and p-Xylene	<3ug/l		VM1791
o-Xylene	<3ug/l		VM1791

DATE: 03/06/98

Upstate Laboratories, Inc.
Analysis Results
Report Number: 04998182
Client I.D.: DELTA ENVIRONMENTAL CONSULTANT HB FULLER (GENEVA)
Sampled by: ULI

APPROVAL:
QC:
Lab I.D.: 10170
S-3 1500H 02/18/98

ULI I.D.: 04998198 Matrix: Water

PARAMETERS	RESULTS	KEY	FILE#
Field Dissolved Oxygen	9.0mg/l		FIELD
Field Eh	-23.1mV		FIELD
Field pH	7.12SU		FIELD
Field Specific Conductivity	320umhos/cm		FIELD
Temperature	3.6degC		FIELD
MBAS	<0.05mg/lLAS		WC0625
TCL Volatiles by EPA Method 8260			
Chloromethane	<3ug/l		VM1791
Bromomethane	<3ug/l		VM1791
Vinyl Chloride	<2ug/l		VM1791
Chloroethane	<3ug/l		VM1791
Methylene Chloride	<3ug/l		VM1791
Acetone	<10ug/l		VM1791
Carbon Disulfide	<3ug/l		VM1791
1,1-Dichloroethene	<3ug/l		VM1791
1,1-Dichloroethane	<3ug/l		VM1791
trans-1,2-Dichloroethene	<3ug/l		VM1791
cis-1,2-Dichloroethene	<3ug/l		VM1791
Chloroform	<3ug/l		VM1791
1,2-Dichloroethane	<3ug/l		VM1791
2-Butanone	<10ug/l		VM1791
1,1,1-Trichloroethane	<3ug/l		VM1791
Carbon Tetrachloride	<3ug/l		VM1791
Bromodichloromethane	<3ug/l		VM1791
1,2-Dichloropropane	<3ug/l		VM1791
cis-1,3-Dichloropropene	<3ug/l		VM1791
Trichloroethene	<3ug/l		VM1791
Dibromochloromethane	<3ug/l		VM1791
1,1,2-Trichloroethane	<3ug/l		VM1791
Benzene	<3ug/l		VM1791
trans-1,3-Dichloropropene	<3ug/l		VM1791
Bromoform	<3ug/l		VM1791
4-Methyl-2-pentanone	<10ug/l		VM1791
2-Hexanone	<10ug/l		VM1791
Tetrachloroethene	<3ug/l		VM1791
1,1,2,2-Tetrachloroethane	<3ug/l		VM1791
Toluene	<3ug/l		VM1791
Chlorobenzene	<3ug/l		VM1791
Ethylbenzene	<3ug/l		VM1791

DATE: 03/06/98

Upstate Laboratories, Inc.
Analysis Results
Report Number: 04998182
Client I.D.: DELTA ENVIRONMENTAL CONSULTANT HB FULLER (GENEVA)
Sampled by: ULI

APPROVAL:
QC:
Lab I.D.: 10170

S-3 1500H 02/18/98

ULI I.D.: 04998198

Matrix: Water

PARAMETERS	RESULTS	KEY	FILE#
Styrene	<3ug/l		VM1791
m-Xylene and p-Xylene	<3ug/l		VM1791
o-Xylene	<3ug/l		VM1791

KEY PAGE

1 MATRIX INTERFERENCE PRECLUDES LOWER DETECTION LIMITS
2 MATRIX INTERFERENCE
3 PRESENT IN BLANK
4 ANALYSIS NOT PERFORMED BECAUSE OF INSUFFICIENT SAMPLE
5 THE PRESENCE OF OTHER TARGET ANALYTE(S) PRECLUDES LOWER DETECTION LIMITS
6 BLANK CORRECTED
7 HEAD SPACE PRESENT IN SAMPLE
8 QUANTITATION LIMIT IS GREATER THAN THE CALCULATED REGULATORY LEVEL. THE QUANTITATION LIMIT THEREFORE BECOMES THE REGULATORY LEVEL.
9 THE OIL WAS TREATED AS A SOLID AND LEACHED WITH EXTRACTION FLUID
10 ADL(AVERAGE DETECTION LIMITS)
11 PQL(PRACTICAL QUANTITATION LIMITS)
12 SAMPLE ANALYZED OVER HOLDING TIME
13 DISSOLVED VALUE MAY BE HIGHER THAN TOTAL DUE TO CONTAMINATION FROM THE FILTERING PROCEDURE
14 SAMPLED BY ULI
15 DISSOLVED VALUE MAY BE HIGHER THAN TOTAL; HOWEVER, THE VALUES ARE WITHIN EXPERIMENTAL ERROR
16 AN INHIBITORY FACTOR WAS OBSERVED IN THIS ANALYSIS
17 PARAMETER NOT ANALYZED WITHIN 15 MINUTES OF SAMPLING
18 THE SERIAL DILUTION OF THIS SAMPLE SUGGESTS A POSSIBLE PHYSICAL AND/OR CHEMICAL INTERFERENT IN THIS DETERMINATION. THE DATA MAY BE BIASED EITHER HIGH OR LOW.
19 CALCULATION BASED ON DRY WEIGHT
20 INDICATES AN ESTIMATED VALUE, DETECTED BUT BELOW THE PRACTICAL QUANTITATION LIMITS
21 UG/KG AS REC.D / UG/KG DRY WT
22 MG/KG AS REC.D / MG/KG DRY WT
23 INSUFFICIENT SAMPLE PRECLUDES LOWER DETECTION LIMITS
24 SAMPLE DILUTED/BLANK CORRECTED
25 ND(NON-DETECTED)
26 MATRIX INTERFERENCE PRECLUDES LOWER DETECTION LIMITS/BLANK CORRECTED
27 SPIKE RECOVERY ABNORMALLY HIGH/LOW DUE TO MATRIX INTERFERENCE
28 POST-DIGESTION SPIKE FOR FURNACE AA ANALYSIS IS OUTSIDE OF THE CONTROL LIMITS (85-115%); HOWEVER, THE SAMPLE CONCENTRATION IS BELOW THE PQL
29 ANALYZED BY METHOD OF STANDARD ADDITIONS
30 METHOD PERFORMANCE STUDY HAS NOT BEEN COMPLETED/ND(NON-DETECTED)
31 FIELD MEASURED PARAMETER TAKEN BY CLIENT
32 TARGET ANALYTE IS BIODEGRADED AND/OR ENVIRONMENTALLY WEATHERED
33 NON-POTABLE WATER SOURCE
34 THE QUALITY CONTROL RESULTS FOR THIS ANALYSIS INDICATE A POSITIVE BIAS OF 1-5 MG/L. THE POSITIVE BIAS FALLS BELOW THE PUBLISHED EPA REGULATORY DETECTION LIMIT OF 5 MG/L BUT ABOVE 1 MG/L.
35 THE HYDROCARBONS DETECTED IN THE SAMPLE DID NOT CROSS-MATCH WITH COMMON PETROLEUM DISTILLATES
36 MATRIX INTERFERENCE CAUSING SPIKES TO RESULT IN LESS THAN 50.0% RECOVERY
37 MILLIGRAMS PER LITER (MG/L) / POUNDS (LBS) PER DAY
38 MILLIGRAMS PER LITER (MG/L) OF RESIDUAL CHLORINE (CL2) / POUNDS (LBS) PER DAY OF CL2
39 MICROGRAMS PER LITER (UG/L) / POUNDS (LBS) PER DAY
40 MILLIGRAMS PER LITER (MG/L) LINEAR ALKYL SULFONATE (LAS) / POUNDS (LBS) PER DAY LAS
41 RESULTS ARE REPORTED ON AN AS REC.D BASIS
42 THE SAMPLE WAS ANALYZED ON A TOTAL BASIS; THE TEST RESULT CAN BE COMPARED TO THE TCLP REGULATORY CRITERIA BY DIVIDING THE TEST RESULT BY 20, CREATING A THEORETICAL TCLP VALUE
43 METAL BY CONCENTRATION PROCEDURE
44 POSSIBLE CONTAMINATION FROM FIELD/LABORATORY

Daily Q.C. Logsheet
Field Sampling

Date: 2/18/98	
Sampler:	

Standards / Reagents table				
Chemical	Vendor	Catalog #	Lot #	Expires
pH 4.0 Buffer	Fischer	SB-101-20	964104-24	Jun-98
pH 7.0 Buffer	Fischer	SB-107-20	967660-24	Nov-98
pH 10.0 Buffer	Fischer	SB-115-20	967713-24	Nov-98
718 umhos Std.	Myron-L	01489-94	7732-18-5	Apr-98
HCl Preservative	Fischer	N/A	936437	N/A
HNO3 Preservative	Fischer	N/A	967090	N/A

Instrument Calibration Data				
Instrument	QC Measurement		Limits (LCL - UCL)	
pH METER	pH: 4.0- 3.91; 10.0- 10.14	Slope: 97.8	Slope = 80 - 120 %	
	7.0 Buffer Check: 7.04		6.8 - 7.2	
	Clean Probe	Yes	Replace Probe	NO
	Test Battery	Yes	Replace Battery	NO
CONDUCTIVITY METER	718 umhos Standard: 718		Set Point 718	
	Cell Constant: 718		Typical 10	
	Clean Probe		Replace Probe	
	Test Battery		Replace Battery	
Min / Max Thermometer N/A	Hg Intact Yes No	Initial	N/A	
	Minimum	Maximum	Range 0 Deg. C to 4 Deg.C	

Daily Q.C. Logsheet
Field Sampling

Date: 2/19/98	
Sampler:	

Standards / Reagents table				
Chemical	Vendor	Catalog #	Lot #	Expires
pH 4.0 Buffer	Fischer	SB-101-20	964104-24	Jun-98
pH 7.0 Buffer	Fischer	SB-107-20	967660-24	Nov-98
pH 10.0 Buffer	Fischer	SB-115-20	967713-24	Nov-98
718 umhos Std.	Myron-L	01489-94	7732-18-5	Apr-98
HCl Preservative	Fischer	N/A	936437	N/A
HNO3 Preservative	Fischer	N/A	967090	N/A

Instrument Calibration Data				
Instrument	QC Measurement		Limits (LCL - UCL)	
pH METER	pH: 4.0- 3.80; 10.0-	Slope: 101.1	Slope = 80 - 120 %	
	7.0 Buffer Check: 7.09		6.8 - 7.2	
	Clean Probe	Yes	Replace Probe	no
	Test Battery	Yes	Replace Battery	no
CONDUCTIVITY METER	718 umhos Standard: 716		Set Point 718	
	Cell Constant: 718		Typical 10	
	Clean Probe		Replace Probe	
	Test Battery		Replace Battery	
Min / Max Thermometer N/A	Hg Intact Yes No	Initial	N/A	
	Minimum	Maximum	Range 0 Deg. C to 4 Deg.C	

Upstate Laboratories, Inc. Ground water Field Log — File: TS-30-01 — Revised: 2/97

Client: DELTA ENVIRONMENTAL

Project: HB FULLER

Well ID.: MW-5

ULI ID No. (enter by lab)

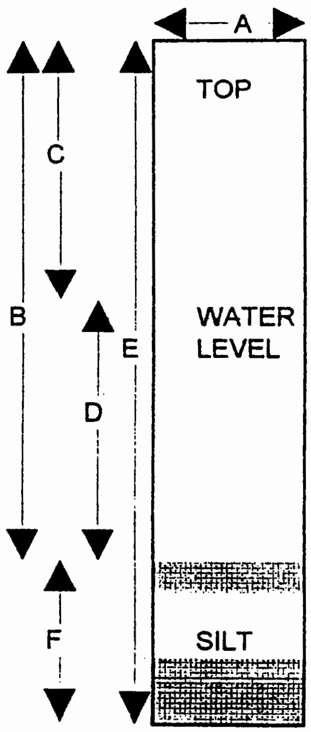
Condition of Well: GOOD

Locked: Yes No

Method of Evacuation: HAND BAILER

Lock ID:

Method of Sampling: HAND BAILER



A.	Diameter of Well	2	inches
B.	Well Depth Measured	14.50	feet
C.	Depth to Water	6.00	feet
D.	Length of Water Column (calculated)	8.50	feet
	Conversion Factor	.16	-----
	Well Volume (calculated)	1.36	gallons
	No. of Volumes to be Evacuated	3	-----
	Total Volume to be Evacuated	4.08	gallons
	Actual Volume Evacuated	4 GALLONS	gallons
E.	Installed Well Depth (if known)	N/A	feet
F.	Depth of Silt (calculated	N/A	feet

Field Measurements	Initial Evacuation		Second		Final Sampling
Date	2/18/98		2/18/98		2/18/98
Time	1253		1257		1304
EH	17.3		15.4		12.9
Temperature	9.7		10.0		10.1
pH	6.39		6.45		6.48
Specific Cond.	1300		1200		1200
Turbidity	N/A		N/A		N/A
Dissolved Oxygen	2.2		3.0		3.4
Appearance	Cloudy		BROWN		BROWN

Weather: Observations: Cloudy, RAIN, 40°F

% Recharge:

Initial Depth to Water N/A feet

Recharge Depth to Water N/A feet

2nd water column height / 1st water column height N/A %

Elevation(Top of Casing) N/A feet

G.W. Elevation= N/A feet

G.W.Elevation =Top of Case Elev-Total Depth

Sampler: PETE Rundell

Signature:

Upstate Laboratories, Inc. Ground water Field Log

File: TS-30-01 Revised: 2/97

Client: DELTA ENVIRONMENTAL

Project: HB FULLER

Well ID.: MW-6

ULI ID No. (enter by lab)

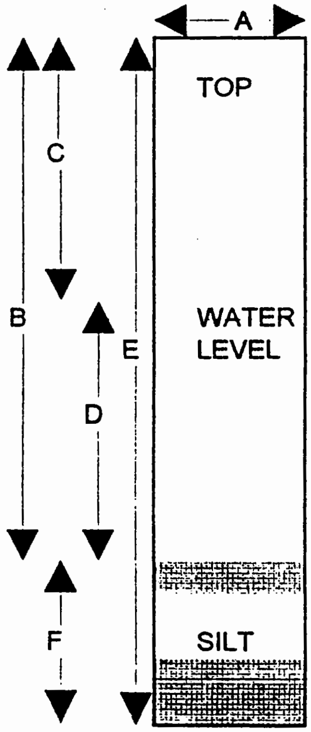
Condition of Well: GOOD

Locked: Yes No

Method of Evacuation: HAND BAILER

Lock ID:

Method of Sampling: HAND BAILER



A.	Diameter of Well	2	inches
B.	Well Depth Measured	15.60	feet
C.	Depth to Water	1.82	feet
D.	Length of Water Column (calculated)	13.78	feet
	Conversion Factor	.16	-----
	Well Volume (calculated)	2.2	gallons
	No. of Volumes to be Evacuated	3	-----
	Total Volume to be Evacuated	6.6	gallons
	Actual Volume Evacuated	6.5	gallons
E.	Installed Well Depth (if known)	N/A	feet
F.	Depth of Silt (calculated	N/A	feet

Field Measurements	Initial Evacuation		Second		Final Sampling
Date	2/18/98		2/18/98		2/18/98
Time	----		1420		14:25
EH	-0.8		1.0		2.2
Temperature	7.7		8.0		8.5
pH	6.73		6.70		6.65
Specific Cond.	840		860		860
Turbidity	N/A		N/A		N/A
Dissolved Oxygen	2.4		2.8		3.0
Appearance	GRAY/Cloudy		GRAY/cloudy		GRAY/Cloudy

Weather: Cloudy, RAIN, 40°F

Observations: "

% Recharge:

Initial Depth to Water N/A feet

Recharge Depth to Water N/A feet

2nd water column height / 1st water column height N/A %

Elevation(Top of Casing) N/A feet

G.W. Elevation= N/A feet

G.W.Elevation =Top of Case Elev-Total Depth

Sampler:

Signature:

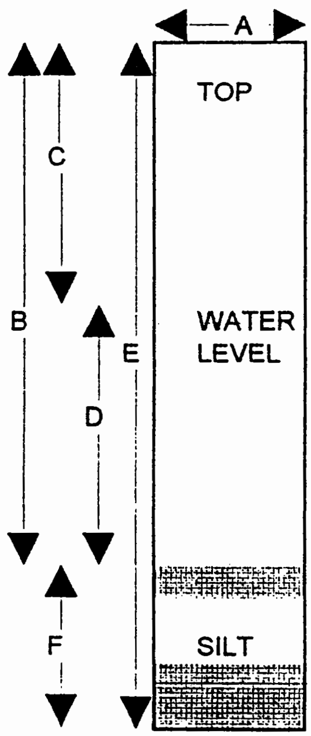
Upstate Laboratories, Inc. Ground water Field Log

File: TS-30-01 Revised: 2/97

Client: DELTA ENVIRONMENTAL
Project: HB FULLER GENEVA
Well ID.: MW-7

ULI ID No. (enter by lab)

Condition of Well: GOOD
Locked: Yes No
Method of Evacuation: HAND BAILER
Lock ID:
Method of Sampling: HAND BAILER



A.	Diameter of Well	2	inches
B.	Well Depth Measured	19.42	feet
C.	Depth to Water	8.67	feet
D.	Length of Water Column (calculated)	10.75	feet
	Conversion Factor	.16	-----
	Well Volume (calculated)	1.72	gallons
	No. of Volumes to be Evacuated	3	-----
	Total Volume to be Evacuated	5.16	gallons
	Actual Volume Evacuated	5	gallons
E.	Installed Well Depth (if known)	N/A	feet
F.	Depth of Silt (calculated	N/A	feet

Field Measurements	Initial Evacuation		Second		Final Sampling
Date	2/18/98		2/18/98		2/18/98
Time	10 37		10 45		10.59
EH	24.5		10.7		2.2
Temperature	8.2		8.5		8.2
pH	6.50		6.73		6.87
Specific Cond.	390		450		440
Turbidity	N/A		N/A		N/A
Dissolved Oxygen	6.0		5.6		6.6
Appearance	Cloudy		GRAYISH		GRAYISH/cloudy

Weather: 40°F, RAIN, Cloudy
Observations:

% Recharge:

Initial Depth to Water N/A feet
Recharge Depth to Water N/A feet
2nd water column height / 1st water column height N/A %

Elevation(Top of Casing) N/A feet
G.W. Elevation= N/A feet
G.W.Elevation =Top of Case Elev-Total Depth

Sampler: PETE RUDDELL
Signature:

Upstate Laboratories, Inc. Ground water Field Log

File: TS-30-01 Revised: 2/97

Client: DELTA ENVIRONMENTAL

Project: HB FULLER GENEVA

Well ID.: MW-2

ULI ID No. (enter by lab)

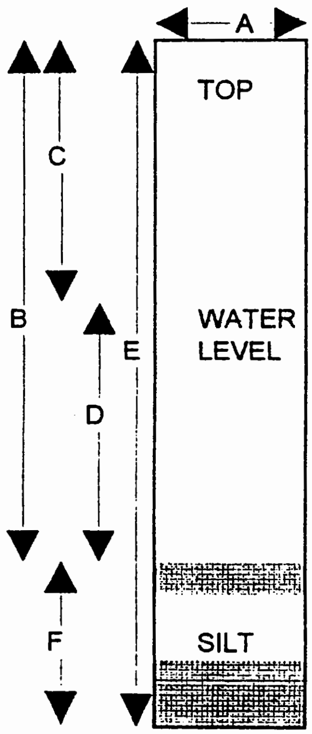
Condition of Well: GOOD

Locked: Yes No

Method of Evacuation: HAND BAILER

Lock ID:

Method of Sampling: HAND BAILER



A.	Diameter of Well	2	inches
B.	Well Depth Measured	14.89	feet
C.	Depth to Water	3.90	feet
D.	Length of Water Column (calculated)	10.99	feet
	Conversion Factor	.16	------
	Well Volume (calculated)	1.75	gallons
	No. of Volumes to be Evacuated	3	------
	Total Volume to be Evacuated	5.25	gallons
	Actual Volume Evacuated	5.25	gallons
E.	Installed Well Depth (if known)	N/A	feet
F.	Depth of Silt (calculated	N/A	feet

Field Measurements	Initial Evacuation		Second		Final Sampling
Date	2/18/98		N/A		2/18/98
Time	826				947
EH	-15.9				-40.2
Temperature	7.4 C°				9.6
pH	7.21				7.66
Specific Cond.	3200				4200
Turbidity	N/A				N/A
Dissolved Oxygen	4.9				5.8
Appearance	GRAY				GRAY

Weather: Cloudy, 40°F, RAIN

Observations: PURGE WATER CONTAIN ALOT SUDS AND SOAP WATER

% Recharge:

Initial Depth to Water N/A feet

Recharge Depth to Water N/A feet

2nd water column height / 1st water column height N/A %

Elevation(Top of Casing) N/A feet

G.W. Elevation= N/A feet

G.W.Elevation =Top of Case Elev-Total Depth

Sampler: PETE RUNDELL

Signature: [signature]

Upstate Laboratories, Inc. Ground water Field Log

File: TS-30-01 Revised: 2/97

Client: DELTA ENVIRONMENTAL

Project: HR FULLER GENEVA

Well ID.: MW-202

ULI ID No. (enter by lab)

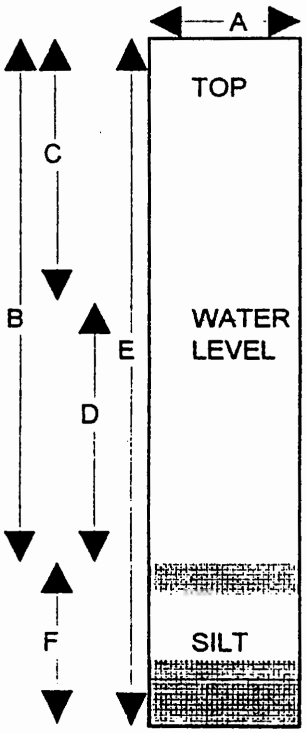
Condition of Well: GOOD

Locked: Yes No

Method of Evacuation: HAND BAILER

Lock ID:

Method of Sampling: HAND BAILER



A.	Diameter of Well	2	inches
B.	Well Depth Measured	22.35	feet
C.	Depth to Water	12.30	feet
D.	Length of Water Column (calculated)	10.05	feet
	Conversion Factor	.16	-----
	Well Volume (calculated)	1.61	gallons
	No. of Volumes to be Evacuated	3	-----
	Total Volume to be Evacuated	4.83	gallons
	Actual Volume Evacuated	2.5 DRY	gallons
E.	Installed Well Depth (if known)	N/A	feet
F.	Depth of Silt (calculated	N/A	feet

Field Measurements	Initial Evacuation		Second		Final Sampling
Date	2/18/98		N/A		2/18/98
Time	8:18				932
EH	-144.8				-41.9
Temperature	11.8				11.7
pH	9.5				7.7
Specific Cond.	700				800
Turbidity	N/A				N/A
Dissolved Oxygen	5.1				6.8
Appearance	GRAY				GRAY

Weather: Observations: Cloudy, RAIN, 40°F

% Recharge:

Initial Depth to Water N/A feet

Recharge Depth to Water N/A feet

2nd water column height N/A %

1st water column height

Elevation(Top of Casing) N/A feet

G.W. Elevation= N/A feet

G.W.Elevation =Top of Case Elev-Total Depth

Sampler: PETE Rundell

Signature: [signature]

Upstate Laboratories, Inc. Ground water Field Log

File: TS-30-01 Revised: 2/97

Client: DELTA ENVIRONMENTAL

Project: HB FULLER GENEVA

Well ID.: MW-10

ULI ID No. (enter by lab)

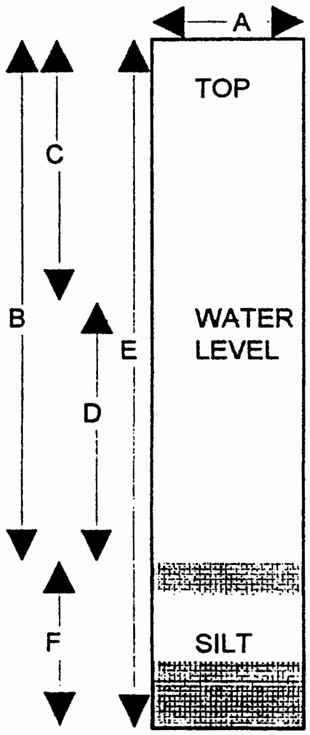
Condition of Well: GOOD

Locked: Yes No

Method of Evacuation: HAND BAILER

Lock ID:

Method of Sampling: BAILER



A.	Diameter of Well	1¼	inches
B.	Well Depth Measured	12.00	feet
C.	Depth to Water	9.20	feet
D.	Length of Water Column (calculated)		feet
	Conversion Factor	.08	-----
	Well Volume (calculated)	.22	gallons
	No. of Volumes to be Evacuated	3	-----
	Total Volume to be Evacuated	.66	gallons
	Actual Volume Evacuated	.25 DRY	gallons
E.	Installed Well Depth (if known)	N/A	feet
F.	Depth of Silt (calculated	NA	feet

Field Measurements	Initial Evacuation		Second		Final Sampling
Date	2/18/98		2/18/98		2/18/98
Time	1316		1317		1512
EH	-13		-25		↓VOC's ONLY
Temperature	9.1		8.7		
pH	6.96		7.18		
Specific Cond.	1200		1000		
Turbidity	N/A		N/A		
Dissolved Oxygen	4.8		5.8		
Appearance	BROWN		BROWN		

% Recharge:

Initial Depth to Water N/A feet

Recharge Depth to Water N/A feet

2nd water column height N/A %

1st water column height

Elevation(Top of Casing) N/A feet

G.W. Elevation= N/A feet

G.W.Elevation =Top of Case Elev-Total Depth

Weather:

Observations: HEAVY Silt + SAND IN BOTTOM of well

* UNABLE TO GET MBAS SAMPLE ON 2/19/98 due to poor Recharge.

* UNABLE TO GET FINAL FIELD READINGS DUE TO POOR Recharge.

Sampler: PETE RUDDELL

Signature:

Upstate Laboratories, Inc. Ground water Field Log

File: TS-30-01 Revised: 2/97

Client: DELTA ENVIRONMENTAL
Project: HB FULLER
Well ID.: MW- 11

ULI ID No. (enter by lab)

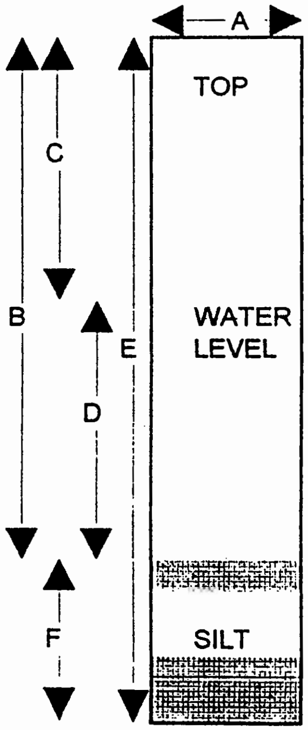
Condition of Well: GOOD

Locked: Yes No

Method of Evacuation: HAND BAILER

Lock ID:

Method of Sampling: BAILER



A.	Diameter of Well	1 1/4	inches
B.	Well Depth Measured	11.25	feet
C.	Depth to Water	5.40	feet
D.	Length of Water Column (calculated)	5.85	feet
	Conversion Factor	.08	-----
	Well Volume (calculated)	.47	gallons
	No. of Volumes to be Evacuated	3	-----
	Total Volume to be Evacuated	1.41	gallons
	Actual Volume Evacuated	.75 DRY	gallons
E.	Installed Well Depth (if known)	N/A	feet
F.	Depth of Silt (calculated	N/A	feet

Field Measurements	Initial Evacuation		Second		Final Sampling
Date	2/18/98		NOT		2/18/98
Time	1340		ENOUGH		1401
EH	-32.8		WATER		-17.9
Temperature	7.1		IN		7.7
pH	7.10		WELL		7.04
Specific Cond.	1100				900
Turbidity	N/A				N/A
Dissolved Oxygen	6.1				2.2
Appearance	BROWN				BROWN

% Recharge:

Initial Depth to Water N/A feet

Recharge Depth to Water N/A feet

2nd water column height / 1st water column height N/A %

Elevation(Top of Casing) N/A feet

G.W. Elevation= N/A feet

G.W.Elevation =Top of Case Elev-Total Depth

Weather:

Observations: HEAVY SILT, THE DROP IN Dissolved oxygen Could be due TO The heavy silt + SAND in well

Sampler: PETE Rundell

Signature:

Upstate Laboratories, Inc. Ground water Field Log

File: TS-30-01 Revised: 2/97

Client: DELTA ENVIRONMENTAL

Project: HB FULLER GENEVA

Well ID.: MW-1

ULI ID No. (enter by lab)

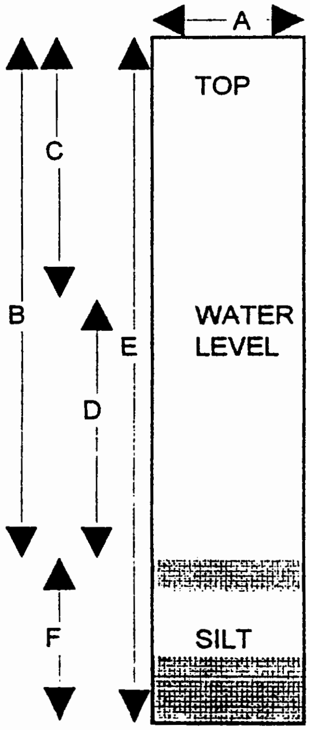
Condition of Well: GOOD

Locked: Yes No

Method of Evacuation: HAND BAILER

Lock ID:

Method of Sampling: BAILER



A.	Diameter of Well	2	inches
B.	Well Depth Measured	17.40	feet
C.	Depth to Water	7.80	feet
D.	Length of Water Column (calculated)	9.60	feet
	Conversion Factor	.16	-----
	Well Volume (calculated)	1.53	gallons
	No. of Volumes to be Evacuated	3	-----
	Total Volume to be Evacuated	4.59	gallons
	Actual Volume Evacuated	4	gallons
E.	Installed Well Depth (if known)	N/A	feet
F.	Depth of Silt (calculated	N/A	feet

Field Measurements	Initial Evacuation		Second		Final Sampling
Date	2/18/98		2/18/98		2/18/98
Time	954		10 05		1207
EH	8.9		11.6		9.4
Temperature	8.6		8.6		8.0
pH	6.80		6.68		6.74
Specific Cond.	700		790		620
Turbidity	N/A		N/A		N/A
Dissolved Oxygen	3.8		4.0		5.6
Appearance	Reddish		Redish		Cloudy

Weather: Observations: Cloudy, 40°F, RAIN

% Recharge:

Initial Depth to Water N/A feet

Recharge Depth to Water N/A feet

2nd water column height / 1st water column height N/A %

Elevation(Top of Casing) N/A feet

G.W. Elevation= N/A feet

G.W.Elevation =Top of Case Elev-Total Depth

Sampler: PETE Rundell

Signature:

Upstate Laboratories, Inc. Ground water Field Log

File: TS-30-01 Revised: 2/97

Client: DELTA ENVIRONMENTAL

Project: HB FULLER GENEVA

Well ID.: MW-4

ULI ID No. (enter by lab)

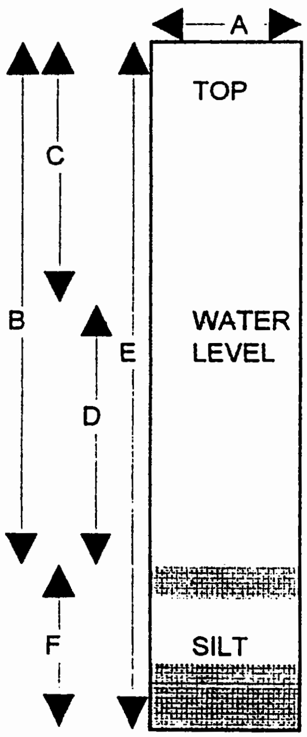
Condition of Well: GOOD

Locked: Yes No

Method of Evacuation: HAND BAILER

Lock ID:

Method of Sampling: BAILER



A.	Diameter of Well	2	inches
B.	Well Depth Measured	11.90	feet
C.	Depth to Water	3.80	feet
D.	Length of Water Column (calculated)	8.1	feet
	Conversion Factor	.16	----
	Well Volume (calculated)	1.29	gallons
	No. of Volumes to be Evacuated	3	----
	Total Volume to be Evacuated	3.8	gallons
	Actual Volume Evacuated	4	gallons
E.	Installed Well Depth (if known)	-	feet
F.	Depth of Silt (calculated	-	feet

Field Measurements	Initial Evacuation		Second		Final Sampling
Date	2/18/98		2/18/98		2/18/98
Time	1132		1139		1242
EH	-12.1		-80.9		-83.4
Temperature C°	8.4		8.9		9.3
pH	7.16		8.32		8.20
Specific Cond.	530		320		400
Turbidity	N/A		N/A		N/A
Dissolved Oxygen	2.6		4.2		5.0
Appearance	GRAY		DK.GRAY		DK.GRAY

Weather: Cloudy, RAIN, 40°F

Observations:

% Recharge:

Initial Depth to Water N/A feet

Recharge Depth to Water N/A feet

2nd water column height N/A %
1st water column height

Elevation(Top of Casing) N/A feet

G.W. Elevation= N/A feet

G.W.Elevation =Top of Case Elev-Total Depth

Sampler: PETE RANDELL

Signature:

Upstate Laboratories, Inc. Ground water Field Log

File: TS-30-01 Revised: 2/97

Client: DELTA ENVIRONMENTAL

Project: HB FULLER GENEVA

Well ID.: MW-3

ULI ID No. (enter by lab)

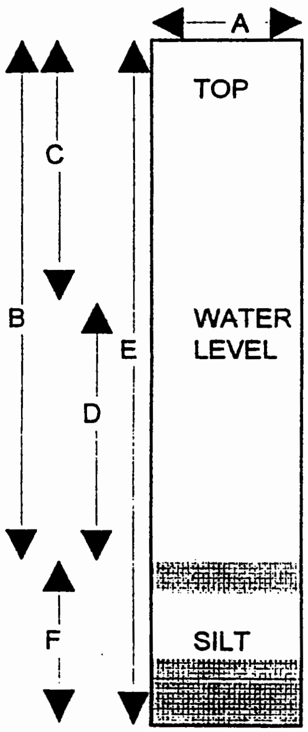
Condition of Well: GOOD

Locked: Yes No

Method of Evacuation: HAND BAILER

Lock ID:

Method of Sampling: BAILER



A.	Diameter of Well	2	inches
B.	Well Depth Measured	14.35	feet
C.	Depth to Water	4.94	feet
D.	Length of Water Column (calculated)	9.41	feet
	Conversion Factor	.16	-----
	Well Volume (calculated)	1.50	gallons
	No. of Volumes to be Evacuated	3	-----
	Total Volume to be Evacuated	4.5	gallons
	Actual Volume Evacuated	4.5	gallons
E.	Installed Well Depth (if known)	N/A	feet
F.	Depth of Silt (calculated	N/A	feet

Field Measurements	Initial Evacuation		Second		Final Sampling
Date	2/18/98		2/18/98		2/18/98
Time	11[13]		1121		12[30]
EH	-94.4		-118.0		-118.6
Temperature C°	9.4		9.8		9.7
pH	8.65		9.07		8.85
Specific Cond.	1000		1800		3000
Turbidity	N/A		N/A		N/A
Dissolved Oxygen	2.2		4.0		4.0
Appearance	GRAY		GRAY		GRAY

Weather: Observations: RAIN, Cloudy, 40°F

% Recharge:

Initial Depth to Water N/A feet

Recharge Depth to Water N/A feet

2nd water column height / 1st water column height N/A %

Elevation(Top of Casing) N/A feet

G.W. Elevation= N/A feet

G.W.Elevation =Top of Case Elev-Total Depth

Sampler: PETE Rundell

Signature:

Upstate Laboratories, Inc. Ground water Field Log File: TS-30-01 Revised: 2/97

Client: DELTA ENVIRONMENTAL

Project: HB FULLER GENEVA

Well ID.: MW- 201

ULI ID No. (enter by lab)

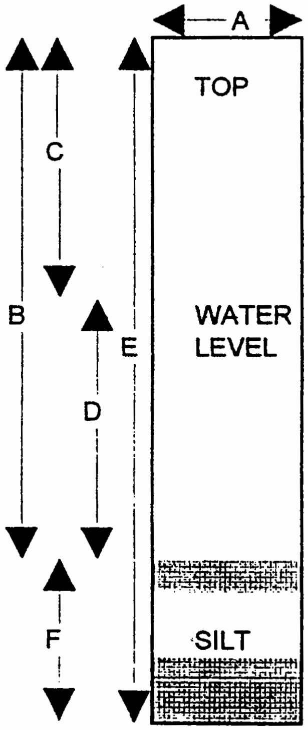
Condition of Well: GOOD

Locked: Yes No

Method of Evacuation: HAND BAILER

Lock ID:

Method of Sampling: BAILER



A.	Diameter of Well	2	inches
B.	Well Depth Measured	25.80	feet
C.	Depth to Water	13.90	feet
D.	Length of Water Column (calculated)	11.9	feet
	Conversion Factor	.16	-----
	Well Volume (calculated)	1.90	gallons
	No. of Volumes to be Evacuated	3	-----
	Total Volume to be Evacuated	5.7	gallons
	Actual Volume Evacuated	6	gallons
E.	Installed Well Depth (if known)	N/A	feet
F.	Depth of Silt (calculated	N/A	feet

Field Measurements	Initial Evacuation		Second		Final Sampling
Date	2/18/98		2/18/98		2/18/98
Time	10^{12}		10^{18}		12^{12}
EH	-16.5		-12.9		-7.2
Temperature	10.4		10.7		10.7
pH	7.19		7.17		7.05
Specific Cond.	810		920		1000
Turbidity	X		X		X
Dissolved Oxygen	4.8		5.1		5.2
Appearance	Cloudy		GRAY		Cloudy/GRAY

Weather: Cloudy, RAIN, 40°F

Observations:

% Recharge:

Initial Depth to Water N/A feet

Recharge Depth to Water N/A feet

2nd water column height N/A %

1st water column height

Elevation(Top of Casing) N/A feet

G.W. Elevation= N/A feet

G.W.Elevation =Top of Case Elev-Total Depth

Sampler: PETE Rundell

Signature:

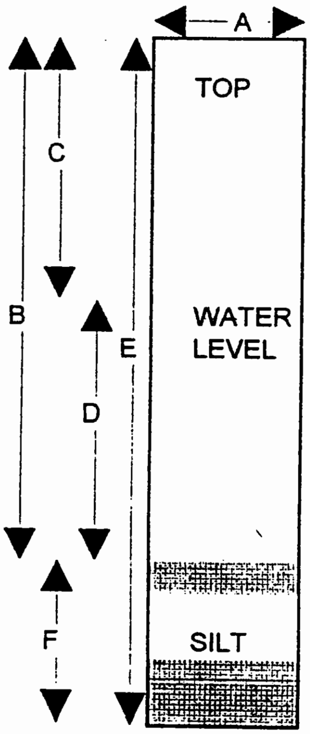
Upstate Laboratories, Inc. Ground water Field Log

File: TS-30-01 Revised: 2/97

Client: DELTA ENVIRONMENTAL
Project: HB FULLER GENEVA
Well ID.: MW-9

ULI ID No. (enter by lab)

Condition of Well: GOOD
Locked: Yes No
Method of Evacuation: HAND BAIL
Lock ID:
Method of Sampling: HAND BAILER



A.	Diameter of Well	1 1/4	inches
B.	Well Depth Measured	13.02	feet
C.	Depth to Water	7.30	feet
D.	Length of Water Column (calculated)	5.72	feet
	Conversion Factor	.08	-----
	Well Volume (calculated)	.46	gallons
	No. of Volumes to be Evacuated	3	-----
	Total Volume to be Evacuated	1.37	gallons
	Actual Volume Evacuated	.5 GALLONS	gallons
E.	Installed Well Depth (if known)	—	feet
F.	Depth of Silt (calculated	—	feet

Field Measurements	Initial Evacuation		Second		Final Sampling
Date	2/18/98		NOT ENOUGH WATER		2/18/98
Time	0847				1145
EH	12.1				8.2
Temperature C°	8.7				8.8
pH	6.70				6.72
Specific Cond.	2400				2200
Turbidity	N/A				N/A
Dissolved Oxygen	3.3				4.0
Appearance	BROWN				BROWN

% Recharge:

Initial Depth to Water N/A feet

Recharge Depth to Water N/A feet

2nd water column height / 1st water column height N/A %

Elevation(Top of Casing) N/A feet

G.W. Elevation= N/A feet

G.W.Elevation =Top of Case Elev-Total Depth

Weather: Cloudy, RAIN, 40°F

Observations: Bottom of well silty

* FLUSH MOUNT WELL

Sampler: PETE Rundell

Signature: [signature]

Upstate Laboratories, Inc. Ground water Field Log

File: TS-30-01 Revised: 2/97

Client: DELTA ENVIRONMENTAL

Project: HB FULLER

Well ID.: MW-8

ULI ID No. (enter by lab)

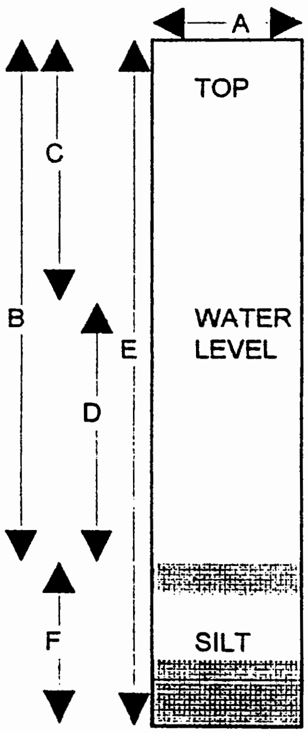
Condition of Well: GOOD

Locked: Yes No

Method of Evacuation: HAND BAILER

Lock ID:

Method of Sampling: HAND BAILER



A.	Diameter of Well	2	inches
B.	Well Depth Measured	16.45	feet
C.	Depth to Water	3.20	feet
D.	Length of Water Column (calculated)	13.25	feet
	Conversion Factor	.16	-----
	Well Volume (calculated)	2.12	gallons
	No. of Volumes to be Evacuated	3	-----
	Total Volume to be Evacuated	6.36	gallons
	Actual Volume Evacuated	6.5	gallons
E.	Installed Well Depth (if known)	N/A	feet
F.	Depth of Silt (calculated	N/A	feet

Field Measurements	Initial Evacuation		Second		Final Sampling
Date	2/18/98		2/18/98		2/18/98
Time	1430		1435		1438
EH	.6		-1.2		-4.2
Temperature	7.8		7.0		6.2
pH	6.71		6.70		6.77
Specific Cond.	900		940		960
Turbidity	N/A		N/A		N/A
Dissolved Oxygen	4.9		5.1		5.8
Appearance	Cloudy		Cloudy		Cloudy

Weather: Cloudy, 40°F, RAIN

Observations:

% Recharge:

Initial Depth to Water ______ feet

Recharge Depth to Water ______ feet

2nd water column height ______ %

1st water column height

Elevation(Top of Casing) ______ feet

G.W. Elevation= ______ feet

G.W.Elevation =Top of Case Elev-Total Depth

Sampler: PETE Rundell

Signature: [signature]

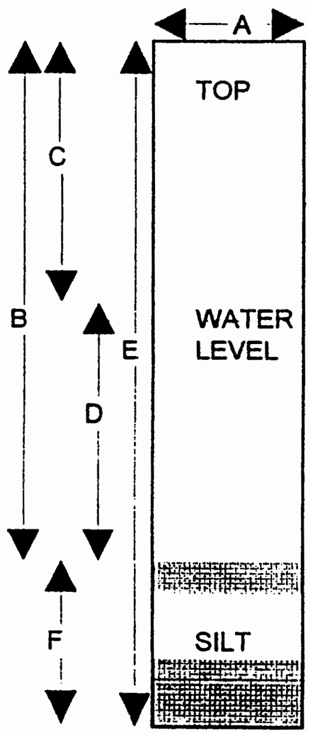
Upstate Laboratories, Inc. Ground water Field Log

File: TS-30-01 Revised: 2/97

Client: DELTA ENVIRONMENTAL
Project: HB FULLER GENEVA
Well ID.: MW- 203

ULI ID No. (enter by lab)

Condition of Well: GOOD
Locked: Yes No
Method of Evacuation: HAND BAILER
Lock ID:
Method of Sampling: HAND BAILER



A.	Diameter of Well	2	inches
B.	Well Depth Measured	24.00	feet
C.	Depth to Water	8.40	feet
D.	Length of Water Column (calculated)	15.6	feet
	Conversion Factor	.16	-----
	Well Volume (calculated)	2.45	gallons
	No. of Volumes to be Evacuated	3	-----
	Total Volume to be Evacuated	7.35	gallons
	Actual Volume Evacuated	7	gallons
E.	Installed Well Depth (if known)	N/A	feet
F.	Depth of Silt (calculated	N/A	feet

Field Measurements	Initial Evacuation		Second		Final Sampling
Date	2/18/98		2/18/98		2/18/98
Time	1430		1435		1440
EH	-68.5		-68.3		-68.6
Temperature	8.3		8.3		8.3
pH	7.97		7.89		7.80
Specific Cond.	780		760		760
Turbidity	N/A		N/A		N/A
Dissolved Oxygen	5.0		5.0		5.1
Appearance	Cloudy		Cloudy		Cloudy

Weather: Cloudy, Rain, 40°F
Observations:

% Recharge:

Initial Depth to Water N/A feet
Recharge Depth to Water N/A feet
2nd water column height / 1st water column height N/A %

Elevation(Top of Casing) N/A feet
G.W. Elevation= N/A feet
G.W.Elevation =Top of Case Elev-Total Depth

Sampler: PETE RUNDELL
Signature:

Upstate Laboratories, Inc.

File: TS-40-01

Tap Water / Surface Water / Wastewater Field Log

Revised: 3/95

Client: DELTA ENVIRONMENTAL

Project: HB FULLER

Date: 2/18/98

Location S-3

Time Sampled: 15 00

ULI ID No. (entered by lab)

Field Measurements:

flow	N/A	(record units)
temperature	3.6	C
pH	7.12	std. units
spec. cond.	320	umhos/cm
turbidity	N/A	NTU
chlorine res.	N/A	mg/l Cl2
sulfite	N/A	mg/l
dis. oxygen	9.0	mg/l

Weather Conditions: Cloudy, RAIN 40°F

Appearance/Observations: Clear

EH - −23.1

If testing for cyanide:
chlorine res. N/A
sulfide ↓

If testing for phenolics:
chlorine res. N/A

Location S-2

Time Sampled: 1

ULI ID No. (entered by lab)

Field Measurements:

flow	N/A	(record units)
temperature	3.3	C
pH	7.22	std. units
spec. cond.	300	umhos/cm
turbidity	N/A	NTU
chlorine res.	N/A	mg/l Cl2
sulfite	N/A	mg/l
dis. oxygen	8.6	mg/l

Weather Conditions: Cloudy, RAIN, 40°F

Appearance/Observations: Clear

EH −28.9

If testing for cyanide:
chlorine res. N/A
sulfide ↓

If testing for phenolics:
chlorine res. N/A

Location S-1

Time Sampled:

ULI ID No. (entered by lab)

Field Measurements:

flow	N/A	(record units)
temperature	3.4	C
pH	7.23	std. units
spec. cond.	300	umhos/cm
turbidity	N/A	NTU
chlorine res.	N/A	mg/l Cl2
sulfite	N/A	mg/l
dis. oxygen	8.8	mg/l

Weather Conditions: Cloudy, RAIN 40°F

Appearance/Observations: Clear

EH −27.7

If testing for cyanide:
chlorine res. N/A
sulfide ↓

If testing for phenolics:
chlorine res. N/A

Sampler (print): PETE Rundell Signature: [signature] Date: 2/18/98

Upstate Laboratories, Inc.

6034 Corporate Drive E. Syracuse New York 13057
(315) 437 0255 Fax 437 1209

Chain of Custody Record

Client	Project #/Project Name
DELTA ENVIRONMENTAL	HB Fuller (GENEVA)

Client Contact	Phone #	Address
STEVE ZBUR		GENEVA, NY

Sample ID	Date	Time	Matrix	GRAB or COMP	ULI Internal Use Only	No. of Containers	1)	2)	3)	4)	5)	6)	7)	8)	9)	10)	11)	12)	Remarks
MW-5	2/18/98	1304	WATER	GRAB	0499182	3	X	X	X										
MW-6		1425			183	3	X	X	X										
MW-7		1059			184	3	X	X	X										
MW-2		947			185	3	X	X	X										
MW-202		932			186	3	X	X	X										
MW-10		1512			187	2		X											
MW-11		1401			188	3	X	X	X										
MW-1		1207			189	3	X	X	X										
MW-4		1242			190	3	X	X	X										
MW-3		1230			191	3	X	X	X										
MW-201		1212			192	3	X	X	X										
MW-9		1145			193	3	X	X	X										
MW-8		1438			194	3	X	X	X										
MW-203		1440			195	3	X	X	X										

Parameter and Method	Sample bottle: Type	Size	Preservative
1) Field pH, EH, TEMP, sp. Cond., Diss. O2	-	-	-
2) EPA 8260	vial	40 ml	1:1 HCL
3) MBAS	PLASTIC	Liter	none
4)			
5)			
6)			
7)			
8)			
9)			
10)			
11)			
12)			
13)			

Sampled by (Print) PETE Rundell

Company: ULI

ULI Internal Use Only

Relinquished by: (sign)	Date	Time	Received by: (sign)

Relinquished by: (sign)	Date	Time	Received by: (sign)

Relinquished by: (sign)	Date	Time	Rec'd for Lab by:
[signature]	2/18/98	5:00	HDono

Syracuse Rochester Buffalo Albany Binghamton Fair Lawn (NJ)

Upstate Laboratories, Inc.
6034 Corporate Drive E. Syracuse New York 13057
(315) 437 0255 Fax 437 1209

Chain of Custody Record

Client: DELTA Environmental
Project #/Project Name: HB Fuller (GENEVA)
Client Contact: STEVE ZBUR
Phone #:
Address: GENEVA

Sample ID	Date	Time	Matrix	GRAB or COMP	ULI Internal Use Only	No. of Containers	1)	2)	3)	4)	5)	6)	7)	8)	9)	10)	11)	12)	Remarks
S-1	2/18/98	1455	WATER		0499896	3	X	X	X										
S-2	↓	1505	↓		197	3	X	X	X										
S-3	↓	1500	↓		198	3	X	X	X										

Parameter and Method	Sample bottle: Type	Size	Preservative
1) Field pH, EH, TEMP., Sp. Cond, Diss. O2	-	-	-
2) EPA 8260	Vial	40ml	1:1 HCl
3) MBAS!	PLASTIC	Liter	NONE
4)			
5)			
6)			
7)			
8)			
9)			
10)			
11)			
12)			
13)			

Sampled by (Print): PETE Rundell
Company: ULI

ULI Internal Use Only

Relinquished by:(sign)	Date	Time	Received by: (sign)

Relinquished by:(sign)	Date	Time	Received by: (sign)

Relinquished by:(sign)	Date	Time	Rec'd for Lab by:
[signature]	2/18/98	5:00	H Dow

Upstate Laboratories inc.

Shipping: 6034 Corporate Dr. • E. Syracuse, NY 13057-1017 • (315) 437-0255 • Fax (315) 437-1209
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Binghamton (607) 724-0478
Buffalo (716) 649-2533
Rochester (716) 436-9070
New Jersey (201) 703-1324

MAR 16 1998

March 10, 1998

Mr. Steve Zbur
Unit Manager
Delta Environmental Consultants
4068 Mt. Royal Blvd.
Suite 225 - Gamma
Allison Park, PA 15101

Re: Analysis Report #05098041 - HB Fuller Geneva

Dear Mr. Zbur:

Please find enclosed the results for your samples which were collected by ULI personnel on February 19, 1998.

We have included the Chain of Custody Record as part of your report. You may need to reference this form for a more detailed explanation of your sample. Samples will be disposed of approximately one month from final report date.

Should you have any questions, please feel free to give us a call.

Thank you for your patronage.

Sincerely,

UPSTATE LABORATORIES, INC.

Anthony J. Scala
Director

AJS/lw

Enclosures: report, field data, invoice

cc/encs: N. Scala, ULI
file

Disclaimer: The test results and procedures utilized, and laboratory interpretations of data obtained by ULI as contained in this report are believed by ULI to be accurate and reliable for sample(s) tested. In accepting this report, the customer agrees that the full extent of any and all liability for actual and consequential damages of ULI for the services performed shall be equal to the fee charged to the customer for the services as liquidated damages.

DATE: 03/10/98

Upstate Laboratories, Inc. APPROVAL:
Analysis Results QC:
Report Number: 05098041 Lab I.D.: 10170
Client I.D.: DELTA ENVIRONMENTAL CONSULTANT HB FULLER GENEVA
Sampled by: ULI W-2A 1040H 02/19/98 G

ULI I.D.: 05098047 Matrix: Soil

PARAMETERS	RESULTS	KEY	FILE#
pH	8.3SU		WC0681
Percent Solids	82%		WC0644
TCL Volatiles by EPA Method 8260			
Chloromethane	<4ug/kg dw		VM1794
Bromomethane	<4ug/kg dw		VM1794
Vinyl Chloride	<2ug/kg dw		VM1794
Chloroethane	<4ug/kg dw		VM1794
Methylene Chloride	<4ug/kg dw		VM1794
Acetone	<12ug/kg dw		VM1794
Carbon Disulfide	<4ug/kg dw		VM1794
1,1-Dichloroethene	<4ug/kg dw		VM1794
1,1-Dichloroethane	<4ug/kg dw		VM1794
trans-1,2-Dichloroethene	<4ug/kg dw		VM1794
cis-1,2-Dichloroethene	<4ug/kg dw		VM1794
Chloroform	<4ug/kg dw		VM1794
1,2-Dichloroethane	<4ug/kg dw		VM1794
2-Butanone	<12ug/kg dw		VM1794
1,1,1-Trichloroethane	<4ug/kg dw		VM1794
Carbon Tetrachloride	<4ug/kg dw		VM1794
Bromodichloromethane	<4ug/kg dw		VM1794
1,2-Dichloropropane	<4ug/kg dw		VM1794
cis-1,3-Dichloropropene	<4ug/kg dw		VM1794
Trichloroethene	<4ug/kg dw		VM1794
Dibromochloromethane	<4ug/kg dw		VM1794
1,1,2-Trichloroethane	<4ug/kg dw		VM1794
Benzene	<4ug/kg dw		VM1794
trans-1,3-Dichloropropene	<4ug/kg dw		VM1794
Bromoform	<4ug/kg dw		VM1794
4-Methyl-2-pentanone	<12ug/kg dw		VM1794
2-Hexanone	<12ug/kg dw		VM1794
Tetrachloroethene	<4ug/kg dw		VM1794
1,1,2,2-Tetrachloroethane	<4ug/kg dw		VM1794
Toluene	<4ug/kg dw		VM1794
Chlorobenzene	<4ug/kg dw		VM1794
Ethylbenzene	<4ug/kg dw		VM1794
Styrene	<4ug/kg dw		VM1794
m-Xylene and p-Xylene	<4ug/kg dw		VM1794
o-Xylene	<4ug/kg dw		VM1794

dw = Dry weight

DATE: 03/10/98

Upstate Laboratories, Inc.
Analysis Results
Report Number: 05098041
Client I.D.: DELTA ENVIRONMENTAL CONSULTANT HB FULLER GENEVA
Sampled by: ULI

APPROVAL:
QC:
Lab I.D.: 10170

MW-7 1045H 02/19/98 G

ULI I.D.: 05098048 Matrix: Soil

PARAMETERS	RESULTS	KEY	FILE#
pH	8.8SU		WC0681
Percent Solids	82%		WC0644
TCL Volatiles by EPA Method 8260			
Chloromethane	<4ug/kg dw		VM1794
Bromomethane	<4ug/kg dw		VM1794
Vinyl Chloride	<2ug/kg dw		VM1794
Chloroethane	<4ug/kg dw		VM1794
Methylene Chloride	<4ug/kg dw		VM1794
Acetone	<12ug/kg dw		VM1794
Carbon Disulfide	<4ug/kg dw		VM1794
1,1-Dichloroethene	<4ug/kg dw		VM1794
1,1-Dichloroethane	7ug/kg dw		VM1794
trans-1,2-Dichloroethene	<4ug/kg dw		VM1794
cis-1,2-Dichloroethene	<4ug/kg dw		VM1794
Chloroform	<4ug/kg dw		VM1794
1,2-Dichloroethane	<4ug/kg dw		VM1794
2-Butanone	<12ug/kg dw		VM1794
1,1,1-Trichloroethane	<4ug/kg dw		VM1794
Carbon Tetrachloride	<4ug/kg dw		VM1794
Bromodichloromethane	<4ug/kg dw		VM1794
1,2-Dichloropropane	<4ug/kg dw		VM1794
cis-1,3-Dichloropropene	<4ug/kg dw		VM1794
Trichloroethene	<4ug/kg dw		VM1794
Dibromochloromethane	<4ug/kg dw		VM1794
1,1,2-Trichloroethane	<4ug/kg dw		VM1794
Benzene	<4ug/kg dw		VM1794
trans-1,3-Dichloropropene	<4ug/kg dw		VM1794
Bromoform	<4ug/kg dw		VM1794
4-Methyl-2-pentanone	<12ug/kg dw		VM1794
2-Hexanone	<12ug/kg dw		VM1794
Tetrachloroethene	11ug/kg dw		VM1794
1,1,2,2-Tetrachloroethane	<4ug/kg dw		VM1794
Toluene	<4ug/kg dw		VM1794
Chlorobenzene	<4ug/kg dw		VM1794
Ethylbenzene	<4ug/kg dw		VM1794
Styrene	<4ug/kg dw		VM1794
m-Xylene and p-Xylene	<4ug/kg dw		VM1794
o-Xylene	<4ug/kg dw		VM1794

dw = Dry weight

DATE: 03/10/98

Upstate Laboratories, Inc.
Analysis Results
Report Number: 05098041
Client I.D.: DELTA ENVIRONMENTAL CONSULTANT HB FULLER GENEVA
Sampled by: ULI

APPROVAL:
QC:
Lab I.D.: 10170
202 1050H 02/19/98 C

ULI I.D.: 05098049 Matrix: Soil

PARAMETERS	RESULTS	KEY	FILE#
pH	9.3SU		WC0681
Percent Solids	81%		WC0644
TCL Volatiles by EPA Method 8260			
Chloromethane	<4ug/kg dw		VM1794
Bromomethane	<4ug/kg dw		VM1794
Vinyl Chloride	<2ug/kg dw		VM1794
Chloroethane	<4ug/kg dw		VM1794
Methylene Chloride	<4ug/kg dw		VM1794
Acetone	<12ug/kg dw		VM1794
Carbon Disulfide	<4ug/kg dw		VM1794
1,1-Dichloroethene	<4ug/kg dw		VM1794
1,1-Dichloroethane	<4ug/kg dw		VM1794
trans-1,2-Dichloroethene	<4ug/kg dw		VM1794
cis-1,2-Dichloroethene	<4ug/kg dw		VM1794
Chloroform	<4ug/kg dw		VM1794
1,2-Dichloroethane	<4ug/kg dw		VM1794
2-Butanone	<12ug/kg dw		VM1794
1,1,1-Trichloroethane	<4ug/kg dw		VM1794
Carbon Tetrachloride	<4ug/kg dw		VM1794
Bromodichloromethane	<4ug/kg dw		VM1794
1,2-Dichloropropane	<4ug/kg dw		VM1794
cis-1,3-Dichloropropene	<4ug/kg dw		VM1794
Trichloroethene	13ug/kg dw		VM1794
Dibromochloromethane	<4ug/kg dw		VM1794
1,1,2-Trichloroethane	<4ug/kg dw		VM1794
Benzene	<4ug/kg dw		VM1794
trans-1,3-Dichloropropene	<4ug/kg dw		VM1794
Bromoform	<4ug/kg dw		VM1794
4-Methyl-2-pentanone	<12ug/kg dw		VM1794
2-Hexanone	<12ug/kg dw		VM1794
Tetrachloroethene	8ug/kg dw		VM1794
1,1,2,2-Tetrachloroethane	<4ug/kg dw		VM1794
Toluene	<4ug/kg dw		VM1794
Chlorobenzene	<4ug/kg dw		VM1794
Ethylbenzene	<4ug/kg dw		VM1794
Styrene	<4ug/kg dw		VM1794
m-Xylene and p-Xylene	<4ug/kg dw		VM1794
o-Xylene	<4ug/kg dw		VM1794

dw = Dry weight

DATE: 03/10/98

Upstate Laboratories, Inc. APPROVAL:
Analysis Results QC:
Report Number: 05098041 Lab I.D.: 10170
Client I.D.: DELTA ENVIRONMENTAL CONSULTANT HB FULLER GENEVA
Sampled by: ULI S-1 1055H 02/19/98 G

ULI I.D.: 05098050 Matrix: Soil

PARAMETERS	RESULTS	KEY	FILE#
pH	9.0SU		WC0681
Percent Solids	83%		WC0644
TCL Volatiles by EPA Method 8260			
Chloromethane	<4ug/kg dw		VM1794
Bromomethane	<4ug/kg dw		VM1794
Vinyl Chloride	<2ug/kg dw		VM1794
Chloroethane	<4ug/kg dw		VM1794
Methylene Chloride	<4ug/kg dw		VM1794
Acetone	<12ug/kg dw		VM1794
Carbon Disulfide	<4ug/kg dw		VM1794
1,1-Dichloroethene	<4ug/kg dw		VM1794
1,1-Dichloroethane	<4ug/kg dw		VM1794
trans-1,2-Dichloroethene	<4ug/kg dw		VM1794
cis-1,2-Dichloroethene	<4ug/kg dw		VM1794
Chloroform	<4ug/kg dw		VM1794
1,2-Dichloroethane	<4ug/kg dw		VM1794
2-Butanone	<12ug/kg dw		VM1794
1,1,1-Trichloroethane	<4ug/kg dw		VM1794
Carbon Tetrachloride	<4ug/kg dw		VM1794
Bromodichloromethane	<4ug/kg dw		VM1794
1,2-Dichloropropane	<4ug/kg dw		VM1794
cis-1,3-Dichloropropene	<4ug/kg dw		VM1794
Trichloroethene	<4ug/kg dw		VM1794
Dibromochloromethane	<4ug/kg dw		VM1794
1,1,2-Trichloroethane	<4ug/kg dw		VM1794
Benzene	<4ug/kg dw		VM1794
trans-1,3-Dichloropropene	<4ug/kg dw		VM1794
Bromoform	<4ug/kg dw		VM1794
4-Methyl-2-pentanone	<12ug/kg dw		VM1794
2-Hexanone	<12ug/kg dw		VM1794
Tetrachloroethene	<4ug/kg dw		VM1794
1,1,2,2-Tetrachloroethane	<4ug/kg dw		VM1794
Toluene	<4ug/kg dw		VM1794
Chlorobenzene	<4ug/kg dw		VM1794
Ethylbenzene	<4ug/kg dw		VM1794
Styrene	<4ug/kg dw		VM1794
m-Xylene and p-Xylene	<4ug/kg dw		VM1794
o-Xylene	<4ug/kg dw		VM1794

dw = Dry weight

DATE: 03/10/98

Upstate Laboratories, Inc.
Analysis Results
Report Number: 05098041
Client I.D.: DELTA ENVIRONMENTAL CONSULTANT HB FULLER GENEVA
Sampled by: ULI

APPROVAL:
QC:
Lab I.D.: 10170

LGB-1 1100H 02/19/98 G

ULI I.D.: 05098051 Matrix: Soil

PARAMETERS	RESULTS	KEY	FILE#
pH	9.7SU		WC0681
Percent Solids	80%		WC0644
TCL Volatiles by EPA Method 8260			
Chloromethane	<4ug/kg dw		VM1796
Bromomethane	<4ug/kg dw		VM1796
Vinyl Chloride	<3ug/kg dw		VM1796
Chloroethane	<4ug/kg dw		VM1796
Methylene Chloride	<4ug/kg dw		VM1796
Acetone	<13ug/kg dw		VM1796
Carbon Disulfide	<4ug/kg dw		VM1796
1,1-Dichloroethene	<4ug/kg dw		VM1796
1,1-Dichloroethane	<4ug/kg dw		VM1796
trans-1,2-Dichloroethene	<4ug/kg dw		VM1796
cis-1,2-Dichloroethene	<4ug/kg dw		VM1796
Chloroform	<4ug/kg dw		VM1796
1,2-Dichloroethane	<4ug/kg dw		VM1796
2-Butanone	<13ug/kg dw		VM1796
1,1,1-Trichloroethane	<4ug/kg dw		VM1796
Carbon Tetrachloride	<4ug/kg dw		VM1796
Bromodichloromethane	<4ug/kg dw		VM1796
1,2-Dichloropropane	<4ug/kg dw		VM1796
cis-1,3-Dichloropropene	<4ug/kg dw		VM1796
Trichloroethene	<4ug/kg dw		VM1796
Dibromochloromethane	<4ug/kg dw		VM1796
1,1,2-Trichloroethane	<4ug/kg dw		VM1796
Benzene	<4ug/kg dw		VM1796
trans-1,3-Dichloropropene	<4ug/kg dw		VM1796
Bromoform	<4ug/kg dw		VM1796
4-Methyl-2-pentanone	<13ug/kg dw		VM1796
2-Hexanone	<13ug/kg dw		VM1796
Tetrachloroethene	31ug/kg dw		VM1796
1,1,2,2-Tetrachloroethane	<4ug/kg dw		VM1796
Toluene	<4ug/kg dw		VM1796
Chlorobenzene	<4ug/kg dw		VM1796
Ethylbenzene	<4ug/kg dw		VM1796
Styrene	<4ug/kg dw		VM1796
m-Xylene and p-Xylene	<4ug/kg dw		VM1796
o-Xylene	<4ug/kg dw		VM1796

dw = Dry weight

DATE: 03/10/98

Upstate Laboratories, Inc.
Analysis Results
Report Number: 05098041
Client I.D.: DELTA ENVIRONMENTAL CONSULTANT HB FULLER GENEVA
Sampled by: ULI

APPROVAL:
QC:
Lab I.D.: 10170

LGB-2 1107H 02/19/98 C

ULI I.D.: 05098052 Matrix: Soil

PARAMETERS	RESULTS	KEY	FILE#
pH	10.1SU		WC0681
Percent Solids	81%		WC0644
TCL Volatiles by EPA Method 8260			
Chloromethane	<19ug/kg dw	05	VM1796
Bromomethane	<19ug/kg dw	05	VM1796
Vinyl Chloride	<12ug/kg dw	05	VM1796
Chloroethane	<19ug/kg dw	05	VM1796
Methylene Chloride	<19ug/kg dw	05	VM1796
Acetone	<62ug/kg dw	05	VM1796
Carbon Disulfide	<19ug/kg dw	05	VM1796
1,1-Dichloroethene	<19ug/kg dw	05	VM1796
1,1-Dichloroethane	<19ug/kg dw	05	VM1796
trans-1,2-Dichloroethene	<19ug/kg dw	05	VM1796
cis-1,2-Dichloroethene	29ug/kg dw		VM1796
Chloroform	<19ug/kg dw	05	VM1796
1,2-Dichloroethane	<19ug/kg dw	05	VM1796
2-Butanone	<62ug/kg dw	05	VM1796
1,1,1-Trichloroethane	<19ug/kg dw	05	VM1796
Carbon Tetrachloride	<19ug/kg dw	05	VM1796
Bromodichloromethane	<19ug/kg dw	05	VM1796
1,2-Dichloropropane	<19ug/kg dw	05	VM1796
cis-1,3-Dichloropropene	<19ug/kg dw	05	VM1796
Trichloroethene	110ug/kg dw		VM1796
Dibromochloromethane	<19ug/kg dw	05	VM1796
1,1,2-Trichloroethane	<19ug/kg dw	05	VM1796
Benzene	<19ug/kg dw	05	VM1796
trans-1,3-Dichloropropene	<19ug/kg dw	05	VM1796
Bromoform	<19ug/kg dw	05	VM1796
4-Methyl-2-pentanone	<62ug/kg dw	05	VM1796
2-Hexanone	<62ug/kg dw	05	VM1796
Tetrachloroethene	560ug/kg dw		VM1796
1,1,2,2-Tetrachloroethane	<19ug/kg dw	05	VM1796
Toluene	<19ug/kg dw	05	VM1796
Chlorobenzene	<19ug/kg dw	05	VM1796
Ethylbenzene	<19ug/kg dw	05	VM1796
Styrene	<19ug/kg dw	05	VM1796
m-Xylene and p-Xylene	<19ug/kg dw	05	VM1796
o-Xylene	<19ug/kg dw	05	VM1796

dw = Dry weight

DATE: 03/10/98

Upstate Laboratories, Inc.
Analysis Results
Report Number: 05098041
Client I.D.: DELTA ENVIRONMENTAL CONSULTANT HB FULLER GENEVA
Sampled by: ULI

APPROVAL:
QC:
Lab I.D.: 10170

S-2 1115H 02/19/98 C

ULI I.D.: 05098053 Matrix: Soil

PARAMETERS	RESULTS	KEY	FILE#
pH	9.1SU		WC0681
Percent Solids	82%		WC0644
TCL Volatiles by EPA Method 8260			
Chloromethane	<4ug/kg dw		VM1794
Bromomethane	<4ug/kg dw		VM1794
Vinyl Chloride	<2ug/kg dw		VM1794
Chloroethane	<4ug/kg dw		VM1794
Methylene Chloride	<4ug/kg dw		VM1794
Acetone	<12ug/kg dw		VM1794
Carbon Disulfide	<4ug/kg dw		VM1794
1,1-Dichloroethene	<4ug/kg dw		VM1794
1,1-Dichloroethane	<4ug/kg dw		VM1794
trans-1,2-Dichloroethene	<4ug/kg dw		VM1794
cis-1,2-Dichloroethene	<4ug/kg dw		VM1794
Chloroform	<4ug/kg dw		VM1794
1,2-Dichloroethane	<4ug/kg dw		VM1794
2-Butanone	<12ug/kg dw		VM1794
1,1,1-Trichloroethane	<4ug/kg dw		VM1794
Carbon Tetrachloride	<4ug/kg dw		VM1794
Bromodichloromethane	<4ug/kg dw		VM1794
1,2-Dichloropropane	<4ug/kg dw		VM1794
cis-1,3-Dichloropropene	<4ug/kg dw		VM1794
Trichloroethene	<4ug/kg dw		VM1794
Dibromochloromethane	<4ug/kg dw		VM1794
1,1,2-Trichloroethane	<4ug/kg dw		VM1794
Benzene	<4ug/kg dw		VM1794
trans-1,3-Dichloropropene	<4ug/kg dw		VM1794
Bromoform	<4ug/kg dw		VM1794
4-Methyl-2-pentanone	<12ug/kg dw		VM1794
2-Hexanone	<12ug/kg dw		VM1794
Tetrachloroethene	<4ug/kg dw		VM1794
1,1,2,2-Tetrachloroethane	<4ug/kg dw		VM1794
Toluene	<4ug/kg dw		VM1794
Chlorobenzene	<4ug/kg dw		VM1794
Ethylbenzene	<4ug/kg dw		VM1794
Styrene	<4ug/kg dw		VM1794
m-Xylene and p-Xylene	<4ug/kg dw		VM1794
o-Xylene	<4ug/kg dw		VM1794

dw = Dry weight

DATE: 03/10/98

Upstate Laboratories, Inc.
Analysis Results
Report Number: 05098041
Client I.D.: DELTA ENVIRONMENTAL CONSULTANT HB FULLER GENEVA
Sampled by: ULI

APPROVAL:
QC:
Lab I.D.: 10170

W-1 1000H 02/19/98 C

ULI I.D.: 05098041 Matrix: Water

PARAMETERS	RESULTS	KEY	FILE#
Field pH	11.3SU		FIELD
MBAS	<0.05mg/lLAS		WC0655
TCL Volatiles by EPA Method 8260			
Chloromethane	<3ug/l		VM1791
Bromomethane	<3ug/l		VM1791
Vinyl Chloride	<2ug/l		VM1791
Chloroethane	<3ug/l		VM1791
Methylene Chloride	<3ug/l		VM1791
Acetone	<10ug/l		VM1791
Carbon Disulfide	<3ug/l		VM1791
1,1-Dichloroethene	<3ug/l		VM1791
1,1-Dichloroethane	<3ug/l		VM1791
trans-1,2-Dichloroethene	<3ug/l		VM1791
cis-1,2-Dichloroethene	<3ug/l		VM1791
Chloroform	<3ug/l		VM1791
1,2-Dichloroethane	<3ug/l		VM1791
2-Butanone	<10ug/l		VM1791
1,1,1-Trichloroethane	<3ug/l		VM1791
Carbon Tetrachloride	<3ug/l		VM1791
Bromodichloromethane	<3ug/l		VM1791
1,2-Dichloropropane	<3ug/l		VM1791
cis-1,3-Dichloropropene	<3ug/l		VM1791
Trichloroethene	<3ug/l		VM1791
Dibromochloromethane	<3ug/l		VM1791
1,1,2-Trichloroethane	<3ug/l		VM1791
Benzene	<3ug/l		VM1791
trans-1,3-Dichloropropene	<3ug/l		VM1791
Bromoform	<3ug/l		VM1791
4-Methyl-2-pentanone	<10ug/l		VM1791
2-Hexanone	<10ug/l		VM1791
Tetrachloroethene	<3ug/l		VM1791
1,1,2,2-Tetrachloroethane	<3ug/l		VM1791
Toluene	<3ug/l		VM1791
Chlorobenzene	<3ug/l		VM1791
Ethylbenzene	<3ug/l		VM1791
Styrene	<3ug/l		VM1791
m-Xylene and p-Xylene	5ug/l		VM1791
o-Xylene	3ug/l		VM1791

DATE: 03/10/98

Upstate Laboratories, Inc. APPROVAL:
Analysis Results QC:
Report Number: 05098041 Lab I.D.: 10170
Client I.D.: DELTA ENVIRONMENTAL CONSULTANT HB FULLER GENEVA
Sampled by: ULI W-2 1012H 02/19/98 G

ULI I.D.: 05098042 Matrix: Water

PARAMETERS	RESULTS	KEY	FILE#
Field pH	9.94SU		FIELD
MBAS	<0.05mg/lLAS		WC0655
TCL Volatiles by EPA Method 8260			
Chloromethane	<3ug/l		VM1791
Bromomethane	<3ug/l		VM1791
Vinyl Chloride	<2ug/l		VM1791
Chloroethane	<3ug/l		VM1791
Methylene Chloride	<3ug/l		VM1791
Acetone	<10ug/l		VM1791
Carbon Disulfide	<3ug/l		VM1791
1,1-Dichloroethene	<3ug/l		VM1791
1,1-Dichloroethane	<3ug/l		VM1791
trans-1,2-Dichloroethene	<3ug/l		VM1791
cis-1,2-Dichloroethene	<3ug/l		VM1791
Chloroform	<3ug/l		VM1791
1,2-Dichloroethane	<3ug/l		VM1791
2-Butanone	<10ug/l		VM1791
1,1,1-Trichloroethane	<3ug/l		VM1791
Carbon Tetrachloride	<3ug/l		VM1791
Bromodichloromethane	<3ug/l		VM1791
1,2-Dichloropropane	<3ug/l		VM1791
cis-1,3-Dichloropropene	<3ug/l		VM1791
Trichloroethene	<3ug/l		VM1791
Dibromochloromethane	<3ug/l		VM1791
1,1,2-Trichloroethane	<3ug/l		VM1791
Benzene	<3ug/l		VM1791
trans-1,3-Dichloropropene	<3ug/l		VM1791
Bromoform	<3ug/l		VM1791
4-Methyl-2-pentanone	<10ug/l		VM1791
2-Hexanone	<10ug/l		VM1791
Tetrachloroethene	<3ug/l		VM1791
1,1,2,2-Tetrachloroethane	<3ug/l		VM1791
Toluene	<3ug/l		VM1791
Chlorobenzene	<3ug/l		VM1791
Ethylbenzene	<3ug/l		VM1791
Styrene	<3ug/l		VM1791
m-Xylene and p-Xylene	<3ug/l		VM1791
o-Xylene	<3ug/l		VM1791

DATE: 03/10/98

Upstate Laboratories, Inc.
Analysis Results
Report Number: 05098041
Client I.D.: DELTA ENVIRONMENTAL CONSULTANT HB FULLER GENEVA
Sampled by: ULI

APPROVAL:
QC:
Lab I.D.: 10170

W-3 1020H 02/19/98 C

ULI I.D.: 05098043 Matrix: Water

PARAMETERS	RESULTS	KEY	FILE#
Field pH	8.25SU		FIELD
MBAS	<0.05mg/lLAS		WC0655
TCL Volatiles by EPA Method 8260			
Chloromethane	<3ug/l		VM1791
Bromomethane	<3ug/l		VM1791
Vinyl Chloride	<2ug/l		VM1791
Chloroethane	<3ug/l		VM1791
Methylene Chloride	<3ug/l		VM1791
Acetone	<10ug/l		VM1791
Carbon Disulfide	<3ug/l		VM1791
1,1-Dichloroethene	<3ug/l		VM1791
1,1-Dichloroethane	<3ug/l		VM1791
trans-1,2-Dichloroethene	<3ug/l		VM1791
cis-1,2-Dichloroethene	<3ug/l		VM1791
Chloroform	<3ug/l		VM1791
1,2-Dichloroethane	<3ug/l		VM1791
2-Butanone	<10ug/l		VM1791
1,1,1-Trichloroethane	<3ug/l		VM1791
Carbon Tetrachloride	<3ug/l		VM1791
Bromodichloromethane	<3ug/l		VM1791
1,2-Dichloropropane	<3ug/l		VM1791
cis-1,3-Dichloropropene	<3ug/l		VM1791
Trichloroethene	<3ug/l		VM1791
Dibromochloromethane	<3ug/l		VM1791
1,1,2-Trichloroethane	<3ug/l		VM1791
Benzene	<3ug/l		VM1791
trans-1,3-Dichloropropene	<3ug/l		VM1791
Bromoform	<3ug/l		VM1791
4-Methyl-2-pentanone	<10ug/l		VM1791
2-Hexanone	<10ug/l		VM1791
Tetrachloroethene	<3ug/l		VM1791
1,1,2,2-Tetrachloroethane	<3ug/l		VM1791
Toluene	<3ug/l		VM1791
Chlorobenzene	<3ug/l		VM1791
Ethylbenzene	<3ug/l		VM1791
Styrene	<3ug/l		VM1791
m-Xylene and p-Xylene	<3ug/l		VM1791
o-Xylene	<3ug/l		VM1791

DATE: 03/10/98

Upstate Laboratories, Inc.
Analysis Results
Report Number: 05098041
Client I.D.: DELTA ENVIRONMENTAL CONSULTANT HB FULLER GENEVA
Sampled by: ULI

APPROVAL:
QC:
Lab I.D.: 10170

W-4 1025H 02/19/98 C

ULI I.D.: 05098044 Matrix: Water

PARAMETERS	RESULTS	KEY	FILE#
Field pH	8.41SU		FIELD
MBAS	<0.05mg/lLAS		WC0655
TCL Volatiles by EPA Method 8260			
Chloromethane	<3ug/l		VM1791
Bromomethane	<3ug/l		VM1791
Vinyl Chloride	<2ug/l		VM1791
Chloroethane	<3ug/l		VM1791
Methylene Chloride	<3ug/l		VM1791
Acetone	<10ug/l		VM1791
Carbon Disulfide	<3ug/l		VM1791
1,1-Dichloroethene	<3ug/l		VM1791
1,1-Dichloroethane	<3ug/l		VM1791
trans-1,2-Dichloroethene	<3ug/l		VM1791
cis-1,2-Dichloroethene	<3ug/l		VM1791
Chloroform	<3ug/l		VM1791
1,2-Dichloroethane	<3ug/l		VM1791
2-Butanone	<10ug/l		VM1791
1,1,1-Trichloroethane	<3ug/l		VM1791
Carbon Tetrachloride	<3ug/l		VM1791
Bromodichloromethane	<3ug/l		VM1791
1,2-Dichloropropane	<3ug/l		VM1791
cis-1,3-Dichloropropene	<3ug/l		VM1791
Trichloroethene	<3ug/l		VM1791
Dibromochloromethane	<3ug/l		VM1791
1,1,2-Trichloroethane	<3ug/l		VM1791
Benzene	<3ug/l		VM1791
trans-1,3-Dichloropropene	<3ug/l		VM1791
Bromoform	<3ug/l		VM1791
4-Methyl-2-pentanone	<10ug/l		VM1791
2-Hexanone	<10ug/l		VM1791
Tetrachloroethene	<3ug/l		VM1791
1,1,2,2-Tetrachloroethane	<3ug/l		VM1791
Toluene	<3ug/l		VM1791
Chlorobenzene	<3ug/l		VM1791
Ethylbenzene	<3ug/l		VM1791
Styrene	<3ug/l		VM1791
m-Xylene and p-Xylene	<3ug/l		VM1791
o-Xylene	<3ug/l		VM1791

DATE: 03/10/98

Upstate Laboratories, Inc. APPROVAL:
Analysis Results QC:
Report Number: 05098041 Lab I.D.: 10170
Client I.D.: DELTA ENVIRONMENTAL CONSULTANT HB FULLER GENEVA
Sampled by: ULI W-5 1028H 02/19/98 G

ULI I.D.: 05098045 Matrix: Water

PARAMETERS	RESULTS	KEY	FILE#
Field pH	8.29SU		FIELD
MBAS	52mg/lLAS		WC0655
TCL Volatiles by EPA Method 8260			
Chloromethane	<30ug/l	01	VM1791
Bromomethane	<30ug/l	01	VM1791
Vinyl Chloride	<20ug/l	01	VM1791
Chloroethane	<30ug/l	01	VM1791
Methylene Chloride	<30ug/l	01	VM1791
Acetone	<100ug/l	01	VM1791
Carbon Disulfide	<30ug/l	01	VM1791
1,1-Dichloroethene	<30ug/l	01	VM1791
1,1-Dichloroethane	<30ug/l	01	VM1791
trans-1,2-Dichloroethene	<30ug/l	01	VM1791
cis-1,2-Dichloroethene	<30ug/l	01	VM1791
Chloroform	<30ug/l	01	VM1791
1,2-Dichloroethane	<30ug/l	01	VM1791
2-Butanone	<100ug/l	01	VM1791
1,1,1-Trichloroethane	<30ug/l	01	VM1791
Carbon Tetrachloride	<30ug/l	01	VM1791
Bromodichloromethane	<30ug/l	01	VM1791
1,2-Dichloropropane	<30ug/l	01	VM1791
cis-1,3-Dichloropropene	<30ug/l	01	VM1791
Trichloroethene	<30ug/l	01	VM1791
Dibromochloromethane	<30ug/l	01	VM1791
1,1,2-Trichloroethane	<30ug/l	01	VM1791
Benzene	<30ug/l	01	VM1791
trans-1,3-Dichloropropene	<30ug/l	01	VM1791
Bromoform	<30ug/l	01	VM1791
4-Methyl-2-pentanone	<100ug/l	01	VM1791
2-Hexanone	<100ug/l	01	VM1791
Tetrachloroethene	<30ug/l	01	VM1791
1,1,2,2-Tetrachloroethane	<30ug/l	01	VM1791
Toluene	<30ug/l	01	VM1791
Chlorobenzene	<30ug/l	01	VM1791
Ethylbenzene	<30ug/l	01	VM1791
Styrene	<30ug/l	01	VM1791
m-Xylene and p-Xylene	<30ug/l	01	VM1791
o-Xylene	<30ug/l	01	VM1791

DATE: 03/10/98

Upstate Laboratories, Inc.
Analysis Results
Report Number: 05098041
Client I.D.: DELTA ENVIRONMENTAL CONSULTANT HB FULLER GENEVA
Sampled by: ULI

APPROVAL:
QC:
Lab I.D.: 10170

W-6 1032H 02/19/98 G

ULI I.D.: 05098046 Matrix: Water

PARAMETERS	RESULTS	KEY	FILE#
Field pH	9.20SU		FIELD
MBAS	<0.05mg/lLAS		WC0655
TCL Volatiles by EPA Method 8260			
Chloromethane	<3ug/l		VM1791
Bromomethane	<3ug/l		VM1791
Vinyl Chloride	<2ug/l		VM1791
Chloroethane	<3ug/l		VM1791
Methylene Chloride	<3ug/l		VM1791
Acetone	<10ug/l		VM1791
Carbon Disulfide	<3ug/l		VM1791
1,1-Dichloroethene	<3ug/l		VM1791
1,1-Dichloroethane	<3ug/l		VM1791
trans-1,2-Dichloroethene	<3ug/l		VM1791
cis-1,2-Dichloroethene	<3ug/l		VM1791
Chloroform	<3ug/l		VM1791
1,2-Dichloroethane	<3ug/l		VM1791
2-Butanone	<10ug/l		VM1791
1,1,1-Trichloroethane	<3ug/l		VM1791
Carbon Tetrachloride	<3ug/l		VM1791
Bromodichloromethane	<3ug/l		VM1791
1,2-Dichloropropane	<3ug/l		VM1791
cis-1,3-Dichloropropene	<3ug/l		VM1791
Trichloroethene	<3ug/l		VM1791
Dibromochloromethane	<3ug/l		VM1791
1,1,2-Trichloroethane	<3ug/l		VM1791
Benzene	<3ug/l		VM1791
trans-1,3-Dichloropropene	<3ug/l		VM1791
Bromoform	<3ug/l		VM1791
4-Methyl-2-pentanone	<10ug/l		VM1791
2-Hexanone	<10ug/l		VM1791
Tetrachloroethene	<3ug/l		VM1791
1,1,2,2-Tetrachloroethane	<3ug/l		VM1791
Toluene	<3ug/l		VM1791
Chlorobenzene	<3ug/l		VM1791
Ethylbenzene	<3ug/l		VM1791
Styrene	<3ug/l		VM1791
m-Xylene and p-Xylene	<3ug/l		VM1791
o-Xylene	<3ug/l		VM1791

KEY PAGE

1 MATRIX INTERFERENCE PRECLUDES LOWER DETECTION LIMITS
2 MATRIX INTERFERENCE
3 PRESENT IN BLANK
4 ANALYSIS NOT PERFORMED BECAUSE OF INSUFFICIENT SAMPLE
5 THE PRESENCE OF OTHER TARGET ANALYTE(S) PRECLUDES LOWER DETECTION LIMITS
6 BLANK CORRECTED
7 HEAD SPACE PRESENT IN SAMPLE
8 QUANTITATION LIMIT IS GREATER THAN THE CALCULATED REGULATORY LEVEL. THE QUANTITATION LIMIT THEREFORE BECOMES THE REGULATORY LEVEL.
9 THE OIL WAS TREATED AS A SOLID AND LEACHED WITH EXTRACTION FLUID
10 ADL(AVERAGE DETECTION LIMITS)
11 PQL(PRACTICAL QUANTITATION LIMITS)
12 SAMPLE ANALYZED OVER HOLDING TIME
13 DISSOLVED VALUE MAY BE HIGHER THAN TOTAL DUE TO CONTAMINATION FROM THE FILTERING PROCEDURE
14 SAMPLED BY ULI
15 DISSOLVED VALUE MAY BE HIGHER THAN TOTAL; HOWEVER, THE VALUES ARE WITHIN EXPERIMENTAL ERROR
16 AN INHIBITORY FACTOR WAS OBSERVED IN THIS ANALYSIS
17 PARAMETER NOT ANALYZED WITHIN 15 MINUTES OF SAMPLING
18 THE SERIAL DILUTION OF THIS SAMPLE SUGGESTS A POSSIBLE PHYSICAL AND/OR CHEMICAL INTERFERENT IN THIS DETERMINATION. THE DATA MAY BE BIASED EITHER HIGH OR LOW.
19 CALCULATION BASED ON DRY WEIGHT
20 INDICATES AN ESTIMATED VALUE, DETECTED BUT BELOW THE PRACTICAL QUANTITATION LIMITS
21 UG/KG AS REC.D / UG/KG DRY WT
22 MG/KG AS REC.D / MG/KG DRY WT
23 INSUFFICIENT SAMPLE PRECLUDES LOWER DETECTION LIMITS
24 SAMPLE DILUTED/BLANK CORRECTED
25 ND(NON-DETECTED)
26 MATRIX INTERFERENCE PRECLUDES LOWER DETECTION LIMITS/BLANK CORRECTED
27 SPIKE RECOVERY ABNORMALLY HIGH/LOW DUE TO MATRIX INTERFERENCE
28 POST-DIGESTION SPIKE FOR FURNACE AA ANALYSIS IS OUTSIDE OF THE CONTROL LIMITS (85-115%); HOWEVER, THE SAMPLE CONCENTRATION IS BELOW THE PQL
29 ANALYZED BY METHOD OF STANDARD ADDITIONS
30 METHOD PERFORMANCE STUDY HAS NOT BEEN COMPLETED/ND(NON-DETECTED)
31 FIELD MEASURED PARAMETER TAKEN BY CLIENT
32 TARGET ANALYTE IS BIODEGRADED AND/OR ENVIRONMENTALLY WEATHERED
33 NON-POTABLE WATER SOURCE
34 THE QUALITY CONTROL RESULTS FOR THIS ANALYSIS INDICATE A POSITIVE BIAS OF 1-5 MG/L. THE POSITIVE BIAS FALLS BELOW THE PUBLISHED EPA REGULATORY DETECTION LIMIT OF 5 MG/L BUT ABOVE 1 MG/L.
35 THE HYDROCARBONS DETECTED IN THE SAMPLE DID NOT CROSS-MATCH WITH COMMON PETROLEUM DISTILLATES
36 MATRIX INTERFERENCE CAUSING SPIKES TO RESULT IN LESS THAN 50.0% RECOVERY
37 MILLIGRAMS PER LITER (MG/L) / POUNDS (LBS) PER DAY
38 MILLIGRAMS PER LITER (MG/L) OF RESIDUAL CHLORINE (CL2) / POUNDS (LBS) PER DAY OF CL2
39 MICROGRAMS PER LITER (UG/L) / POUNDS (LBS) PER DAY
40 MILLIGRAMS PER LITER (MG/L) LINEAR ALKYL SULFONATE (LAS) / POUNDS (LBS) PER DAY LAS
41 RESULTS ARE REPORTED ON AN AS REC.D BASIS
42 THE SAMPLE WAS ANALYZED ON A TOTAL BASIS; THE TEST RESULT CAN BE COMPARED TO THE TCLP REGULATORY CRITERIA BY DIVIDING THE TEST RESULT BY 20, CREATING A THEORETICAL TCLP VALUE
43 METAL BY CONCENTRATION PROCEDURE
44 POSSIBLE CONTAMINATION FROM FIELD/LABORATORY

Upstate Laboratories, Inc.

File: TS-40-01

Tap Water / Surface Water / Wastewater Field Log

Revised: 3/95

Client: DECTA Environmental

Project: HB Fuller PORGE WATER

Date: 2/19/98

Location W-1 **Time Sampled:** 10^00 ULI ID No. (entered by lab)

Field Measurements:			
flow	N/A	(record units)	
temperature	5.7	C	
pH	11.3	std. units	
spec. cond.	N/A	umhos/cm	
turbidity		NTU	
chlorine res.		mg/l Cl2	
sulfite		mg/l	
dis. oxygen		mg/l	

Weather Conditions: N/A

Appearance/Observations: ICE in DRUMS comp W-1A + 1B

If testing for cyanide: chlorine res. N/A sulfide

If testing for phenolics: chlorine res. N/A

Location W-2 **Time Sampled:** 10^12 ULI ID No. (entered by lab)

Field Measurements:			
flow	–	(record units)	
temperature	6.5	C	
pH	9.94	std. units	
spec. cond.	N/A	umhos/cm	
turbidity		NTU	
chlorine res.		mg/l Cl2	
sulfite		mg/l	
dis. oxygen		mg/l	

Weather Conditions: N/A

Appearance/Observations: W-2B Drum

If testing for cyanide: chlorine res. N/A sulfide

If testing for phenolics: chlorine res. N/A

Location W-3 **Time Sampled:** 1020 ULI ID No. (entered by lab)

Field Measurements:			
flow	–	(record units)	
temperature	5.4	C	
pH	8.25	std. units	
spec. cond.	N/A	umhos/cm	
turbidity		NTU	
chlorine res.		mg/l Cl2	
sulfite		mg/l	
dis. oxygen		mg/l	

Weather Conditions: N/A

Appearance/Observations: comp - W-3A + 3B

If testing for cyanide: chlorine res. N/A sulfide

If testing for phenolics: chlorine res. N/A

Sampler (print): PETE Rundell Signature: [signature] Date: 2/19/98

Upstate Laboratories, Inc.

File: TS-40-01

Tap Water / Surface Water / Wastewater Field Log

Revised: 3/95

Client: DELTA ENVIRONMENTAL
Project: HB FULLER GENEVA PURGEWATER
Date: 2/19/98

Location W-4 **Time Sampled:** 1025 ULI ID No. (entered by lab)

Field Measurements:

flow	N/A	(record units)
temperature	5.7	C
pH	8.41/8.17	std. units
spec. cond.	N/A	umhos/cm
turbidity		NTU
chlorine res.		mg/l Cl2
sulfite		mg/l
dis. oxygen		mg/l

Weather Conditions: N/A

Appearance/Observations:

If testing for cyanide: chlorine res. N/A; sulfide N/A

If testing for phenolics: chlorine res. N/A

Location W-5 **Time Sampled:** 1028 ULI ID No. (entered by lab)

Field Measurements:

flow	N/A	(record units)
temperature	13.4	C
pH	8.29	std. units
spec. cond.	N/A	umhos/cm
turbidity		NTU
chlorine res.		mg/l Cl2
sulfite		mg/l
dis. oxygen		mg/l

Weather Conditions: N/A

Appearance/Observations:

If testing for cyanide: chlorine res. N/A; sulfide

If testing for phenolics: chlorine res. N/A

Location W-6 **Time Sampled:** 1032 ULI ID No. (entered by lab)

Field Measurements:

flow	N/A	(record units)
temperature	4.4	C
pH	9.20	std. units
spec. cond.	N/A	umhos/cm
turbidity		NTU
chlorine res.		mg/l Cl2
sulfite		mg/l
dis. oxygen		mg/l

Weather Conditions: N/A

Appearance/Observations:

If testing for cyanide: chlorine res. N/A; sulfide

If testing for phenolics: chlorine res. N/A

Sampler (print): PETE Rundell Signature: [signature] Date: 2/19/88

U. . .al La. . .al. . .es, . nc.
034 Corporate Drive • E. Syracuse, NY 13057-1017
315) 437 0255 Fax 437 1209

Chain Of Custody Record

3/5

lient:	Client Project # / Project Name
DELTA Environmental	HB Fuller Geneva

lient Contact:	Phone #	Site Location (city/state)
TEVE ZBUR		Geneva, NY

Special Turnaround Time______ (Lab Notification required)

ample Location:	Date	Time	Matrix	Grab or Comp.	ULI Internal Use Only	No. of Containers	1)	2)	3)	4)	5)	6)	7)	8)	9)	10)	Remarks
W-1	2/19/98	10^{00}	WATER	COMP*	05098041	3	X		X	X							COMP- W-1A+1B
W-2	↓	10^{12}	↓	GRAB*	42	3	X		X	X							* W-2B DRUM
W-3	↓	10^{20}	↓	COMP	43	3	X		X	X							Comp-W-3A+3B
W-4	↓	10^{25}	↓	COMP	44	3	X		X	X							Comp W-4A+4B
W-5	↓	10^{28}	↓	GRAB	45	3	X		X	X							* W-5 DRUM
W-6	↓	10^{32}	↓	GRAB	46	3	X		X	X							* W-6 DRUM
W-2A	2/19/98	10^{40}	SOIL	GRAB	47	1		X		X	(X)						DRUM W-2A
MW-7	↓	10^{45}	↓	GRAB	48	1		X		X	(X)						DRUM W-7
202	↓	10^{50}	↓	COMP	49	1		X		X	(X)						comp-202A+202B
S-1	↓	10^{55}	↓	GRAB	50	1		X		X	(X)						DRUM S-1

rameter and method	sample bottle: type	size	pres.
Field pH	–	–	–
pH	~~4oz~~ GLASS	4oz.	NONE
MBAS	PLASTIC	Liter	NONE
EPA 8260	4oz./40ml	4oz/40ml	NONE/1:1HCl
(% SOLIDS)[HO]			

The numbered columns above cross-reference with the numbered columns in the upper right-hand corner.

Sampled by: (Please Print) PETE Rundell

Company: ULI

ULI Internal Use Only
Delivery (check one):
☒ ULI Sampled
☐ Pickup ☐ Dropoff
☐ CC ______

Relinquished by: (Signature)	Date	Time	Received by: (Signature)

Relinquished by: (Signature)	Date	Time	Rec'd for Lab by: (Signature)
[signature]	2/19/98	13^{20}	[signature]

Syracuse Rochester Buffalo Albany Binghamton Fair Lawn (NJ)

U tat La rat ies nc
034 Corporate Drive • E. Syracuse, NY 13057-1017
315) 437 0255 Fax 437 1209

Chain Of Custody Record

3/5

lient: DELTA ENVIRONMENTAL

Client Project # / Project Name: HB Fuller Geneva

lient Contact: STEVE ZBUR

Phone #:

Site Location (city/state): GENEVA, NY

Special Turnaround Time______ (Lab Notification required)

ample Location:	Date	Time	Matrix	Grab or Comp.	ULI Internal Use Only	No. of Containers	1)	2)	3)	4)	5)	6)	7)	8)	9)	10)	Remarks
LBG-1	2/19/98	11⁰⁰	Soil	GRAB	05098051	1	X	X	(X)								LBG-1 DRUM
LBG-2	2/19/98	11⁰⁷	Soil	COMP	52	1	X	X	(X)								LBG 2A + LBG 2B
S-2	2/19/98	11¹⁵	Soil	comp	53	1	X	X	(X)								Comp - S-1, S-2, S-3
~~MW-10~~	~~2/19/98~~	~~11³⁵~~	~~WATER~~	~~GRAB~~		~~1~~				~~X~~							~~Sam~~ well DRY

arameter and method	sample bottle: type	size	pres.
pH	Glass	4oz	None
EPA 8260	"	"	"
(% SOLIDS)ᴵᴺ			
MBAS	Plastic	Liter	None
)			

Sampled by: (Please Print) PETE Rundell

Company: ULI

ULI Internal Use Only
Delivery (check one):
☒ ULI Sampled
☐ Pickup ☐ Dropoff
☐ CC ______

Relinquished by: (Signature)	Date	Time	Received by: (Signature)
Relinquished by: (Signature)	Date	Time	Received by: (Signature)
Relinquished by: (Signature)	Date	Time	Received by: (Signature)
Relinquished by: (Signature)	Date	Time	Rec'd for Lab by: (Signature)
[signature]	2/19/98	13²⁰	HDme

Note: The numbered columns above cross-reference with the numbered columns in the upper right-hand corner.

Syracuse Rochester Buffalo Albany Binghamton Fair Lawn (NJ)

JUL - 1 1998

Upstate Laboratories inc.

Shipping: 6034 Corporate Dr. • E. Syracuse, NY 13057-1017 • (315) 437-0255 • Fax (315) 437-1209
Mailing: Box 289 • Syracuse, NY 13206
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Rochester (716) 436-9070
New Jersey (201) 703-1324

June 26, 1998

Mr. Steve Zbur
Unit Manager
Delta Environmental Consultants
4068 Mt. Royal Blvd.
Suite 225 - Gamma
Allison Park, PA 15101

Re: Analysis Report #14898064 - HB Fuller Geneva

Dear Mr. Zbur:

Please find enclosed the results for your samples which were collected by ULI personnel on May 28, 1998.

We have included the Chain of Custody Record as part of your report. You may need to reference this form for a more detailed explanation of your sample. Samples will be disposed of approximately one month from final report date.

Should you have any questions, please feel free to give us a call.

Thank you for your patronage.

Sincerely,

UPSTATE LABORATORIES, INC.

Anthony J. Scala
Director

AJS/lw

Enclosures: report, disk, invoice

cc/encs: N. Scala, ULI
file

__Note__: Faxed results were given to your office on 6/26/98. AJS

Disclaimer: The test results and procedures utilized, and laboratory interpretations of data obtained by ULI as contained in this report are believed by ULI to be accurate and reliable for sample(s) tested. In accepting this report, the customer agrees that the full extent of any and all liability for actual and consequential damages of ULI for the services performed shall be equal to the fee charged to the customer for the services as liquidated damages.

DATE: 06/26/98

Upstate Laboratories, Inc.
Analysis Results
Report Number: 14898064
Client I.D.: DELTA ENVIRONMENTAL CONSULTANT HB FULLER GENEVA
Sampled by: ULI

APPROVAL:
QC:
Lab I.D.: 10170

MW-9 0815H 05/28/98 G

ULI I.D.: 14898064 Matrix: Water

	PARAMETERS	RESULTS	KEY	FILE#
	BOD5	<8mg/l		WC1837
	Carbon Dioxide	260mg/lCO2		WC1822
	Nitrite-Nitrogen	<0.05mg/l		WC1831
	Nitrate-Nitrogen	<0.2mg/l		WC1831
	Total Alkalinity	960mg/lCaCO3		WC1855
	Chloride	210mg/l		WC1934
	COD	53mg/l		WC1912
	Ammonia-Nitrogen	<0.5mg/l		WC1859
	Sulfide	<0.1mg/l		WC1896
	Sulfate	370mg/l		WC1836
	Total Dissolved Solids	1700mg/l		WC1872
	TOC	20mg/l		WC1838
	Total Phosphorus	18mg/l		WC1960
Dissolved	Iron	0.59mg/l		MB0012
Dissolved	Manganese	1.1mg/l		MB0012
Dissolved	Sodium	420mg/l		ME1458
	TCL Volatiles by EPA Method 8260			
	Chloromethane	<15ug/l	05	VM1911
	Bromomethane	<15ug/l	05	VM1911
	Vinyl Chloride	25ug/l		VM1911
	Chloroethane	<15ug/l	05	VM1911
	Methylene Chloride	<15ug/l	05	VM1911
	Acetone	56ug/l		VM1911
	Carbon Disulfide	<15ug/l	05	VM1911
	1,1-Dichloroethene	47ug/l		VM1911
	1,1-Dichloroethane	56ug/l		VM1911
	trans-1,2-Dichloroethene	<15ug/l	05	VM1911
	cis-1,2-Dichloroethene	150ug/l		VM1911
	Chloroform	<15ug/l	05	VM1911
	1,2-Dichloroethane	<15ug/l	05	VM1911
	2-Butanone	74ug/l		VM1911
	1,1,1-Trichloroethane	230ug/l		VM1911
	Carbon Tetrachloride	<15ug/l	05	VM1911
	Bromodichloromethane	<15ug/l	05	VM1911
	1,2-Dichloropropane	<15ug/l	05	VM1911
	cis-1,3-Dichloropropene	<15ug/l	05	VM1911
	Trichloroethene	210ug/l		VM1911
	Dibromochloromethane	<15ug/l	05	VM1911
	1,1,2-Trichloroethane	<15ug/l	05	VM1911

DATE: 06/26/98

Upstate Laboratories, Inc.
Analysis Results
Report Number: 14898064
Client I.D.: DELTA ENVIRONMENTAL CONSULTANT HB FULLER GENEVA
Sampled by: ULI

APPROVAL:
QC:
Lab I.D.: 10170

MW-9 0815H 05/28/98 G

ULI I.D.: 14898064 Matrix: Water

PARAMETERS	RESULTS	KEY	FILE#
Benzene	<15ug/l	05	VM1911
trans-1,3-Dichloropropene	<15ug/l	05	VM1911
Bromoform	<15ug/l	05	VM1911
4-Methyl-2-pentanone	<50ug/l	05	VM1911
2-Hexanone	<50ug/l	05	VM1911
Tetrachloroethene	310ug/l		VM1911
1,1,2,2-Tetrachloroethane	<15ug/l	05	VM1911
Toluene	<15ug/l	05	VM1911
Chlorobenzene	<15ug/l	05	VM1911
Ethylbenzene	<15ug/l	05	VM1911
Styrene	<15ug/l	05	VM1911
m-Xylene and p-Xylene	<15ug/l	05	VM1911
o-Xylene	<15ug/l	05	VM1911
Ethane	<1mg/l		SC0001
Ethene	<1mg/l		SC0001
Methane	<1mg/l		SC0001

DATE: 06/26/98

Upstate Laboratories, Inc.
Analysis Results
Report Number: 14898064
Client I.D.: DELTA ENVIRONMENTAL CONSULTANT HB FULLER GENEVA
Sampled by: ULI

APPROVAL:
QC:
Lab I.D.: 10170

MW-2 0915H 05/28/98 G

ULI I.D.: 14898065 Matrix: Water

	PARAMETERS	RESULTS	KEY	FILE#
	BOD5	<24mg/l		WC1837
	Carbon Dioxide	120mg/lCO2		WC1822
	Nitrite-Nitrogen	<0.05mg/l		WC1831
	Nitrate-Nitrogen	<0.2mg/l		WC1831
	Total Alkalinity	2000mg/lCaCO3		WC1855
	Chloride	350mg/l		WC1934
	COD	210mg/l		WC1864
	Ammonia-Nitrogen	1.0mg/l		WC1859
	Sulfide	<0.1mg/l		WC1896
	Sulfate	210mg/l		WC1836
	Total Dissolved Solids	3000mg/l		WC1872
	TOC	3mg/l		WC1838
	Total Phosphorus	40mg/l		WC1960
Dissolved	Iron	5.4mg/l		MB0012
Dissolved	Manganese	2.5mg/l		MB0012
Dissolved	Sodium	910mg/l		ME1458

TCL Volatiles by EPA Method 8260

PARAMETERS	RESULTS	KEY	FILE#
Chloromethane	<15ug/l	05	VM1911
Bromomethane	<15ug/l	05	VM1911
Vinyl Chloride	240ug/l		VM1911
Chloroethane	<15ug/l	05	VM1911
Methylene Chloride	<15ug/l	05	VM1911
Acetone	50ug/l		VM1911
Carbon Disulfide	<15ug/l	05	VM1911
1,1-Dichloroethene	<15ug/l	05	VM1911
1,1-Dichloroethane	130ug/l		VM1911
trans-1,2-Dichloroethene	<15ug/l	05	VM1911
cis-1,2-Dichloroethene	260ug/l		VM1911
Chloroform	<15ug/l	05	VM1911
1,2-Dichloroethane	<15ug/l	05	VM1911
2-Butanone	<50ug/l	05	VM1911
1,1,1-Trichloroethane	23ug/l		VM1911
Carbon Tetrachloride	<15ug/l	05	VM1911
Bromodichloromethane	<15ug/l	05	VM1911
1,2-Dichloropropane	<15ug/l	05	VM1911
cis-1,3-Dichloropropene	<15ug/l	05	VM1911
Trichloroethene	280ug/l		VM1911
Dibromochloromethane	<15ug/l	05	VM1911
1,1,2-Trichloroethane	<15ug/l	05	VM1911

DATE: 06/26/98

Upstate Laboratories, Inc.
Analysis Results
Report Number: 14898064
Client I.D.: DELTA ENVIRONMENTAL CONSULTANT HB FULLER GENEVA
Sampled by: ULI

APPROVAL:
QC:
Lab I.D.: 10170

MW-2 0915H 05/28/98 G

ULI I.D.: 14898065   Matrix: Water

PARAMETERS	RESULTS	KEY	FILE#
Benzene	<15ug/l	05	VM1911
trans-1,3-Dichloropropene	<15ug/l	05	VM1911
Bromoform	<15ug/l	05	VM1911
4-Methyl-2-pentanone	<50ug/l	05	VM1911
2-Hexanone	<50ug/l	05	VM1911
Tetrachloroethene	53ug/l		VM1911
1,1,2,2-Tetrachloroethane	<15ug/l	05	VM1911
Toluene	<15ug/l	05	VM1911
Chlorobenzene	<15ug/l	05	VM1911
Ethylbenzene	<15ug/l	05	VM1911
Styrene	<15ug/l	05	VM1911
m-Xylene and p-Xylene	<15ug/l	05	VM1911
o-Xylene	<15ug/l	05	VM1911
Ethane	<1mg/l		SC0001
Ethene	<1mg/l		SC0001
Methane	<1mg/l		SC0001

DATE: 06/26/98

Upstate Laboratories, Inc.
Analysis Results
Report Number: 14898064
Client I.D.: DELTA ENVIRONMENTAL CONSULTANT HB FULLER GENEVA
Sampled by: ULI

APPROVAL:
QC:
Lab I.D.: 10170

MW-1 1020H 05/28/98 G

ULI I.D.: 14898066 Matrix: Water

	PARAMETERS	RESULTS	KEY	FILE#
	BOD5	<8mg/l		WC1837
	Carbon Dioxide	20mg/lCO2		WC1822
	Nitrite-Nitrogen	<0.05mg/l		WC1831
	Nitrate-Nitrogen	0.3mg/l		WC1831
	Total Alkalinity	300mg/lCaCO3		WC1855
	Chloride	2mg/l		WC1862
	COD	<20mg/l		WC2005
	Ammonia-Nitrogen	0.7mg/l		WC1859
	Sulfide	<0.1mg/l		WC1896
	Sulfate	38mg/l		WC1836
	Total Dissolved Solids	330mg/l		WC1872
	TOC	7mg/l		WC1838
	Total Phosphorus	0.62mg/l		WC1915
Dissolved	Iron	1.6mg/l		MB0012
Dissolved	Manganese	0.64mg/l		MB0012
Dissolved	Sodium	17mg/l		ME1458
	TCL Volatiles by EPA Method 8260			
	Chloromethane	7ug/l		VM1913
	Bromomethane	<3ug/l		VM1913
	Vinyl Chloride	<2ug/l		VM1913
	Chloroethane	<3ug/l		VM1913
	Methylene Chloride	3ug/l	44	VM1913
	Acetone	<10ug/l		VM1913
	Carbon Disulfide	<3ug/l		VM1913
	1,1-Dichloroethene	<3ug/l		VM1913
	1,1-Dichloroethane	<3ug/l		VM1913
	trans-1,2-Dichloroethene	<3ug/l		VM1913
	cis-1,2-Dichloroethene	<3ug/l		VM1913
	Chloroform	<3ug/l		VM1913
	1,2-Dichloroethane	<3ug/l		VM1913
	2-Butanone	<10ug/l		VM1913
	1,1,1-Trichloroethane	<3ug/l		VM1913
	Carbon Tetrachloride	<3ug/l		VM1913
	Bromodichloromethane	<3ug/l		VM1913
	1,2-Dichloropropane	<3ug/l		VM1913
	cis-1,3-Dichloropropene	<3ug/l		VM1913
	Trichloroethene	4ug/l		VM1913
	Dibromochloromethane	<3ug/l		VM1913
	1,1,2-Trichloroethane	<3ug/l		VM1913

DATE: 06/26/98

Upstate Laboratories, Inc.
Analysis Results
Report Number: 14898064
Client I.D.: DELTA ENVIRONMENTAL CONSULTANT HB FULLER GENEVA
Sampled by: ULI

APPROVAL:
QC: _ _ _ _ _
Lab I.D.: 10170

MW-1 1020H 05/28/98 G

ULI I.D.: 14898066 Matrix: Water

PARAMETERS	RESULTS	KEY	FILE#
Benzene	<3ug/l		VM1913
trans-1,3-Dichloropropene	<3ug/l		VM1913
Bromoform	<3ug/l		VM1913
4-Methyl-2-pentanone	<10ug/l		VM1913
2-Hexanone	<10ug/l		VM1913
Tetrachloroethene	11ug/l		VM1913
1,1,2,2-Tetrachloroethane	<3ug/l		VM1913
Toluene	<3ug/l		VM1913
Chlorobenzene	<3ug/l		VM1913
Ethylbenzene	<3ug/l		VM1913
Styrene	<3ug/l		VM1913
m-Xylene and p-Xylene	<3ug/l		VM1913
o-Xylene	<3ug/l		VM1913
Ethane	<1mg/l		SC0001
Ethene	<1mg/l		SC0001
Methane	<1mg/l		SC0001

DATE: 06/26/98

Upstate Laboratories, Inc.
Analysis Results
Report Number: 14898064
Client I.D.: DELTA ENVIRONMENTAL CONSULTANT HB FULLER GENEVA
Sampled by: ULI

APPROVAL:
QC:
Lab I.D.: 10170

MW-3 1130H 05/28/98 G

ULI I.D.: 14898067 Matrix: Water

	PARAMETERS	RESULTS	KEY	FILE#
	BOD5	140mg/l		WC1837
	Carbon Dioxide	<1.25mg/lCO2		WC1822
	Nitrite-Nitrogen	<0.05mg/l		WC1831
	Nitrate-Nitrogen	<0.2mg/l		WC1831
	Total Alkalinity	2400mg/lCaCO3		WC1855
	Chloride	210mg/l		WC1934
	COD	500mg/l		WC1864
	Ammonia-Nitrogen	7.8mg/l		WC1859
	Sulfide	<0.1mg/l		WC1896
	Sulfate	200mg/l		WC1836
	Total Dissolved Solids	3800mg/l		WC1872
	TOC	220mg/l		WC1838
	Total Phosphorus	270mg/l		WC2013
Dissolved	Iron	3.5mg/l		MB0012
Dissolved	Manganese	0.75mg/l		MB0012
Dissolved	Sodium	1200mg/l		ME1458

TCL Volatiles by EPA Method 8260

PARAMETERS	RESULTS	KEY	FILE#
Chloromethane	<15ug/l	01	VM1911
Bromomethane	<15ug/l	01	VM1911
Vinyl Chloride	<10ug/l	01	VM1911
Chloroethane	<15ug/l	01	VM1911
Methylene Chloride	<15ug/l	01	VM1911
Acetone	180ug/l		VM1911
Carbon Disulfide	<15ug/l	01	VM1911
1,1-Dichloroethene	<15ug/l	01	VM1911
1,1-Dichloroethane	<15ug/l	01	VM1911
trans-1,2-Dichloroethene	<15ug/l	01	VM1911
cis-1,2-Dichloroethene	<15ug/l	01	VM1911
Chloroform	<15ug/l	01	VM1911
1,2-Dichloroethane	<15ug/l	01	VM1911
2-Butanone	<50ug/l	01	VM1911
1,1,1-Trichloroethane	<15ug/l	01	VM1911
Carbon Tetrachloride	<15ug/l	01	VM1911
Bromodichloromethane	<15ug/l	01	VM1911
1,2-Dichloropropane	<15ug/l	01	VM1911
cis-1,3-Dichloropropene	<15ug/l	01	VM1911
Trichloroethene	<15ug/l	01	VM1911
Dibromochloromethane	<15ug/l	01	VM1911
1,1,2-Trichloroethane	<15ug/l	01	VM1911

DATE: 06/26/98

Upstate Laboratories, Inc.
Analysis Results
Report Number: 14898064
Client I.D.: DELTA ENVIRONMENTAL CONSULTANT HB FULLER GENEVA
Sampled by: ULI

APPROVAL:
QC:
Lab I.D.: 10170
MW-3 1130H 05/28/98 G

ULI I.D.: 14898067 Matrix: Water

PARAMETERS	RESULTS	KEY	FILE#
Benzene	<15ug/l	01	VM1911
trans-1,3-Dichloropropene	<15ug/l	01	VM1911
Bromoform	<15ug/l	01	VM1911
4-Methyl-2-pentanone	<50ug/l	01	VM1911
2-Hexanone	<50ug/l	01	VM1911
Tetrachloroethene	<15ug/l	01	VM1911
1,1,2,2-Tetrachloroethane	<15ug/l	01	VM1911
Toluene	<15ug/l	01	VM1911
Chlorobenzene	<15ug/l	01	VM1911
Ethylbenzene	<15ug/l	01	VM1911
Styrene	<15ug/l	01	VM1911
m-Xylene and p-Xylene	<15ug/l	01	VM1911
o-Xylene	<15ug/l	01	VM1911
Ethane	<1mg/l		SC0001
Ethene	<1mg/l		SC0001
Methane	<1mg/l		SC0001

DATE: 06/26/98

Upstate Laboratories, Inc.
Analysis Results
Report Number: 14898064
Client I.D.: DELTA ENVIRONMENTAL CONSULTANT HB FULLER GENEVA
Sampled by: ULI

APPROVAL:
QC:
Lab I.D.: 10170
SW-01 1155H 05/28/98 G

ULI I.D.: 14898068 Matrix: Water

PARAMETERS	RESULTS	KEY	FILE#
TCL Volatiles by EPA Method 8260			
Chloromethane	<3ug/l		VM1913
Bromomethane	<3ug/l		VM1913
Vinyl Chloride	<2ug/l		VM1913
Chloroethane	<3ug/l		VM1913
Methylene Chloride	<3ug/l		VM1913
Acetone	<10ug/l		VM1913
Carbon Disulfide	<3ug/l		VM1913
1,1-Dichloroethene	<3ug/l		VM1913
1,1-Dichloroethane	<3ug/l		VM1913
trans-1,2-Dichloroethene	<3ug/l		VM1913
cis-1,2-Dichloroethene	<3ug/l		VM1913
Chloroform	<3ug/l		VM1913
1,2-Dichloroethane	<3ug/l		VM1913
2-Butanone	<10ug/l		VM1913
1,1,1-Trichloroethane	<3ug/l		VM1913
Carbon Tetrachloride	<3ug/l		VM1913
Bromodichloromethane	<3ug/l		VM1913
1,2-Dichloropropane	<3ug/l		VM1913
cis-1,3-Dichloropropene	<3ug/l		VM1913
Trichloroethene	<3ug/l		VM1913
Dibromochloromethane	<3ug/l		VM1913
1,1,2-Trichloroethane	<3ug/l		VM1913
Benzene	<3ug/l		VM1913
trans-1,3-Dichloropropene	<3ug/l		VM1913
Bromoform	<3ug/l		VM1913
4-Methyl-2-pentanone	<10ug/l		VM1913
2-Hexanone	<10ug/l		VM1913
Tetrachloroethene	<3ug/l		VM1913
1,1,2,2-Tetrachloroethane	<3ug/l		VM1913
Toluene	<3ug/l		VM1913
Chlorobenzene	<3ug/l		VM1913
Ethylbenzene	<3ug/l		VM1913
Styrene	<3ug/l		VM1913
m-Xylene and p-Xylene	<3ug/l		VM1913
o-Xylene	<3ug/l		VM1913
Ethane	<1mg/l		SC0001
Ethene	<1mg/l		SC0001
Methane	<1mg/l		SC0001

DATE: 06/26/98

Upstate Laboratories, Inc.
Analysis Results
Report Number: 14898064
Client I.D.: DELTA ENVIRONMENTAL CONSULTANT HB FULLER GENEVA
Sampled by: ULI

APPROVAL:
QC:
Lab I.D.: 10170

SW-02 1200H 05/28/98 G

ULI I.D.: 14898069 Matrix: Water

PARAMETERS	RESULTS	KEY	FILE#
TCL Volatiles by EPA Method 8260			
Chloromethane	<3ug/l		VM1913
Bromomethane	<3ug/l		VM1913
Vinyl Chloride	<2ug/l		VM1913
Chloroethane	<3ug/l		VM1913
Methylene Chloride	<3ug/l		VM1913
Acetone	<10ug/l		VM1913
Carbon Disulfide	<3ug/l		VM1913
1,1-Dichloroethene	<3ug/l		VM1913
1,1-Dichloroethane	6ug/l		VM1913
trans-1,2-Dichloroethene	<3ug/l		VM1913
cis-1,2-Dichloroethene	5ug/l		VM1913
Chloroform	<3ug/l		VM1913
1,2-Dichloroethane	<3ug/l		VM1913
2-Butanone	<10ug/l		VM1913
1,1,1-Trichloroethane	<3ug/l		VM1913
Carbon Tetrachloride	<3ug/l		VM1913
Bromodichloromethane	<3ug/l		VM1913
1,2-Dichloropropane	<3ug/l		VM1913
cis-1,3-Dichloropropene	<3ug/l		VM1913
Trichloroethene	<3ug/l		VM1913
Dibromochloromethane	<3ug/l		VM1913
1,1,2-Trichloroethane	<3ug/l		VM1913
Benzene	<3ug/l		VM1913
trans-1,3-Dichloropropene	<3ug/l		VM1913
Bromoform	<3ug/l		VM1913
4-Methyl-2-pentanone	<10ug/l		VM1913
2-Hexanone	<10ug/l		VM1913
Tetrachloroethene	<3ug/l		VM1913
1,1,2,2-Tetrachloroethane	<3ug/l		VM1913
Toluene	<3ug/l		VM1913
Chlorobenzene	<3ug/l		VM1913
Ethylbenzene	<3ug/l		VM1913
Styrene	<3ug/l		VM1913
m-Xylene and p-Xylene	<3ug/l		VM1913
o-Xylene	<3ug/l		VM1913
Ethane	<1mg/l		SC0001
Ethene	<1mg/l		SC0001
Methane	<1mg/l		SC0001

DATE: 06/26/98

Upstate Laboratories, Inc.
Analysis Results
Report Number: 14898064
Client I.D.: DELTA ENVIRONMENTAL CONSULTANT HB FULLER GENEVA
Sampled by: ULI

APPROVAL:
QC:
Lab I.D.: 10170

SW-03 1205H 05/28/98 G

ULI I.D.: 14898070 Matrix: Water

PARAMETERS	RESULTS	KEY	FILE#
TCL Volatiles by EPA Method 8260			
Chloromethane	<3ug/l		VM1913
Bromomethane	<3ug/l		VM1913
Vinyl Chloride	<2ug/l		VM1913
Chloroethane	<3ug/l		VM1913
Methylene Chloride	3ug/l	44	VM1913
Acetone	<10ug/l		VM1913
Carbon Disulfide	<3ug/l		VM1913
1,1-Dichloroethene	<3ug/l		VM1913
1,1-Dichloroethane	6ug/l		VM1913
trans-1,2-Dichloroethene	<3ug/l		VM1913
cis-1,2-Dichloroethene	4ug/l		VM1913
Chloroform	<3ug/l		VM1913
1,2-Dichloroethane	<3ug/l		VM1913
2-Butanone	<10ug/l		VM1913
1,1,1-Trichloroethane	<3ug/l		VM1913
Carbon Tetrachloride	<3ug/l		VM1913
Bromodichloromethane	<3ug/l		VM1913
1,2-Dichloropropane	<3ug/l		VM1913
cis-1,3-Dichloropropene	<3ug/l		VM1913
Trichloroethene	<3ug/l		VM1913
Dibromochloromethane	<3ug/l		VM1913
1,1,2-Trichloroethane	<3ug/l		VM1913
Benzene	<3ug/l		VM1913
trans-1,3-Dichloropropene	<3ug/l		VM1913
Bromoform	<3ug/l		VM1913
4-Methyl-2-pentanone	<10ug/l		VM1913
2-Hexanone	<10ug/l		VM1913
Tetrachloroethene	<3ug/l		VM1913
1,1,2,2-Tetrachloroethane	<3ug/l		VM1913
Toluene	<3ug/l		VM1913
Chlorobenzene	<3ug/l		VM1913
Ethylbenzene	<3ug/l		VM1913
Styrene	<3ug/l		VM1913
m-Xylene and p-Xylene	<3ug/l		VM1913
o-Xylene	<3ug/l		VM1913
Ethane	<1mg/l		SC0001
Ethene	<1mg/l		SC0001
Methane	<1mg/l		SC0001

KEY PAGE

1 MATRIX INTERFERENCE PRECLUDES LOWER DETECTION LIMITS
2 MATRIX INTERFERENCE
3 PRESENT IN BLANK
4 ANALYSIS NOT PERFORMED BECAUSE OF INSUFFICIENT SAMPLE
5 THE PRESENCE OF OTHER TARGET ANALYTE(S) PRECLUDES LOWER DETECTION LIMITS
6 BLANK CORRECTED
7 HEAD SPACE PRESENT IN SAMPLE
8 QUANTITATION LIMIT IS GREATER THAN THE CALCULATED REGULATORY LEVEL. THE QUANTITATION LIMIT THEREFORE BECOMES THE REGULATORY LEVEL.
9 THE OIL WAS TREATED AS A SOLID AND LEACHED WITH EXTRACTION FLUID
10 ADL(AVERAGE DETECTION LIMITS)
11 PQL(PRACTICAL QUANTITATION LIMITS)
12 SAMPLE ANALYZED OVER HOLDING TIME
13 DISSOLVED VALUE MAY BE HIGHER THAN TOTAL DUE TO CONTAMINATION FROM THE FILTERING PROCEDURE
14 SAMPLED BY ULI
15 DISSOLVED VALUE MAY BE HIGHER THAN TOTAL; HOWEVER, THE VALUES ARE WITHIN EXPERIMENTAL ERROR
16 AN INHIBITORY FACTOR WAS OBSERVED IN THIS ANALYSIS
17 PARAMETER NOT ANALYZED WITHIN 15 MINUTES OF SAMPLING
18 THE SERIAL DILUTION OF THIS SAMPLE SUGGESTS A POSSIBLE PHYSICAL AND/OR CHEMICAL INTERFERENT IN THIS DETERMINATION. THE DATA MAY BE BIASED EITHER HIGH OR LOW.
19 CALCULATION BASED ON DRY WEIGHT
20 INDICATES AN ESTIMATED VALUE, DETECTED BUT BELOW THE PRACTICAL QUANTITATION LIMITS
21 UG/KG AS REC.D / UG/KG DRY WT
22 MG/KG AS REC.D / MG/KG DRY WT
23 INSUFFICIENT SAMPLE PRECLUDES LOWER DETECTION LIMITS
24 SAMPLE DILUTED/BLANK CORRECTED
25 ND(NON-DETECTED)
26 MATRIX INTERFERENCE PRECLUDES LOWER DETECTION LIMITS/BLANK CORRECTED
27 SPIKE RECOVERY ABNORMALLY HIGH/LOW DUE TO MATRIX INTERFERENCE
28 POST-DIGESTION SPIKE FOR FURNACE AA ANALYSIS IS OUTSIDE OF THE CONTROL LIMITS (85-115%); HOWEVER, THE SAMPLE CONCENTRATION IS BELOW THE PQL
29 ANALYZED BY METHOD OF STANDARD ADDITIONS
30 METHOD PERFORMANCE STUDY HAS NOT BEEN COMPLETED/ND(NON-DETECTED)
31 FIELD MEASURED PARAMETER TAKEN BY CLIENT
32 TARGET ANALYTE IS BIODEGRADED AND/OR ENVIRONMENTALLY WEATHERED
33 NON-POTABLE WATER SOURCE
34 THE QUALITY CONTROL RESULTS FOR THIS ANALYSIS INDICATE A POSITIVE BIAS OF 1-5 MG/L. THE POSITIVE BIAS FALLS BELOW THE PUBLISHED EPA REGULATORY DETECTION LIMIT OF 5 MG/L BUT ABOVE 1 MG/L.
35 THE HYDROCARBONS DETECTED IN THE SAMPLE DID NOT CROSS-MATCH WITH COMMON PETROLEUM DISTILLATES
36 MATRIX INTERFERENCE CAUSING SPIKES TO RESULT IN LESS THAN 50.0% RECOVERY
37 MILLIGRAMS PER LITER (MG/L) / POUNDS (LBS) PER DAY
38 MILLIGRAMS PER LITER (MG/L) OF RESIDUAL CHLORINE (CL2) / POUNDS (LBS) PER DAY OF CL2
39 MICROGRAMS PER LITER (UG/L) / POUNDS (LBS) PER DAY
40 MILLIGRAMS PER LITER (MG/L) LINEAR ALKYL SULFONATE (LAS) / POUNDS (LBS) PER DAY LAS
41 RESULTS ARE REPORTED ON AN AS REC.D BASIS
42 THE SAMPLE WAS ANALYZED ON A TOTAL BASIS; THE TEST RESULT CAN BE COMPARED TO THE TCLP REGULATORY CRITERIA BY DIVIDING THE TEST RESULT BY 20, CREATING A THEORETICAL TCLP VALUE
43 METAL BY CONCENTRATION PROCEDURE
44 POSSIBLE CONTAMINATION FROM FIELD/LABORATORY

6/11

Upstate Laboratories, Inc.

Chain of Custody Record

6034 Corporate Drive E. Syracuse New York 13057
(315) 437 0255 Fax 437 1209

Client: Delta Environmental
Project #/Project Name: HB Fuller Geneva
Client Contact: Ron Jenkens
Phone #: 412-487-7700
Address: Geneva, NY

Sample ID	Date	Time	Matrix	GRAB or COMP	ULI Internal Use Only	No. of Containers	1)	2)	3)	4)	5)	6)	7)	8)	9)	10)	11)	12)	Remarks
MW-9	5/28/98	0815	WATER	GRAB	14898064	9	X	X	X	X	X	X	X	X					Surfactants present!
MW-2	↓	0915	↓	↓	65	9	X	X	X	X	X	X	X	X					
MW-1	↓	1020	↓	↓	66	10	X	X	X	X	X	X	X	X					
MW-3	↓	1130	↓	↓	67	10	X	X	X	X	X	X	X	X					
SW-01	↓	1155	↓	↓	68	2	X (x)						(x)	(x)					
SW-02	↓	1200	↓	↓	69	2	X (x)						(x)	(x)					
SW-03	↓	1205	↓	↓	70	2	X (x)						(x)	(x)					

Parameter and Method	Type	Size	Preservative
1) NO2, TDS, NO3, Cl, SO4, BOD, CO2	Plastic	1/2 gallon	None
2) T-Alkalinity	Glass	8 oz.	None
3) TOC	Plastic	120 ml.	1:1 HCl
4) NH_3-N, COD, T-P	Plastic	500 ml.	H_2SO_4
5) Sulfide	Plastic	120 ml.	ZnAce/NaOH
6) D-Fe, Mn, Na	Plastic	500 ml.	HNO_3
7) Methane, Ethane, Ethylene	Glass	(2) 40 ml.	None
8) EPA 8260	Glass	(2) 40 ml.	1:1 HCl
9)			
10)			
11)			
12)			

Sampled by (Print): PETE Rundell / RON JENKINS
Company: ULI / DELTA

ULI Internal Use Only

Relinquished by: (sign)	Date	Time	Received by: (sign)
[signature]	5/28/98	1335	Rec'd for Lab by: H Dow

Syracuse Rochester Buffalo Albany Binghamton Fair Lawn (NJ)

05/21/98 SMP

Upstate Laboratories inc.

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New Jersey (201) 703-1324

JUL 31 1998

July 29, 1998

Mr. Steve Zbur
Unit Manager
Delta Environmental Consultants
4068 Mt. Royal Blvd.
Suite 225 - Gamma
Allison Park, PA 15101

Re: Analysis Report #19898033 - HB Fuller Geneva

Dear Mr. Zbur:

Please find enclosed the results for your samples which were collected by ULI personnel on July 16, 1998.

We have included the Chain of Custody Record as part of your report. You may need to reference this form for a more detailed explanation of your sample. Samples will be disposed of approximately one month from final report date.

Should you have any questions, please feel free to give us a call.

Thank you for your patronage.

Sincerely,

UPSTATE LABORATORIES, INC.

Anthony J. Scala

Anthony J. Scala
Director

AJS/jd

Enclosures: report, invoice

cc/encs: N. Scala, ULI
file

Note: Faxed results were given to your office on 7/24/98. AJS

Disclaimer: The test results and procedures utilized, and laboratory interpretations of data obtained by ULI as contained in this report are believed by ULI to be accurate and reliable for sample(s) tested. In accepting this report, the customer agrees that the full extent of any and all liability for actual and consequential damages of ULI for the services performed shall be equal to the fee charged to the customer for the services as liquidated damages.

DATE: 07/29/98

Upstate Laboratories, Inc. APPROVAL: QJS
Analysis Results QC: JT
Report Number: 19898033 Lab I.D.: 10170
Client I.D.: DELTA ENVIRONMENTAL CONSULTANT HB FULLER GENEVA
Sampled by: ULI MW-1 1103H 07/16/98 G

ULI I.D.: 19898033 Matrix: Water

PARAMETERS	RESULTS	KEY	FILE#
TCL Volatiles by EPA Method 8260			
Chloromethane	<3ug/l		VM1981
Bromomethane	<3ug/l		VM1981
Vinyl Chloride	<2ug/l		VM1981
Chloroethane	<3ug/l		VM1981
Methylene Chloride	<3ug/l		VM1981
Acetone	<10ug/l		VM1981
Carbon Disulfide	<3ug/l		VM1981
1,1-Dichloroethene	<3ug/l		VM1981
1,1-Dichloroethane	<3ug/l		VM1981
trans-1,2-Dichloroethene	<3ug/l		VM1981
cis-1,2-Dichloroethene	5ug/l		VM1981
Chloroform	<3ug/l		VM1981
1,2-Dichloroethane	<3ug/l		VM1981
2-Butanone	<10ug/l		VM1981
1,1,1-Trichloroethane	<3ug/l		VM1981
Carbon Tetrachloride	<3ug/l		VM1981
Bromodichloromethane	<3ug/l		VM1981
1,2-Dichloropropane	<3ug/l		VM1981
cis-1,3-Dichloropropene	<3ug/l		VM1981
Trichloroethene	9ug/l		VM1981
Dibromochloromethane	<3ug/l		VM1981
1,1,2-Trichloroethane	<3ug/l		VM1981
Benzene	<3ug/l		VM1981
trans-1,3-Dichloropropene	<3ug/l		VM1981
Bromoform	<3ug/l		VM1981
4-Methyl-2-pentanone	<10ug/l		VM1981
2-Hexanone	<10ug/l		VM1981
Tetrachloroethene	13ug/l		VM1981
1,1,2,2-Tetrachloroethane	<3ug/l		VM1981
Toluene	<3ug/l		VM1981
Chlorobenzene	<3ug/l		VM1981
Ethylbenzene	<3ug/l		VM1981
Styrene	<3ug/l		VM1981
m-Xylene and p-Xylene	<3ug/l		VM1981
o-Xylene	<3ug/l		VM1981

DATE: 07/29/98

Upstate Laboratories, Inc.
Analysis Results
Report Number: 19898033
Client I.D.: DELTA ENVIRONMENTAL CONSULTANT HB FULLER GENEVA
Sampled by: ULI

APPROVAL: QJS
QC: QT
Lab I.D.: 10170

MW-2 1015H 07/16/98 G

ULI I.D.: 19898034 Matrix: Water

PARAMETERS	RESULTS	KEY	FILE#
TCL Volatiles by EPA Method 8260			
Chloromethane	<3ug/l		VM1983
Bromomethane	<3ug/l		VM1983
Vinyl Chloride	260ug/l		VM1983
Chloroethane	<3ug/l		VM1983
Methylene Chloride	3ug/l	44	VM1983
Acetone	76ug/l		VM1983
Carbon Disulfide	<3ug/l		VM1983
1,1-Dichloroethene	9ug/l		VM1983
1,1-Dichloroethane	130ug/l		VM1983
trans-1,2-Dichloroethene	6ug/l		VM1983
cis-1,2-Dichloroethene	510ug/l		VM1983
Chloroform	8ug/l		VM1983
1,2-Dichloroethane	<3ug/l		VM1983
2-Butanone	<10ug/l		VM1983
1,1,1-Trichloroethane	16ug/l		VM1983
Carbon Tetrachloride	<3ug/l		VM1983
Bromodichloromethane	<3ug/l		VM1983
1,2-Dichloropropane	<3ug/l		VM1983
cis-1,3-Dichloropropene	<3ug/l		VM1983
Trichloroethene	460ug/l		VM1983
Dibromochloromethane	<3ug/l		VM1983
1,1,2-Trichloroethane	3ug/l		VM1983
Benzene	<3ug/l		VM1983
trans-1,3-Dichloropropene	<3ug/l		VM1983
Bromoform	<3ug/l		VM1983
4-Methyl-2-pentanone	<10ug/l		VM1983
2-Hexanone	<10ug/l		VM1983
Tetrachloroethene	33ug/l		VM1983
1,1,2,2-Tetrachloroethane	<3ug/l		VM1983
Toluene	<3ug/l		VM1983
Chlorobenzene	<3ug/l		VM1983
Ethylbenzene	<3ug/l		VM1983
Styrene	<3ug/l		VM1983
m-Xylene and p-Xylene	<3ug/l		VM1983
o-Xylene	<3ug/l		VM1983

DATE: 07/29/98

Upstate Laboratories, Inc. APPROVAL:____
Analysis Results QC:______
Report Number: 19898033 Lab I.D.: 10170
Client I.D.: DELTA ENVIRONMENTAL CONSULTANT HB FULLER GENEVA
Sampled by: ULI MW-3 1147H 07/16/98 G

ULI I.D.: 19898035 Matrix: Water

PARAMETERS	RESULTS	DATE ANAL.	KEY	FILE#
TCL Volatiles by EPA Method 8260				
Chloromethane	<3ug/l	07/20/98		VM1983
Bromomethane	<3ug/l	07/20/98		VM1983
Vinyl Chloride	4ug/l	07/20/98		VM1983
Chloroethane	<3ug/l	07/20/98		VM1983
Methylene Chloride	6ug/l	07/20/98	44	VM1983
Acetone	300ug/l	07/20/98		VM1983
Carbon Disulfide	<3ug/l	07/20/98		VM1983
1,1-Dichloroethene	<3ug/l	07/20/98		VM1983
1,1-Dichloroethane	11ug/l	07/20/98		VM1983
trans-1,2-Dichloroethene	<3ug/l	07/20/98		VM1983
cis-1,2-Dichloroethene	9ug/l	07/20/98		VM1983
Chloroform	<3ug/l	07/20/98		VM1983
1,2-Dichloroethane	<3ug/l	07/20/98		VM1983
2-Butanone	10ug/l	07/20/98		VM1983
1,1,1-Trichloroethane	<3ug/l	07/20/98		VM1983
Carbon Tetrachloride	<3ug/l	07/20/98		VM1983
Bromodichloromethane	<3ug/l	07/20/98		VM1983
1,2-Dichloropropane	<3ug/l	07/20/98		VM1983
cis-1,3-Dichloropropene	<3ug/l	07/20/98		VM1983
Trichloroethene	15ug/l	07/20/98		VM1983
Dibromochloromethane	<3ug/l	07/20/98		VM1983
1,1,2-Trichloroethane	<3ug/l	07/20/98		VM1983
Benzene	<3ug/l	07/20/98		VM1983
trans-1,3-Dichloropropene	<3ug/l	07/20/98		VM1983
Bromoform	<3ug/l	07/20/98		VM1983
4-Methyl-2-pentanone	<10ug/l	07/20/98		VM1983
2-Hexanone	<10ug/l	07/20/98		VM1983
Tetrachloroethene	7ug/l	07/20/98		VM1983
1,1,2,2-Tetrachloroethane	<3ug/l	07/20/98		VM1983
Toluene	<3ug/l	07/20/98		VM1983
Chlorobenzene	<3ug/l	07/20/98		VM1983
Ethylbenzene	<3ug/l	07/20/98		VM1983
Styrene	<3ug/l	07/20/98		VM1983
m-Xylene and p-Xylene	<3ug/l	07/20/98		VM1983
o-Xylene	<3ug/l	07/20/98		VM1983

DATE: 07/29/98

Upstate Laboratories, Inc. APPROVAL: QJS
Analysis Results QC: JT
Report Number: 19898033 Lab I.D.: 10170
Client I.D.: DELTA ENVIRONMENTAL CONSULTANT HB FULLER GENEVA
Sampled by: ULI MW-9 1225H 07/16/98 G

ULI I.D.: 19898036 Matrix: Water

PARAMETERS	RESULTS	KEY	FILE#
TCL Volatiles by EPA Method 8260			
Chloromethane	<3ug/l		VM1983
Bromomethane	<3ug/l		VM1983
Vinyl Chloride	38ug/l		VM1983
Chloroethane	<3ug/l		VM1983
Methylene Chloride	<3ug/l		VM1983
Acetone	<10ug/l		VM1983
Carbon Disulfide	<3ug/l		VM1983
1,1-Dichloroethene	39ug/l		VM1983
1,1-Dichloroethane	61ug/l		VM1983
trans-1,2-Dichloroethene	<3ug/l		VM1983
cis-1,2-Dichloroethene	200ug/l		VM1983
Chloroform	9ug/l		VM1983
1,2-Dichloroethane	<3ug/l		VM1983
2-Butanone	<10ug/l		VM1983
1,1,1-Trichloroethane	220ug/l		VM1983
Carbon Tetrachloride	<3ug/l		VM1983
Bromodichloromethane	<3ug/l		VM1983
1,2-Dichloropropane	<3ug/l		VM1983
cis-1,3-Dichloropropene	<3ug/l		VM1983
Trichloroethene	230ug/l		VM1983
Dibromochloromethane	<3ug/l		VM1983
1,1,2-Trichloroethane	<3ug/l		VM1983
Benzene	<3ug/l		VM1983
trans-1,3-Dichloropropene	<3ug/l		VM1983
Bromoform	<3ug/l		VM1983
4-Methyl-2-pentanone	<10ug/l		VM1983
2-Hexanone	<10ug/l		VM1983
Tetrachloroethene	350ug/l		VM1983
1,1,2,2-Tetrachloroethane	<3ug/l		VM1983
Toluene	<3ug/l		VM1983
Chlorobenzene	<3ug/l		VM1983
Ethylbenzene	<3ug/l		VM1983
Styrene	<3ug/l		VM1983
m-Xylene and p-Xylene	<3ug/l		VM1983
o-Xylene	<3ug/l		VM1983

DATE: 07/29/98

Upstate Laboratories, Inc. APPROVAL: AJS
Analysis Results QC: JT
Report Number: 19898033 Lab I.D.: 10170
Client I.D.: DELTA ENVIRONMENTAL CONSULTANT HB FULLER GENEVA
Sampled by: ULI SW-1 1400H 07/16/98 G

ULI I.D.: 19898037 Matrix: Water

PARAMETERS	RESULTS	KEY	FILE#
TCL Volatiles by EPA Method 8260			
Chloromethane	<3ug/l		VM1981
Bromomethane	<3ug/l		VM1981
Vinyl Chloride	<2ug/l		VM1981
Chloroethane	<3ug/l		VM1981
Methylene Chloride	<3ug/l		VM1981
Acetone	<10ug/l		VM1981
Carbon Disulfide	<3ug/l		VM1981
1,1-Dichloroethene	<3ug/l		VM1981
1,1-Dichloroethane	<3ug/l		VM1981
trans-1,2-Dichloroethene	<3ug/l		VM1981
cis-1,2-Dichloroethene	<3ug/l		VM1981
Chloroform	<3ug/l		VM1981
1,2-Dichloroethane	<3ug/l		VM1981
2-Butanone	<10ug/l		VM1981
1,1,1-Trichloroethane	<3ug/l		VM1981
Carbon Tetrachloride	<3ug/l		VM1981
Bromodichloromethane	<3ug/l		VM1981
1,2-Dichloropropane	<3ug/l		VM1981
cis-1,3-Dichloropropene	<3ug/l		VM1981
Trichloroethene	<3ug/l		VM1981
Dibromochloromethane	<3ug/l		VM1981
1,1,2-Trichloroethane	<3ug/l		VM1981
Benzene	<3ug/l		VM1981
trans-1,3-Dichloropropene	<3ug/l		VM1981
Bromoform	<3ug/l		VM1981
4-Methyl-2-pentanone	<10ug/l		VM1981
2-Hexanone	<10ug/l		VM1981
Tetrachloroethene	<3ug/l		VM1981
1,1,2,2-Tetrachloroethane	<3ug/l		VM1981
Toluene	<3ug/l		VM1981
Chlorobenzene	<3ug/l		VM1981
Ethylbenzene	<3ug/l		VM1981
Styrene	<3ug/l		VM1981
m-Xylene and p-Xylene	<3ug/l		VM1981
o-Xylene	<3ug/l		VM1981

DATE: 07/29/98

Upstate Laboratories, Inc. APPROVAL: QJS
Analysis Results QC: GT
Report Number: 19898033 Lab I.D.: 10170
Client I.D.: DELTA ENVIRONMENTAL CONSULTANT HB FULLER GENEVA
Sampled by: ULI SW-2 1350H 07/16/98 G

ULI I.D.: 19898038 Matrix: Water

PARAMETERS	RESULTS	KEY	FILE#
TCL Volatiles by EPA Method 8260			
Chloromethane	<3ug/l		VM1981
Bromomethane	<3ug/l		VM1981
Vinyl Chloride	<2ug/l		VM1981
Chloroethane	<3ug/l		VM1981
Methylene Chloride	<3ug/l		VM1981
Acetone	<10ug/l		VM1981
Carbon Disulfide	<3ug/l		VM1981
1,1-Dichloroethene	<3ug/l		VM1981
1,1-Dichloroethane	9ug/l		VM1981
trans-1,2-Dichloroethene	<3ug/l		VM1981
cis-1,2-Dichloroethene	5ug/l		VM1981
Chloroform	<3ug/l		VM1981
1,2-Dichloroethane	<3ug/l		VM1981
2-Butanone	<10ug/l		VM1981
1,1,1-Trichloroethane	<3ug/l		VM1981
Carbon Tetrachloride	<3ug/l		VM1981
Bromodichloromethane	<3ug/l		VM1981
1,2-Dichloropropane	<3ug/l		VM1981
cis-1,3-Dichloropropene	<3ug/l		VM1981
Trichloroethene	<3ug/l		VM1981
Dibromochloromethane	<3ug/l		VM1981
1,1,2-Trichloroethane	<3ug/l		VM1981
Benzene	<3ug/l		VM1981
trans-1,3-Dichloropropene	<3ug/l		VM1981
Bromoform	<3ug/l		VM1981
4-Methyl-2-pentanone	<10ug/l		VM1981
2-Hexanone	<10ug/l		VM1981
Tetrachloroethene	<3ug/l		VM1981
1,1,2,2-Tetrachloroethane	<3ug/l		VM1981
Toluene	<3ug/l		VM1981
Chlorobenzene	<3ug/l		VM1981
Ethylbenzene	<3ug/l		VM1981
Styrene	<3ug/l		VM1981
m-Xylene and p-Xylene	<3ug/l		VM1981
o-Xylene	<3ug/l		VM1981

DATE: 07/29/98

Upstate Laboratories, Inc. APPROVAL: GJS
Analysis Results QC: GT
Report Number: 19898033 Lab I.D.: 10170
Client I.D.: DELTA ENVIRONMENTAL CONSULTANT HB FULLER GENEVA
Sampled by: ULI SW-3 1345H 07/16/98 G

ULI I.D.: 19898039 Matrix: Water

PARAMETERS	RESULTS	KEY	FILE#
TCL Volatiles by EPA Method 8260			
Chloromethane	<3ug/l		VM1981
Bromomethane	<3ug/l		VM1981
Vinyl Chloride	<2ug/l		VM1981
Chloroethane	<3ug/l		VM1981
Methylene Chloride	<3ug/l		VM1981
Acetone	<10ug/l		VM1981
Carbon Disulfide	<3ug/l		VM1981
1,1-Dichloroethene	<3ug/l		VM1981
1,1-Dichloroethane	8ug/l		VM1981
trans-1,2-Dichloroethene	<3ug/l		VM1981
cis-1,2-Dichloroethene	5ug/l		VM1981
Chloroform	<3ug/l		VM1981
1,2-Dichloroethane	<3ug/l		VM1981
2-Butanone	<10ug/l		VM1981
1,1,1-Trichloroethane	<3ug/l		VM1981
Carbon Tetrachloride	<3ug/l		VM1981
Bromodichloromethane	<3ug/l		VM1981
1,2-Dichloropropane	<3ug/l		VM1981
cis-1,3-Dichloropropene	<3ug/l		VM1981
Trichloroethene	<3ug/l		VM1981
Dibromochloromethane	<3ug/l		VM1981
1,1,2-Trichloroethane	<3ug/l		VM1981
Benzene	<3ug/l		VM1981
trans-1,3-Dichloropropene	<3ug/l		VM1981
Bromoform	<3ug/l		VM1981
4-Methyl-2-pentanone	<10ug/l		VM1981
2-Hexanone	<10ug/l		VM1981
Tetrachloroethene	<3ug/l		VM1981
1,1,2,2-Tetrachloroethane	<3ug/l		VM1981
Toluene	<3ug/l		VM1981
Chlorobenzene	<3ug/l		VM1981
Ethylbenzene	<3ug/l		VM1981
Styrene	<3ug/l		VM1981
m-Xylene and p-Xylene	<3ug/l		VM1981
o-Xylene	<3ug/l		VM1981

DATE: 07/29/98

Upstate Laboratories, Inc.
Analysis Results
Report Number: 19898033
Client I.D.: DELTA ENVIRONMENTAL CONSULTANT HB FULLER GENEVA
Sampled by: ULI

APPROVAL: AJS
QC: JT
Lab I.D.: 10170

ULI TRIP BLANK 07/16/98

ULI I.D.: 19898040 Matrix: Water

PARAMETERS	RESULTS	KEY	FILE#
TCL Volatiles by EPA Method 8260			
Chloromethane	<3ug/l		VM1981
Bromomethane	<3ug/l		VM1981
Vinyl Chloride	<2ug/l		VM1981
Chloroethane	<3ug/l		VM1981
Methylene Chloride	<3ug/l		VM1981
Acetone	<10ug/l		VM1981
Carbon Disulfide	<3ug/l		VM1981
1,1-Dichloroethene	<3ug/l		VM1981
1,1-Dichloroethane	<3ug/l		VM1981
trans-1,2-Dichloroethene	<3ug/l		VM1981
cis-1,2-Dichloroethene	<3ug/l		VM1981
Chloroform	<3ug/l		VM1981
1,2-Dichloroethane	<3ug/l		VM1981
2-Butanone	<10ug/l		VM1981
1,1,1-Trichloroethane	<3ug/l		VM1981
Carbon Tetrachloride	<3ug/l		VM1981
Bromodichloromethane	<3ug/l		VM1981
1,2-Dichloropropane	<3ug/l		VM1981
cis-1,3-Dichloropropene	<3ug/l		VM1981
Trichloroethene	<3ug/l		VM1981
Dibromochloromethane	<3ug/l		VM1981
1,1,2-Trichloroethane	<3ug/l		VM1981
Benzene	<3ug/l		VM1981
trans-1,3-Dichloropropene	<3ug/l		VM1981
Bromoform	<3ug/l		VM1981
4-Methyl-2-pentanone	<10ug/l		VM1981
2-Hexanone	<10ug/l		VM1981
Tetrachloroethene	<3ug/l		VM1981
1,1,2,2-Tetrachloroethane	<3ug/l		VM1981
Toluene	<3ug/l		VM1981
Chlorobenzene	<3ug/l		VM1981
Ethylbenzene	<3ug/l		VM1981
Styrene	<3ug/l		VM1981
m-Xylene and p-Xylene	<3ug/l		VM1981
o-Xylene	<3ug/l		VM1981

KEY PAGE

1 MATRIX INTERFERENCE PRECLUDES LOWER DETECTION LIMITS
2 MATRIX INTERFERENCE
3 PRESENT IN BLANK
4 ANALYSIS NOT PERFORMED BECAUSE OF INSUFFICIENT SAMPLE
5 THE PRESENCE OF OTHER TARGET ANALYTE(S) PRECLUDES LOWER DETECTION LIMITS
6 BLANK CORRECTED
7 HEAD SPACE PRESENT IN SAMPLE
8 QUANTITATION LIMIT IS GREATER THAN THE CALCULATED REGULATORY LEVEL. THE QUANTITATION LIMIT THEREFORE BECOMES THE REGULATORY LEVEL.
9 THE OIL WAS TREATED AS A SOLID AND LEACHED WITH EXTRACTION FLUID
10 ADL(AVERAGE DETECTION LIMITS)
11 PQL(PRACTICAL QUANTITATION LIMITS)
12 SAMPLE ANALYZED OVER HOLDING TIME
13 DISSOLVED VALUE MAY BE HIGHER THAN TOTAL DUE TO CONTAMINATION FROM THE FILTERING PROCEDURE
14 SAMPLED BY ULI
15 DISSOLVED VALUE MAY BE HIGHER THAN TOTAL; HOWEVER, THE VALUES ARE WITHIN EXPERIMENTAL ERROR
16 AN INHIBITORY FACTOR WAS OBSERVED IN THIS ANALYSIS
17 PARAMETER NOT ANALYZED WITHIN 15 MINUTES OF SAMPLING
18 THE SERIAL DILUTION OF THIS SAMPLE SUGGESTS A POSSIBLE PHYSICAL AND/OR CHEMICAL INTERFERENT IN THIS DETERMINATION. THE DATA MAY BE BIASED EITHER HIGH OR LOW.
19 CALCULATION BASED ON DRY WEIGHT
20 INDICATES AN ESTIMATED VALUE, DETECTED BUT BELOW THE PRACTICAL QUANTITATION LIMITS
21 UG/KG AS REC.D / UG/KG DRY WT
22 MG/KG AS REC.D / MG/KG DRY WT
23 INSUFFICIENT SAMPLE PRECLUDES LOWER DETECTION LIMITS
24 SAMPLE DILUTED/BLANK CORRECTED
25 ND(NON-DETECTED)
26 MATRIX INTERFERENCE PRECLUDES LOWER DETECTION LIMITS/BLANK CORRECTED
27 SPIKE RECOVERY ABNORMALLY HIGH/LOW DUE TO MATRIX INTERFERENCE
28 POST-DIGESTION SPIKE FOR FURNACE AA ANALYSIS IS OUTSIDE OF THE CONTROL LIMITS (85-115%); HOWEVER, THE SAMPLE CONCENTRATION IS BELOW THE PQL
29 ANALYZED BY METHOD OF STANDARD ADDITIONS
30 METHOD PERFORMANCE STUDY HAS NOT BEEN COMPLETED/ND(NON-DETECTED)
31 FIELD MEASURED PARAMETER TAKEN BY CLIENT
32 TARGET ANALYTE IS BIODEGRADED AND/OR ENVIRONMENTALLY WEATHERED
33 NON-POTABLE WATER SOURCE
34 THE QUALITY CONTROL RESULTS FOR THIS ANALYSIS INDICATE A POSITIVE BIAS OF 1-5 MG/L. THE POSITIVE BIAS FALLS BELOW THE PUBLISHED EPA REGULATORY DETECTION LIMIT OF 5 MG/L BUT ABOVE 1 MG/L.
35 THE HYDROCARBONS DETECTED IN THE SAMPLE DID NOT CROSS-MATCH WITH COMMON PETROLEUM DISTILLATES
36 MATRIX INTERFERENCE CAUSING SPIKES TO RESULT IN LESS THAN 50.0% RECOVERY
37 MILLIGRAMS PER LITER (MG/L) / POUNDS (LBS) PER DAY
38 MILLIGRAMS PER LITER (MG/L) OF RESIDUAL CHLORINE (CL2) / POUNDS (LBS) PER DAY OF CL2
39 MICROGRAMS PER LITER (UG/L) / POUNDS (LBS) PER DAY
40 MILLIGRAMS PER LITER (MG/L) LINEAR ALKYL SULFONATE (LAS) / POUNDS (LBS) PER DAY LAS
41 RESULTS ARE REPORTED ON AN AS REC.D BASIS
42 THE SAMPLE WAS ANALYZED ON A TOTAL BASIS; THE TEST RESULT CAN BE COMPARED TO THE TCLP REGULATORY CRITERIA BY DIVIDING THE TEST RESULT BY 20, CREATING A THEORETICAL TCLP VALUE
43 METAL BY CONCENTRATION PROCEDURE
44 POSSIBLE CONTAMINATION FROM FIELD/LABORATORY

Upstate Laboratories Inc
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15) 437 0255 Fax 437 1209

Chain Of Custody Record

7/31
7/24 HPD

Client: DELTA ENVIRONMENTAL

Client Project # / Project Name: HB Fuller Geneva

Client Contact: STEVE ZBUR

Phone #:

Site Location (city/state): GENEVA, NY

Special Turnaround Time ______ (Lab Notification required)

Sample Location	Date	Time	Matrix	Grab or Comp.	ULI Internal Use Only	No. of Containers	1)	2)	3)	4)	5)	6)	7)	8)	9)	10)	Remarks
MW-1	7/16/98	1103	WATER	GRAB	19898033	2	X										
MW-2	↓	1015	↓	↓	34	2	X										
MW-3	↓	1147	↓	↓	35	2	X										
MW-9	↓	1225	↓	↓	36	2	X										
MW-10	XXX	NO SAMPLE (DRY)				X											
MW-11	XXX	NO SAMPLE (DRY)				X											
SW-1	7/16/98	1400	water	GRAB	37	2	X										
SW-2	↓	1350	↓	↓	38	2	X										
SW-3	↓	1345	↓	↓	39	2	X										
TRIP BLANK	↓	—	↓	↓	40	1	X										

Parameter and method	sample bottle: type	size	pres.
EPA 8260	GLASS	40 mL	1:1 HCl

Sampled by: (Please Print) PETE RUNDELL

Company: UPSTATE LABORATORIES

ULI Internal Use Only
Delivery (check one):
☐ ULI Sampled
☐ Pickup ☐ Dropoff
☐ CC ______

Relinquished by: (Signature)	Date	Time	Received by: (Signature)
	7/16/98		Rec'd for Lab by: (Signature) S. Jillson

Note: The numbered columns above cross-reference with the numbered columns in the upper right-hand corner.

Syracuse Rochester Buffalo Albany Binghamton Fair Lawn (NJ)

APPENDIX F

WIEDEMEIR ARTICLE (1996)

Overview of the Technical Protocol for Natural Attenuation of Chlorinated Aliphatic Hydrocarbons in Ground Water Under Development for the U.S. Air Force Center for Environmental Excellence

Todd H. Wiedemeier, Matthew A. Swanson, and David E. Moutoux
Parsons Engineering Science, Inc., Denver, Colorado

John T. Wilson and Donald H. Kampbell
U.S. Environmental Protection Agency, National Risk Management Research Laboratory, Ada, Oklahoma

Jerry E. Hansen and Patrick Haas
U.S. Air Force Center for Environmental Excellence, Technology Transfer Division, Brooks Air Force Base, Texas

Introduction

Over the past several years, natural attenuation has become increasingly accepted as a remedial alternative for organic compounds dissolved in ground water. The U.S. Environmental Protection Agency's (EPA) Office of Research and Development and Office of Solid Waste and Emergency Response define natural attenuation as:

> The biodegradation, dispersion, dilution, sorption, volatilization, and/or chemical and biochemical stabilization of contaminants to effectively reduce contaminant toxicity, mobility, or volume to levels that are protective of human health and the ecosystem.

In practice, natural attenuation has several other names, such as intrinsic remediation, intrinsic bioremediation, or passive bioremediation. The goal of any site characterization effort is to understand the fate and transport of the contaminants of concern over time in order to assess any current or potential threat to human health or the environment. Natural attenuation processes, such as biodegradation, can often be dominant factors in the fate and transport of contaminants. Thus, consideration and quantification of natural attenuation is essential to more thoroughly understand contaminant fate and transport.

This paper presents a technical protocol for data collection and analysis in support of remediation by natural attenuation to restore ground water contaminated with chlorinated aliphatic hydrocarbons and ground water contaminated with mixtures of fuels and chlorinated aliphatic hydrocarbons. In some cases, the information collected using this protocol will show that natural attenuation processes, with or without source removal, will reduce the concentrations of these contaminants to below risk-based corrective action criteria or regulatory standards before potential receptor exposure pathways are completed. The evaluation should include consideration of existing exposure pathways as well as exposure pathways arising from potential future use of the ground water.

This protocol is intended to be used within the established regulatory framework. It is not the intent of this document to replace existing EPA or state-specific guidance on conducting remedial investigations.

Overview of the Technical Protocol

Natural attenuation in ground-water systems results from the integration of several subsurface attenuation mechanisms that are classified as either destructive or nondestructive. Biodegradation is the most important destructive attenuation mechanism. Nondestructive attenuation mechanisms include sorption, dispersion, dilution from recharge, and volatilization. The natural attenuation of fuel hydrocarbons is described in the *Technical Protocol for Implementing Intrinsic Remediation With Long-Term Monitoring for Natural Attenuation of Fuel Contamination Dissolved in Groundwater,* recently published by the U.S. Air Force Center for Environmental

Excellence (AFCEE) (1). This document differs from the technical protocol for intrinsic remediation of fuel hydrocarbons because the individual processes of chlorinated aliphatic hydrocarbon biodegradation are fundamentally different from the processes involved in the biodegradation of fuel hydrocarbons.

For example, biodegradation of fuel hydrocarbons, especially benzene, toluene, ethylbenzene, and xylenes (BTEX), is mainly limited by electron acceptor availability, and biodegradation of these compounds generally will proceed until all of the contaminants are destroyed. In the experience of the authors, there appears to be an inexhaustible supply of electron acceptors in most, if not all, hydrogeologic environments. On the other hand, the more highly chlorinated solvents (e.g., perchloroethene and trichloroethene) typically are biodegraded under natural conditions via reductive dechlorination, a process that requires both electron acceptors (the chlorinated aliphatic hydrocarbons) and an adequate supply of electron donors. Electron donors include fuel hydrocarbons or other types of anthropogenic carbon (e.g., landfill leachate, BTEX, or natural organic carbon). If the subsurface environment is depleted of electron donors before the chlorinated aliphatic hydrocarbons are removed, reductive dechlorination will cease, and natural attenuation may no longer be protective of human health and the environment. This is the most significant difference between the processes of fuel hydrocarbon and chlorinated aliphatic hydrocarbon biodegradation.

For this reason, it is more difficult to predict the long-term behavior of chlorinated aliphatic hydrocarbon plumes than fuel hydrocarbon plumes. Thus, it is important to have a thorough understanding of the operant natural attenuation mechanisms. In addition to having a better understanding of the processes of advection, dispersion, dilution from recharge, and sorption, it is necessary to better quantify biodegradation. This requires a thorough understanding of the interactions between chlorinated aliphatic hydrocarbons, anthropogenic/natural carbon, and inorganic electron acceptors at the site. Detailed site characterization is required to adequately understand these processes.

Chlorinated solvents are released into the subsurface under two possible scenarios: 1) as relatively pure solvent mixtures that are more dense than water, or 2) as mixtures of fuel hydrocarbons and chlorinated aliphatic hydrocarbons which, depending on the relative proportion of each, may be more or less dense than water. These products commonly are referred to as "nonaqueous-phase liquids," or NAPLs. If the NAPL is more dense than water, the material is referred to as a "dense nonaqueous-phase liquid," or DNAPL. If the NAPL is less dense than water, the material is referred to as a "light nonaqueous-phase liquid," or LNAPL. In general, the greatest mass of contaminant is associated with these NAPL source areas, not with the aqueous phase.

As ground water moves through or past the NAPL source areas, soluble constituents partition into the moving ground water to generate a plume of dissolved contamination. After further releases have been stopped, these NAPL source areas tend to slowly weather away as the soluble components, such as BTEX or trichloroethene, are depleted. In cases where source removal or reduction is feasible, it is desirable to remove product and decrease the time required for complete remediation of the site. At many sites, however, mobile NAPL removal is not feasible with available technology. In fact, the quantity of NAPL recovered by commonly used recovery techniques is a trivial fraction of the total NAPL available to contaminate ground water. Mobile NAPL recovery typically recovers less than 10 percent of the total NAPL mass in a spill.

Compared with conventional engineered remediation technologies, natural attenuation has the following advantages:

- During natural attenuation, contaminants are ultimately transformed to innocuous byproducts (e.g., carbon dioxide, ethene, and water), not just transferred to another phase or location in the environment.
- Natural attenuation is nonintrusive and allows continuing use of infrastructure during remediation.
- Engineered remedial technologies can pose greater risk to potential receptors than natural attenuation because contaminants may be transferred into the atmosphere during remediation activities.
- Natural attenuation is less costly than currently available remedial technologies, such as pump-and-treat.
- Natural attenuation is not subject to the limitations of mechanized remediation equipment (e.g., no equipment downtime).
- Those compounds that are the most mobile and toxic are generally the most susceptible to biodegradation.

Natural attenuation has the following limitations:

- Natural attenuation is subject to natural and anthropogenic changes in local hydrogeologic conditions, including changes in ground-water gradients and velocity, pH, electron acceptor concentrations, electron donor concentrations, and/or potential future contaminant releases.
- Aquifer heterogeneity may complicate site characterization and quantification of natural attenuation.
- Time frames for complete remediation may be relatively long.

- Intermediate products of biodegradation (e.g., vinyl chloride) can be more toxic than the original contaminant.

This document describes those processes that bring about natural attenuation, the site characterization activities that may be performed to support a feasibility study to include an evaluation of natural attenuation, natural attenuation modeling using analytical or numerical solute fate-and-transport models, and the post-modeling activities that should be completed to ensure successful support and verification of natural attenuation. The objective of the work described herein is to quantify and provide defensible data in support of natural attenuation at sites where naturally occurring subsurface attenuation processes are capable of reducing dissolved chlorinated aliphatic hydrocarbon and/or fuel hydrocarbon concentrations to acceptable levels. A comment made by a member of the regulatory community (2) summarizes what is required to successfully implement natural attenuation:

> A regulator looks for the data necessary to determine that a proposed treatment technology, if properly installed and operated, will reduce the contaminant concentrations in the soil and water to legally mandated limits. In this sense the use of biological treatment systems calls for the same level of investigation, demonstration of effectiveness, and monitoring as any conventional [remediation] system.

To support remediation by natural attenuation, the proponent must scientifically demonstrate that degradation of site contaminants is occurring at rates sufficient to be protective of human health and the environment. Three lines of evidence can be used to support natural attenuation of chlorinated aliphatic hydrocarbons, including:

- Observed reduction in contaminant concentrations along the flow path downgradient from the source of contamination.
- Documented loss of contaminant mass at the field scale using:
  - Chemical and geochemical analytical data (e.g., decreasing parent compound concentrations, increasing daughter compound concentrations, depletion of electron acceptors and donors, and increasing metabolic byproduct concentrations).
  - A conservative tracer and a rigorous estimate of residence time along the flow path to document contaminant mass reduction and to calculate biological decay rates at the field scale.
- Microbiological laboratory data that support the occurrence of biodegradation and give rates of biodegradation.

At a minimum, the investigator must obtain the first two lines of evidence or the first and third lines of evidence. The second and third lines of evidence are crucial to the natural attenuation demonstration because they provide biodegradation rate constants. These rate constants are used in conjunction with the other fate-and-transport parameters to predict contaminant concentrations and to assess risk at downgradient points of compliance.

The first line of evidence is simply an observed reduction in the concentration of released contaminants downgradient from the NAPL source area along the groundwater flow path. This line of evidence does not prove that contaminants are being destroyed because the reduction in contaminant concentration could be the result of advection, dispersion, dilution from recharge, sorption, and volatilization with no loss of contaminant mass (i.e., the majority of apparent contaminant loss could be due to dilution). Conversely, an increase in the concentrations of some contaminants, most notably degradation products such as vinyl chloride, could be indicative of natural attenuation.

To support remediation by natural attenuation at most sites, the investigator will have to show that contaminant mass is being destroyed via biodegradation. This is done using either or both of the second or third lines of evidence. The second line of evidence relies on chemical and physical data to show that contaminant mass is being destroyed via biodegradation, not just diluted. The second line of evidence is divided into two components:

- Using chemical analytical data in mass balance calculations to show that decreases in contaminant and electron acceptor and donor concentrations can be directly correlated to increases in metabolic end products and daughter compounds. This evidence can be used to show that electron acceptor and donor concentrations in ground water are sufficient to facilitate degradation of dissolved contaminants. Solute fate-and-transport models can be used to aid mass balance calculations and to collate information on degradation.
- Using measured concentrations of contaminants and/or biologically recalcitrant tracers in conjunction with aquifer hydrogeologic parameters, such as seepage velocity and dilution, to show that a reduction in contaminant mass is occurring at the site and to calculate biodegradation rate constants.

The third line of evidence, microbiological laboratory data, can be used to provide additional evidence that indigenous biota are capable of degrading site contaminants at a particular rate. Because it is necessary to show that biodegradation is occurring and to obtain biodegradation rate constants, the most useful type of microbiological laboratory data is the microcosm study.

This paper presents a technical course of action that allows converging lines of evidence to be used to scientifically document the occurrence and quantify the rates of natural attenuation. Ideally, the first two lines of evidence should be used in the natural attenuation demonstration. To further document natural attenuation, or at sites with complex hydrogeology, obtaining a field-scale biodegradation rate may not be possible; in this case, microbiological laboratory data can be used. Such a "weight-of-evidence" approach will greatly increase the likelihood of successfully implementing natural attenuation at sites where natural processes are restoring the environmental quality of ground water.

Collection of an adequate database during the iterative site characterization process is an important step in the documentation of natural attenuation. Site characterization should provide data on the location, nature, and extent of contaminant sources. Contaminant sources generally consist of hydrocarbons present as mobile NAPL (i.e., NAPL occurring at sufficiently high saturations to drain under the influence of gravity into a well) and residual NAPL (i.e., NAPL occurring at immobile, residual saturation that is unable to drain into a well by gravity). Site characterization also should provide information on the location, extent, and concentrations of dissolved contamination; ground-water geochemical data; geologic information on the type and distribution of subsurface materials; and hydrogeologic parameters such as hydraulic conductivity, hydraulic gradients, and potential contaminant migration pathways to human or ecological receptor exposure points.

The data collected during site characterization can be used to simulate the fate and transport of contaminants in the subsurface. Such simulation allows prediction of the future extent and concentrations of the dissolved contaminant plume. Several models can be used to simulate dissolved contaminant transport and attenuation. The natural attenuation modeling effort has three primary objectives: 1) to predict the future extent and concentration of a dissolved contaminant plume by simulating the combined effects of advection, dispersion, sorption, and biodegradation; 2) to assess the potential for downgradient receptors to be exposed to contaminant concentrations that exceed regulatory or risk-based levels intended to be protective of human health and the environment; and 3) to provide technical support for the natural attenuation remedial option at postmodeling regulatory negotiations to help design a more accurate verification and monitoring strategy and to help identify early source removal strategies.

Upon completion of the fate-and-transport modeling effort, model predictions can be used in an exposure pathways analysis. If natural attenuation is sufficient to mitigate risks to potential receptors, the proponent of natural attenuation has a reasonable basis for negotiating this option with regulators. The exposure pathways analysis allows the proponent to show that potential exposure pathways to receptors will not be completed.

The material presented herein was prepared through the joint effort of the AFCEE Technology Transfer Division; the Bioremediation Research Team at EPA's National Risk Management Research Laboratory in Ada, Oklahoma (NRMRL), Subsurface Protection and Remediation Division; and Parsons Engineering Science, Inc. (Parsons ES). This compilation is designed to facilitate implementation of natural attenuation at chlorinated aliphatic hydrocarbon-contaminated sites owned by the U.S. Air Force and other U.S. Department of Defense agencies, the U.S. Department of Energy, and public interests.

Overview of Chlorinated Aliphatic Hydrocarbon Biodegradation

Because biodegradation is the most important process acting to remove contaminants from ground water, an accurate estimate of the potential for natural biodegradation is important to obtain when determining whether ground-water contamination presents a substantial threat to human health and the environment. This information also will be useful when selecting the remedial alternative that will be most cost-effective in eliminating or abating these threats should natural attenuation alone not prove to be sufficient.

Over the past two decades, numerous laboratory and field studies have demonstrated that subsurface microorganisms can degrade a variety of hydrocarbons and chlorinated solvents (3-23). Whereas fuel hydrocarbons are biodegraded through use as a primary substrate (electron donor), chlorinated aliphatic hydrocarbons may undergo biodegradation through three different pathways: through use as an electron acceptor, through use as an electron donor, or through co-metabolism, where degradation of the chlorinated organic is fortuitous and there is no benefit to the microorganism. At a given site, one or all of these processes may be operating, although at many sites the use of chlorinated aliphatic hydrocarbons as electron acceptors appears to be most important under natural conditions. In general, but in this case especially, biodegradation of chlorinated aliphatic hydrocarbons will be an electron-donor-limited process. Conversely, biodegradation of fuel hydrocarbons is an electron-acceptor-limited process.

In a pristine aquifer, native organic carbon is used as an electron donor, and dissolved oxygen (DO) is used first as the prime electron acceptor. Where anthropogenic carbon (e.g., fuel hydrocarbon) is present, it also will be used as an electron donor. After the DO is consumed, anaerobic microorganisms typically use additional electron acceptors (as available) in the following order of preference: nitrate, ferric iron oxyhydroxide, sulfate, and finally carbon dioxide. Evaluation of the distribution of these electron acceptors can provide evidence of where and how chlorinated aliphatic hydrocarbon biodegradation is occurring. In addition, because chlorinated aliphatic hydrocarbons may be used as electron acceptors or electron donors (in competition with other acceptors or donors), isopleth maps showing the distribution of these compounds can provide evidence of the mechanisms of biodegradation working at a site. As with BTEX, the driving force behind oxidation-reduction reactions resulting in chlorinated aliphatic hydrocarbon degradation is electron transfer. Although thermodynamically favorable, most of the reactions involved in chlorinated aliphatic hydrocarbon reduction and oxidation do not proceed abiotically. Microorganisms are capable of carrying out the reactions, but they will facilitate only those oxidation-reduction reactions that have a net yield of energy.

Mechanisms of Chlorinated Aliphatic Hydrocarbon Biodegradation

Electron Acceptor Reactions (Reductive Dechlorination)

The most important process for the natural biodegradation of the more highly chlorinated solvents is reductive dechlorination. During this process, the chlorinated hydrocarbon is used as an electron acceptor, not as a source of carbon, and a chlorine atom is removed and replaced with a hydrogen atom. In general, reductive dechlorination occurs by sequential dechlorination from perchloroethene to trichloroethene to dichloroethene to vinyl chloride to ethene. Depending on environmental conditions, this sequence may be interrupted, with other processes then acting on the products. During reductive dechlorination, all three isomers of dichloroethene can theoretically be produced; however, Bouwer (24) reports that under the influence of biodegradation, *cis*-1,2-dichloroethene is a more common intermediate than *trans*-1,2-dichloroethene, and that 1,1-dichloroethene is the least prevalent intermediate of the three dichloroethene isomers. Reductive dechlorination of chlorinated solvent compounds is associated with all accumulation of daughter products and an increase in the concentration of chloride ions.

Reductive dechlorination affects each of the chlorinated ethenes differently. Of these compounds, perchloroethene is the most susceptible to reductive dechlorination because it is the most oxidized. Conversely, vinyl chloride is the least susceptible to reductive dechlorination because it is the least oxidized of these compounds. The rate of reductive dechlorination also has been observed to decrease as the degree of chlorination decreases (24, 25). Murray and Richardson (26) have postulated that this rate decrease may explain the accumulation of vinyl chloride in perchloroethene and trichloroethene plumes that are undergoing reductive dechlorination.

Reductive dechlorination has been demonstrated under nitrate- and sulfate-reducing conditions, but the most rapid biodegradation rates, affecting the widest range of chlorinated aliphatic hydrocarbons, occur under methanogenic conditions (24). Because chlorinated aliphatic hydrocarbon compounds are used as electron acceptors during reductive dechlorination, there must be an appropriate source of carbon in order for microbial growth to occur (24). Potential carbon sources include natural organic matter, fuel hydrocarbons, or other organic compounds such as those found in landfill leachate.

Electron Donor Reactions

Murray and Richardson (26) write that microorganisms are generally believed to be incapable of growth using trichloroethene and perchloroethene as a primary substrate (i.e., electron donor). Under aerobic and some anaerobic conditions, the less-oxidized chlorinated aliphatic hydrocarbons (e.g., vinyl chloride) can be used as the primary substrate in biologically mediated redox reactions (22). In this type of reaction, the facilitating microorganism obtains energy and organic carbon from the degraded chlorinated aliphatic hydrocarbon. This is the process by which fuel hydrocarbons are biodegraded.

In contrast to reactions in which the chlorinated aliphatic hydrocarbon is used as an electron acceptor, only the least oxidized chlorinated aliphatic hydrocarbons can be used as electron donors in biologically mediated redox reactions. McCarty and Semprini (22) describe investigations in which vinyl chloride and 1,2-dichloroethane were shown to serve as primary substrates under aerobic conditions. These authors also document that dichloromethane has the potential to function as a primary substrate under either aerobic or anaerobic environments. In addition, Bradley and Chapelle (27) show evidence of mineralization of vinyl chloride under iron-reducing conditions so long as there is sufficient bioavailable iron(III). Aerobic metabolism of vinyl chloride may be characterized by a loss of vinyl chloride mass and a decreasing molar ratio of vinyl chloride to other chlorinated aliphatic hydrocarbon compounds.

Co-metabolism

When a chlorinated aliphatic hydrocarbon is biodegraded via co-metabolism, the degradation is catalyzed by an enzyme or cofactor that is fortuitously produced by the organisms for other purposes. The organism receives no known benefit from the degradation of the chlorinated aliphatic hydrocarbon; in fact, the co-metabolic degradation of the chlorinated aliphatic hydrocarbon may be harmful to the microorganism responsible for the production of the enzyme or cofactor (22).

Co-metabolism is best documented in aerobic environments, although it could occur under anaerobic conditions. It has been reported that under aerobic conditions chlorinated ethenes, with the exception of perchloroethene, are susceptible to co-metabolic degradation (22, 23, 26). Vogel (23) further elaborates that the co-metabolism rate increases as the degree of dechlorination decreases. During co-metabolism, trichloroethene is indirectly transformed by bacteria as they use BTEX or another substrate to meet their energy requirements. Therefore, trichloroethene does not enhance the degradation of BTEX or other carbon sources, nor will its co-metabolism interfere with the use of electron acceptors involved in the oxidation of those carbon sources.

Behavior of Chlorinated Solvent Plumes

Chlorinated solvent plumes can exhibit three types of behavior depending on the amount of solvent, the amount of biologically available organic carbon in the aquifer, the distribution and concentration of natural electron acceptors, and the types of electron acceptors being used. Individual plumes may exhibit all three types of behavior in different portions of the plume. The different types of plume behavior are summarized below.

Type 1 Behavior

Type 1 behavior occurs where the primary substrate is anthropogenic carbon (e.g., BTEX or landfill leachate), and this anthropogenic carbon drives reductive dechlorination. When evaluating natural attenuation of a plume exhibiting Type 1, behavior the following questions must be answered:

1. Is the electron donor supply adequate to allow microbial reduction of the chlorinated organic compounds? In other words, will the microorganisms "strangle" before they "starve"—will they run out of chlorinated aliphatic hydrocarbons (electron acceptors) before they run out of electron donors?
2. What is the role of competing electron acceptors (e.g., DO, nitrate, iron(III), and sulfate)?
3. Is vinyl chloride oxidized, or is it reduced?

Type 1 behavior results in the rapid and extensive degradation of the highly chlorinated solvents such as perchloroethene, trichloroethene, and dichloroethene.

Type 2 Behavior

Type 2 behavior dominates in areas that are characterized by relatively high concentrations of biologically available native organic carbon. This natural carbon source drives reductive dechlorination (i.e., is the primary substrate for microorganism growth). When evaluating natural attenuation of a Type 2 chlorinated solvent plume, the same questions as those posed for Type 1 behavior must be answered. Type 2 behavior generally results in slower biodegradation of the highly chlorinated solvents than Type 1 behavior, but under the right conditions (e.g., areas with high natural organic carbon contents) this type of behavior also can result in rapid degradation of these compounds.

Type 3 Behavior

Type 3 behavior dominates in areas that are characterized by low concentrations of native and/or anthropogenic carbon and by DO concentrations greater than 1.0 milligrams per liter. Under these aerobic conditions, reductive dechlorination will not occur; thus, there is no removal of perchloroethene, trichloroethene, and dichloroethene. The most significant natural attenuation mechanisms for these compounds is advection, dispersion, and sorption. However, vinyl chloride can be rapidly oxidized under these conditions.

Mixed Behavior

A single chlorinated solvent plume can exhibit all three types of behavior in different portions of the plume. This can be beneficial for natural biodegradation of chlorinated aliphatic hydrocarbon plumes. For example, Wiedemeier et al. (28) describe a plume at Plattsburgh Air Force Base, New York, that exhibits Type 1 behavior in the source area and Type 3 behavior downgradient from the source. The most fortuitous scenario involves a plume in which perchloroethene, trichloroethene, and dichloroethene are reductively dechlorinated (Type 1 or 2 behavior), then vinyl chloride is oxidized (Type 3 behavior) either aerobically or via iron reduction. Vinyl chloride is oxidized to carbon dioxide in this type of plume and does not accumulate. The following sequence of reactions occurs in a plume that exhibits this type of mixed behavior:

Perchloroethene → Trichloroethene →
Dichloroethene → Vinyl chloride → Carbon dioxide

The trichloroethene, dichloroethene, and vinyl chloride may attenuate at approximately the same rate, and thus these reactions may be confused with simple dilution. Note that no ethene is produced during this reaction. Vinyl chloride is removed from the system much faster under these conditions than it is under vinyl chloride-reducing conditions.

A less desirable scenario—but one in which all contaminants may be entirely biodegraded— involves a plume in which all chlorinated aliphatic hydrocarbons are reductively dechlorinated via Type 1 or Type 2 behavior. Vinyl chloride is reduced to ethene, which may be further reduced to ethane or methane. The following sequence of reactions occurs in this type of plume:

Perchloroethene → Trichloroethene →
Dichloroethene → Vinyl chloride → Ethene → Ethane

This sequence has been investigated by Freedman and Gossett (13). In this type of plume, vinyl chloride degrades more slowly than trichloroethene and thus tends to accumulate.

Protocol for Quantifying Natural Attenuation During the Remedial Investigation Process

The primary objective of the natural attenuation investigation is to show that natural processes of contaminant degradation will reduce contaminant concentrations in ground water to below risk-based corrective action or regulatory levels before potential receptor exposure pathways are completed. This requires a projection of the potential extent and concentration of the contaminant plume in time and space. The projection should be based on historic variations in, and the current extent and concentrations of, the contaminant plume, as well as the measured rates of contaminant attenuation. Because of the inherent uncertainty associated with such predictions, the investigator must provide sufficient evidence to demonstrate that the mechanisms of natural attenuation will reduce contaminant concentrations to acceptable levels before potential receptors are reached. This requires the use of conservative solute fate-and-transport model input parameters and numerous sensitivity analyses so that consideration is given to all plausible contaminant migration scenarios. When possible, both historical data and modeling should be used to provide information that collectively and consistently supports the natural reduction and removal of the dissolved contaminant plume.

Figure 1 outlines the steps involved in the natural attenuation demonstration. This figure also shows the important regulatory decision points in the process of implementing natural attenuation. Predicting the fate of a contaminant plume requires the quantification of solute transport and transformation processes. Quantification of contaminant migration and attenuation rates and successful implementation of the natural attenuation remedial option requires completion of the following steps:

1. Review available site data, and develop a preliminary conceptual model.
2. Screen the site, and assess the potential for natural attenuation.
3. Collect additional site characterization data to support natural attenuation, as required.
4. Refine the conceptual model, complete premodeling calculations, and document indicators of natural attenuation.
5. Simulate natural attenuation using analytical or numerical solute fate-and-transport models that allow incorporation of a biodegradation term, as necessary.
6. Identify potential receptors, and conduct an exposure-pathway analysis.
7. Evaluate the practicability and potential efficiency of supplemental source removal options.
8. If natural attenuation with or without source removal is acceptable, prepare a long-term monitoring plan.
9. Present findings to regulatory agencies, and obtain approval for remediation by natural attenuation.

Review Available Site Data, and Develop a Preliminary Conceptual Model

Existing site characterization data should be reviewed and used to develop a conceptual model for the site. The preliminary conceptual model will help identify any shortcomings in the data and will allow placement of additional data collection points in the most scientifically advantageous and cost-effective manner. A conceptual model is a three-dimensional representation of the ground-water flow and solute transport system based on available geological, biological, geochemical, hydrological, climatological, and analytical data for the site. This type of conceptual model differs from the conceptual site models that risk assessors commonly use that qualitatively consider the location of contaminant sources, release mechanisms, transport pathways, exposure points, and receptors. The ground-water system conceptual model, however, facilitates identification of these risk-assessment elements for the exposure pathways analysis. After development, the conceptual model can be used to help determine optimal placement of additional data collection points (as necessary) to aid in the natural attenuation investigation and to develop the solute fate-and-transport model.

Contracting and management controls must be flexible enough to allow for the potential for revisions to the conceptual model and thus the data collection effort. In cases where few or no site-specific data are available, all future site characterization activities should be designed to collect the data necessary to screen the site to determine the potential for remediation by natural attenuation. The additional costs incurred by such data collection are greatly outweighed by the cost savings that will be realized if natural attenuation is selected. Moreover, most of the data collected in support of natural attenuation can be used to design and support other remedial measures.

Table 1 contains the soil and ground-water analytical protocol for natural attenuation of chlorinated aliphatic hydrocarbons and/or fuel hydrocarbons. Table 1A lists a standard set of methods, while Table 1B lists methods that are under development and/or consideration. Any plan to collect additional ground-water and soil quality data should include targeting the analytes listed in Table 1A, and possibly Table 1B.

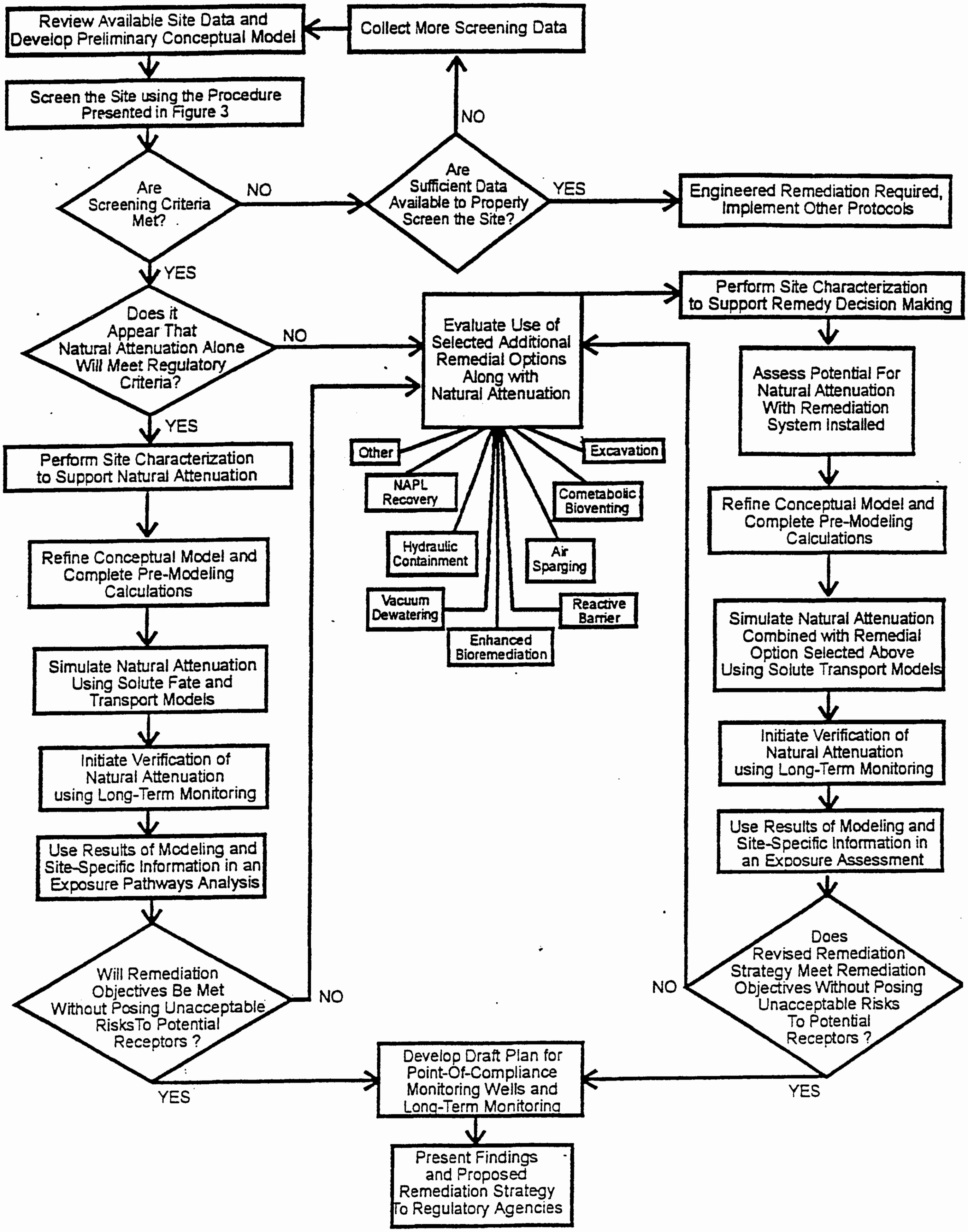


Figure 1. Natural attenuation of chlorinated solvents flow chart.

Table 1A. Soil and Ground-Water Analytical Protocol[a]

Matrix	Analysis	Method/Reference[b-e]	Comments[f,g]	Data Use	Recommended Frequency of Analysis	Sample Volume, Sample Container, Sample Preservation	Field or Fixed-Base Laboratory
Soil	Volatile organic compounds	SW8260A	Handbook method modified for field extraction of soil using methanol	Useful for determining the extent of soil contamination, the contaminant mass present, and the need for source removal	Each soil sampling round	Collect 100 g of soil in a glass container with Teflon-lined cap; cool to 4°C	Fixed-base
Soil	Total organic carbon (TOC)	SW9060, modified for soil samples	Procedure must be accurate over the range of 0.5 to 15% TOC	The amount of TOC in the aquifer matrix influences contaminant migration and biodegradation	At initial sampling	Collect 100 g of soil in a glass container with Teflon-lined cap; cool to 4°C	Fixed-base
Soil gas	O_2, CO_2	Field soil gas analyzer		Useful for determining bioactivity in the vadose zone	At initial sampling and respiration testing	Reuseable 3-L Tedlar bags	Field
Soil gas	Fuel and chlorinated volatile organic compounds	EPA Method TO-14		Useful for determining the distribution of chlorinated and BTEX compounds in soil	At initial sampling	1-L Summa canister	Fixed-base
Water	Volatile organic compounds	SW8260A	Handbook method; analysis may be extended to higher molecular-weight alkyl benzenes	Method of analysis for BTEX and chlorinated solvents/byproducts	Each sampling round	Collect water samples in a 40-mL volatile organic analysis vial; cool to 4°C; add hydrochloric acid to pH 2	Fixed-base
Water	Polycyclic aromatic hydro-carbons (PAHs) (optional; intended for diesel and other heavy oils)	Gas chromatography/ mass spectroscopy Method SW8270B; high-performance liquid chromatography Method SW8310	Analysis needed only when required for regulatory compliance	PAHs are components of fuel and are typically analyzed for regulatory compliance	As required by regulations	Collect 1 L of water in a glass container; cool to 4°C	Fixed-base
Water	Oxygen	DO meter	Refer to Method A4500 for a comparable laboratory procedure	Concentrations less than 1 mg/L generally indicate an anaerobic pathway	Each sampling round	Measure DO on site using a flow-through cell	Field
Water	Nitrate	Iron chromatography Method E300; anion method	Method E300 is a handbook method; also provides chloride data	Substrate for microbial respiration if oxygen is depleted	Each sampling round	Collect up to 40 mL of water in a glass or plastic container; add H_2SO_4 to pH less than 2; cool to 4°C	Fixed-base
Water	Iron(II) (Fe^{+2})	Colorimetric HACH Method 8146	Filter if turbid	May indicate an anaerobic degradation process due to depletion of oxygen, nitrate, and manganese	Each sampling round	Collect 100 mL of water in a glass container	Field

Table 1A. Soil and Ground-Water Analytical Protocol[a] (Continued)

Matrix	Analysis	Method/Reference[b-e]	Comments[f,g]	Data Use	Recommended Frequency of Analysis	Sample Volume, Sample Container, Sample Preservation	Field or Fixed-Base Laboratory
Water	Sulfate (SO_4-2)	Iron chromatography Method E300 or HACH Method 8051	Method E300 is a handbook method, HACH Method 8051 is a colorimetric method; use one or the other	Substrate for anaerobic microbial respiration	Each sampling round	Collect up to 40 mL of water in a glass or plastic container; cool to 4°C	E300 = Fixed-base HACH Method 8051 = Field
Water	Methane, ethane, and ethene	Kampbell et al. (35) or SW3810, modified	Method published by EPA researchers	The presence of CH_4 suggests biodegradation of organic carbon via methanogensis; ethane and ethane are produced during reductive dechlorination	Each sampling round	Collect water samples in 50 mL glass serum bottles with butyl gray/Teflon-lined caps; add H_2SO_4 to pH less than 2; cool to 4°C	Fixed-base
Water	Alkalinity	HACH alkalinity test kit Model AL AP MG-L	Phenolphtalein method	Water quality parameter used to measure the buffering capacity of ground water; can be used to estimate the amount of CO_2 produced during biodegradation	Each sampling round	Collect 100 mL of water in glass container	Field
Water	Oxidation-reduction potential	A2580B	Measurements made with electrodes, results are displayed on a meter, protect samples from exposure to oxygen; report results against a silver/silver chloride reference electrode	The oxidation-reduction potential of ground water influences and is influenced by the nature of the biologically mediated degradation of contaminants; the oxidation-reduction potential of ground water may range from more than 800 mV to less than -400 mV	Each sampling round	Collect 100 to 250 mL of water in a glass container	Field
Water	pH	Field probe with direct reading meter	Field	Aerobic and anaerobic processes are pH-sensitive	Each sampling round	Collect 100 to 250 mL of water in a glass or plastic container; analyze immediately	Field
Water	Temperature	Field probe with direct reading meter	Field only	Well development	Each sampling round	Not applicable	Field
Water	Conductivity	E120.1/SW9050, direct reading meter	Protocols/ Handbook methods	Water quality parameter used as a marker to verify that site samples are obtained from the same ground-water system	Each sampling round	Collect 100 to 250 mL of water in a glass or plastic container	Field
Water	Chloride	Mercuric nitrate titration A4500-Cl⁻ C	Ion chromatography Method E300; Method SW9050 may also be used	Final product of chlorinated solvent reduction; can be used to estimate dilution in calculation of rate constant	Each sampling round	Collect 250 mL of water in a glass container	Fixed-base

Table 1A. Soil and Ground-Water Analytical Protocol[a] (Continued)

Matrix	Analysis	Method/Reference[b-e]	Comments[f,g]	Data Use	Recommended Frequency of Analysis	Sample Volume, Sample Container, Sample Preservation	Field or Fixed-Base Laboratory
Water	Chloride (optional; see data use)	HACH chloride test kit Model 8-P	Silver nitrate titration	As above, and to guide selection of additional data points in real time while in the field	Each sampling round	Collect 100 mL of water in a glass container	Field
Water	Total organic carbon	SW9060	Laboratory	Used to classify plumes and to determine whether anaerobic metabolism of chlorinated solvents is possible in the absence of anthropogenic carbon	Each sampling round	Collect 100 mL of water in a glass container; cool	Laboratory

[a] Analyses other than those listed in this table may be required for regulatory compliance.
[b] "SW" refers to the *Test Methods for Evaluating Solid Waste, Physical, and Chemical Methods* (29).
[c] "E" refers to *Methods for Chemical Analysis of Water and Wastes* (30).
[d] "HACH" refers to the Hach Company catalog (31).
[e] "A" refers to *Standard Methods for the Examination of Water and Wastewater* (32).
[f] "Handbook" refers to the AFCEE *Handbook to Support the Installation Restoration Program (IRP) Remedial Investigations and Feasibility Studies (RI/FS)* (33).
[g] "Protocols" refers to the AFCEE *Environmental Chemistry Function Installation Restoration Program Analytical Protocols* (34).

Table 1B. Soil and Ground-Water Analytical Protocol: Special Analyses Under Development and/or Consideration[a,b]

Matrix	Analysis	Method/Reference	Comments	Data Use	Recommended Frequency of Analysis	Sample Volume, Container, Preservation	Field or Fixed-Base Laboratory
Soil	Biologically available iron(III)	Under development	HCl extraction followed by quantification of released iron(III)	To predict the possible extent of iron reduction in an aquifer	One round of sampling in five borings, five cores from each boring	Collect minimum 1-inch diameter core samples into a plastic liner; cap and prevent aeration	Laboratory
Water	Nutritional quality of native organic matter	Under development	Spectro-photometric method	To determine the extent of reductive dechlorination allowed by the supply of electron donor	One round of sampling in two to five wells	Collect 1,000 mL in an amber glass container	Laboratory
Water	Hydrogen (H_2)	Equilibration with gas in the field; determined with a reducing gas detector	Specialized analysis	To determine the terminal electron accepting process; predicts the possibility for reductive dechlorination	One round of sampling	Sampling at well head requires the production of 100 mL per minute of water for 30 minutes	Field
Water	Oxygenates (including methyl-*tert*-butyl ether, ethers, acetic acid, methanol, and acetone)	SW8260/8015[c]	Laboratory	Contaminant or electron donors for dechlorination of solvents	At least one sampling round or as determined by regulators	Collect 1 L of water in a glass container; preserve with HCl	Laboratory

[a] Analyses other than those listed in this table may be required for regulatory compliance.
[b] Site characterization should not be delayed if these methods are unavailable.
[c] "SW" refers to *Test Methods for Evaluating Solid Waste, Physical and Chemical Methods* (29).

Screen the Site, and Assess the Potential for Natural Attenuation

After reviewing available site data and developing a preliminary conceptual model, an assessment of the potential for natural attenuation must be made. As stated previously, existing data can be useful in determining whether natural attenuation will be sufficient to prevent a dissolved contaminant plume from completing exposure pathways, or from reaching a predetermined point of compliance, in concentrations above applicable regulatory or risk-based corrective action standards. Determining the likelihood of exposure pathway completion is an important component of the natural attenuation investigation. This is achieved by estimating the migration and future extent of the plume based on contaminant properties, including volatility, sorptive properties, and biodegradability; aquifer properties, including hydraulic gradient, hydraulic conductivity, porosity, and total organic carbon (TOC) content; and the location of the plume and contaminant source relative to potential receptors (i.e., the distance between the leading edge of the plume and the potential receptor exposure points). These parameters (estimated or actual) are used in this section to make a preliminary assessment of the effectiveness of natural attenuation in reducing contaminant concentrations.

If, after completing the steps outlined in this section, it appears that natural attenuation will be a significant factor in contaminant removal, detailed site characterization activities in support of this remedial option should be performed. If exposure pathways have already been completed and contaminant concentrations exceed regulatory levels, or if such completion is likely, other remedial measures should be considered, possibly in conjunction with natural attenuation. Even so, the collection of data in support of the natural attenuation option can be integrated into a comprehensive remedial plan and may help reduce the cost and duration of other remedial measures, such as intensive source removal operations or pump-and-treat technologies. For example, dissolved iron concentrations can have a profound influence on the design of pump-and-treat systems.

Based on the experience of the authors, in an estimated 80 percent of fuel hydrocarbon spills at federal facilities, natural attenuation alone will be protective of human health and the environment. For spills of chlorinated aliphatic hydrocarbons at federal facilities, however, natural attenuation alone will be protective of human health and the environment in an estimated 20 percent of the cases. With this in mind, it is easy to understand why an accurate assessment of the potential for natural biodegradation of chlorinated compounds should be made before investing in a detailed study of natural attenuation. The screening process presented in this section is outlined in Figure 2. This approach should allow the investigator to determine whether natural attenuation is likely to be a viable remedial alternative before additional time and money are expended. The data required to make the preliminary assessment of natural attenuation can also be used to aid the design of an engineered remedial solution, should the screening process suggest that natural attenuation alone is not feasible.

The following information is required for the screening process:

- The chemical and geochemical data presented in Table 2 for a minimum of six samples. Figure 3 shows the approximate location of these data collection points. If other contaminants are suspected, then data on the concentration and distribution of these compounds also should be obtained.
- Locations of source(s) and receptor(s).
- An estimate of the contaminant transport velocity and direction of ground-water flow.

Once these data have been collected, the screening process can be undertaken. The following steps summarize the screening process:

1. Determine whether biodegradation is occurring using geochemical data. If biodegradation is occurring, proceed to Step 2. If it is not, assess the amount and types of data available. If data are insufficient to determine whether biodegradation is occurring, collect supplemental data.
2. Determine ground-water flow and solute transport parameters. Hydraulic conductivity and porosity may be estimated, but the ground-water gradient and flow direction may not. The investigator should use the highest hydraulic conductivity measured at the site during the preliminary screening because solute plumes tend to follow the path of least resistance (i.e., highest hydraulic conductivity). This will give the "worst case" estimate of solute migration over a given period.
3. Locate sources and receptor exposure points.
4. Estimate the biodegradation rate constant. Biodegradation rate constants can be estimated using a conservative tracer found commingled with the contaminant plume, as described by Wiedemeier et al. (36). When dealing with a plume that contains only chlorinated solvents, this procedure will have to be modified to use chloride as a tracer. Rate constants derived from microcosm studies can also be used. If it is not possible to estimate the biodegradation rate using these procedures, then use a range of accepted literature values for biodegradation of the contaminants of concern.

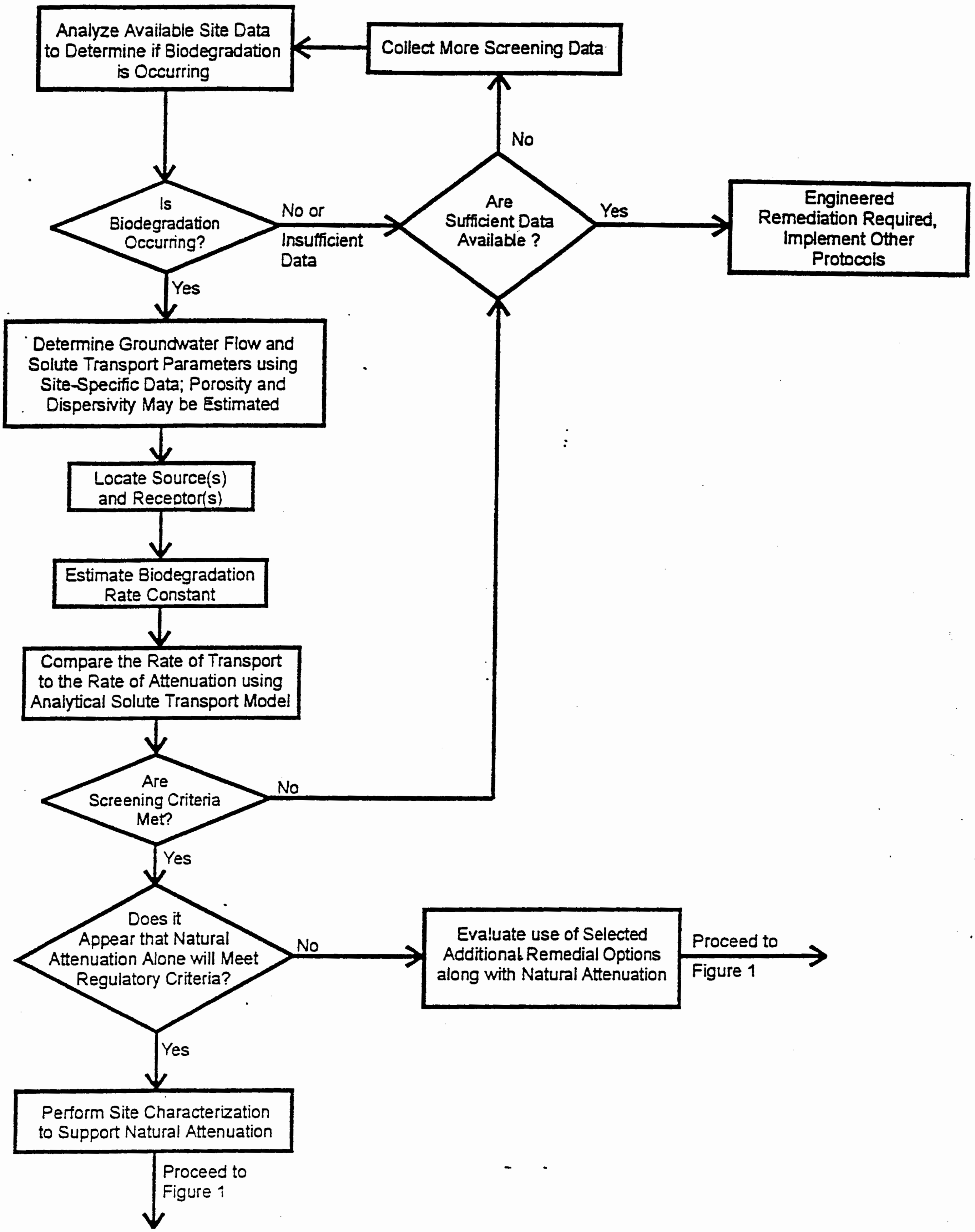


Figure 2. Initial screening process flow chart.

Table 2. Analytical Parameters and Weighting for Preliminary Screening

Analyte	Concentration in Most Contaminated Zone	Interpretation	Points Awarded
Oxygen[a]	< 0.5 mg/L	Tolerated; suppresses reductive dechlorination at higher concentrations	3
Oxygen[a]	> 1 mg/L	Vinyl chloride may be oxidized aerobically, but reductive dechlorination will not occur	-3
Nitrate[a]	< 1 mg/L	May compete with reductive pathway at higher concentrations	2
Iron (II)[a]	> 1 mg/L	Reductive pathway possible	3
Sulfate[a]	< 20 mg/L	May compete with reductive pathway at higher concentrations	2
Sulfide[a]	> 1 mg/L	Reductive pathway possible	3
Methane[a]	> 0.1 mg/L	Ultimate reductive daughter product	2
	> 1	Vinyl chloride accumulates	3
	< 1	Vinyl chloride oxidizes	
Oxidation reduction potential[a]	< 50 mV against Ag/AgCl	Reductive pathway possible	< 50 mV = 1 < -100 mV = 2
pH[a]	5 < pH < 9	Tolerated range for reductive pathway	
DOC	> 20 mg/L	Carbon and energy source; drives dechlorination; can be natural or anthropogenic	2
Temperature[a]	> 20°C	At T > 20ÉC, biochemical process is accelerated	1
Carbon dioxide	> 2x background	Ultimate oxidative daughter product	1
Alkalinity	> 2x background	Results from interaction of carbon dioxide with aquifer minerals	1
Chloride[a]	> 2x background	Daughter product of organic chlorine; compare chloride in plume to background conditions	2
Hydrogen	> 1 nM	Reductive pathway possible; vinyl chloride may accumulate	3
Hydrogen	< 1 nM	Vinyl chloride oxidized	
Volatile fatty acids	> 0.1 mg/L	Intermediates resulting from biodegradation of aromatic compounds; carbon and energy source	2
BTEX[a]	> 0.1 mg/L	Carbon and energy source; drives dechlorination	2
Perchloroethene[a]		Material released	
Trichloroethene[a]		Material released or daughter product of perchloroethene	2[b]
Dichloroethene[a]		Material released or daughter product of trichloroethene; if amount of *cis*-1,2-dichloroethene is greater than 80% of total dichloroethene, it is likely a daughter product of trichloroethene	2[b]
Vinyl chloride[a]		Material released or daughter product of dichloroethenes	2[b]
Ethene/Ethane	< 0.1 mg/L	Daughter product of vinyl chloride/ethene	> 0.01 mg/L= 2 > 0.1 = 3
Chloroethane[a]		Daughter product of vinyl chloride under reducing conditions	2
1,1,1-Trichloroethane[a]		Material released	
1,1-dichloroethene[a]		Daughter product of trichloroethene or chemical reaction of 1,1,1-trichloroethane	

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

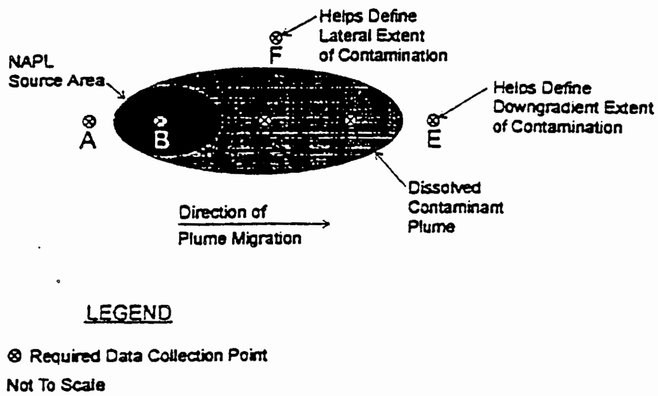


Figure 3. Data collection points required for screening.

5. Compare the rate of transport to the rate of attenuation, using analytical solutions or a screening model such as BIOSCREEN.
6. Determine whether the screening criteria are met.

Each of these steps is described in detail below.

Step 1: Determine Whether Biodegradation Is Occurring

The first step in the screening process is to sample at least six wells that are representative of the contaminant flow system and to analyze the samples for the parameters listed in Table 2. Samples should be taken 1) from the most contaminated portion of the aquifer (generally in the area where NAPL currently is present or was present in the past); 2) downgradient from the NAPL source area but still in the dissolved contaminant plume; 3) downgradient from the dissolved contaminant plume; and 4) from upgradient and lateral locations that are not affected by the plume.

Samples collected in the NAPL source area allow determination of the dominant terminal electron-accepting processes at the site. In conjunction with samples collected in the NAPL source zone, samples collected in the dissolved plume downgradient from the NAPL source zone allow the investigator to determine whether the plume is degrading with distance along the flow path and what the distribution of electron acceptors and donors and metabolic byproducts might be along the flow path. The sample collected downgradient from the dissolved plume aids in plume delineation and allows the investigator to determine whether metabolic byproducts are present in an area of ground water that has been remediated. The upgradient and lateral samples allow delineation of the plume and indicate background concentrations of the electron acceptors and donors.

After these samples have been analyzed for the parameters listed in Table 2, the investigator should analyze the data to determine whether biodegradation is occurring. The right-hand column of Table 2 contains scoring values that can be used for this task. For example, if the DO concentration in the area of the plume with the highest contaminant concentration is less than 0.5 milligrams per liter, this parameter is awarded 3 points. Table 3 summarizes the range of possible scores and gives an interpretation for each score. If the site scores a total of 15 or more points, biodegradation is probably occurring, and the investigator can proceed to Step 2. This method relies on the fact that biodegradation will cause predictable changes in ground-water chemistry.

Table 3. Interpretation of Points Awarded During Screening Step 1

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

Consider the following two examples. Example 1 contains data for a site with strong evidence that reductive dechlorination is occurring. Example 2 contains data for a site with strong evidence that reductive dechlorination is not occurring.

Example 1. Strong Evidence for Biodegradation of Chlorinated Organics

Analyte	Concentration in Most Contaminated Zone	Points Awarded
DO	0.1 mg/L	3
Nitrate	0.3 mg/L	2
Iron(II)	10 mg/L	3
Sulfate	2 mg/L	2
Methane	5 mg/L	3
Oxidation-reduction potential	-190 mV	2
Chloride	3x background	2
Perchloroethene (released)	1,000 µg/L	0
Trichloroethene (none released)	1,200 µg/L	2
cis-1,2-Dichloroethene (none released)	500 µg/L	2
Vinyl chloride (none released)	50 µg/L	2
	Total points awarded	23

In this example, the investigator can infer that biodegradation is occurring and may proceed to Step 2.

Example 2. Biodegradation of Chlorinated Organics Unlikely

Analyte	Concentration in Most Contaminated Zone	Points Awarded
DO	3 mg/L	-3
Nitrate	0.3 mg/L	2
Iron(II)	Not detected	0
Sulfate	10 mg/L	2
Methane	ND	0
Oxidation-reduction potential	100 mV	0
Chloride	Background	0
Trichloroethene (released)	1,200 µg/L	0
cis-1,2-Dichloroethene	Not detected	0
Vinyl chloride	ND	0
	Total points awarded	1

In this example, the investigator can infer that biodegradation is probably not occurring or is occurring too slowly to be a viable remedial option. In this case, the investigator cannot proceed to Step 2 and will likely have to implement an engineered remediation system.

Step 2: Determine Ground-Water Flow and Solute Transport Parameters

After biodegradation has been shown to be occurring, it is important to quantify ground-water flow and solute transport parameters. This will make it possible to use a solute transport model to quantitatively estimate the concentration of the plume and its direction and rate of travel. To use an analytical model, it is necessary to know the hydraulic gradient and hydraulic conductivity for the site and to have estimates of the porosity and dispersivity. The coefficient of retardation also is helpful to know. Quantification of these parameters is discussed by Wiedemeier et al. (1).

To make modeling as accurate as possible, the investigator must have site-specific hydraulic gradient and hydraulic conductivity data. To determine the ground-water flow and solute transport direction, the site must have at least three accurately surveyed wells. The porosity and dispersivity are generally estimated using accepted literature values for the types of sediments found at the site. If the investigator does not have TOC data for soil, the coefficient of retardation can be estimated; however, assuming that the solute transport and ground-water velocities are the same may be more conservative.

Step 3: Locate Sources and Receptor Exposure Points

To determine the length of flow for the predictive modeling conducted in Step 5, it is important to know the distance between the source of contamination, the downgradient end of the dissolved plume, and any potential downgradient or cross-gradient receptors.

Step 4: Estimate the Biodegradation Rate Constant

Biodegradation is the most important process that degrades contaminants in the subsurface; therefore, the biodegradation rate is one of the most important model input parameters. Biodegradation of chlorinated aliphatic hydrocarbons can commonly be represented as a first-order rate constant. Site-specific biodegradation rates generally are best to use. Calculation of site-specific biodegradation rates is discussed by Wiedemeier et al. (1, 36, 37). If determining site-specific biodegradation rates is impossible, then literature values for the biodegradation rate of the contaminant of interest must be used. It is generally best to start with the average value and then to vary the model input to predict "best case" and "worst case" scenarios. Estimated biodegradation rates can be used only after biodegradation has been shown to be occurring (see Step 1).

Step 5: Compare the Rate of Transport to the Rate of Attenuation

At this early stage in the natural attenuation demonstration, comparison of the rate of solute transport to the rate of attenuation is best accomplished using an analytical model. Several analytical models are available, but the BIOSCREEN model is probably the simplest to use. This model is nonproprietary and is available from the Robert S. Kerr Laboratory's home page on the Internet (www.epa.gov/ada/kerrlab.html). The BIOSCREEN model is based on Domenico's solution to the advection-dispersion equation (38), and allows use of either a first-order biodegradation rate or an instantaneous reaction between contaminants and electron acceptors to simulate the effects of biodegradation. To model transport of chlorinated aliphatic hydrocarbons using BIOSCREEN, only the first-order decay rate option should be used. BIOCHLOR, a similar model, is under development by the Technology Transfer Division of AFCEE. This model will likely use the same analytical solution as BIOSCREEN but will be geared towards evaluating transport of chlorinated compounds under the influence of biodegradation.

The primary purpose of comparing the rate of transport with the rate of attenuation is to determine whether the residence time along the flow path is adequate to be protective of human health and the environment (i.e., to qualitatively estimate whether the contaminant is attenuating at a rate fast enough to allow degradation of the contaminant to acceptable concentrations before receptors are reached). It is important to perform a sensitivity analysis to help evaluate the confidence in the preliminary screening modeling effort. If modeling shows that receptors may not be exposed to contaminants at concentrations above risk-based corrective action criteria, then the screening criteria are met, and the investigator can proceed with the natural attenuation feasibility study.

Step 6: Determine Whether the Screening Criteria Are Met

Before proceeding with the full-scale natural attenuation feasibility study, the investigator should ensure that the answers to all of the following criteria are "yes":

- Has the plume moved a distance less than expected, based on the known (or estimated) time since the contaminant release and the contaminant velocity, as calculated from site-specific measurements of hydraulic conductivity and hydraulic gradient, as well as estimates of effective porosity and contaminant retardation?
- Is it likely that the contaminant mass is attenuating at rates sufficient to be protective of human health and the environment at a point of discharge to a sensitive environmental receptor?
- Is the plume going to attenuate to concentrations less than risk-based corrective action guidelines before reaching potential receptors?

Collect Additional Site Characterization Data To Support Natural Attenuation, As Required

Detailed site characterization is necessary to document the potential for natural attenuation. Review of existing site characterization data is particularly useful before initiating site characterization activities. Such review should allow identification of data gaps and guide the most effective placement of additional data collection points.

There are two goals during the site characterization phase of a natural attenuation investigation. The first is to collect the data needed to determine whether natural mechanisms of contaminant attenuation are occurring at rates sufficient to protect human health and the environment. The second is to provide sufficient site-specific data to allow prediction of the future extent and concentration of a contaminant plume through solute fate-and-transport modeling. Because the burden of proof for natural attenuation is on the proponent, detailed site characterization is required to achieve these goals and to support this remedial option. Adequate site characterization in support of natural attenuation requires that the following site-specific parameters be determined:

- The extent and type of soil and ground-water contamination.
- The location and extent of contaminant source area(s) (i.e., areas containing mobile or residual NAPL).
- The potential for a continuing source due to leaking tanks or pipelines.
- Aquifer geochemical parameters.
- Regional hydrogeology, including drinking water aquifers and regional confining units.
- Local and site-specific hydrogeology, including local drinking water aquifers; location of industrial, agricultural, and domestic water wells; patterns of aquifer use (current and future); lithology; site stratigraphy, including identification of transmissive and nontransmissive units; grain-size distribution (sand versus silt versus clay); aquifer hydraulic conductivity; ground-water hydraulic information; preferential flow paths; locations and types of surface water bodies; and areas of local ground-water recharge and discharge.
- Identification of potential exposure pathways and receptors.

The following sections describe the methodologies that should be implemented to allow successful site characterization in support of natural attenuation. Additional information can be obtained from Wiedemeier et al. (1, 37).

Soil Characterization

To adequately define the subsurface hydrogeologic system and to determine the amount and three-dimensional distribution of mobile and residual NAPL that can act as a continuing source of ground-water contamination, extensive soil characterization must be completed. Depending on the status of the site, this work may have been completed during previous remedial investigation activities. The results of soils characterization will be used as input into a solute fate-and-transport model to help define a contaminant source term and to support the natural attenuation investigation.

The purpose of soil sampling is to determine the subsurface distribution of hydrostratigraphic units and the distribution of mobile and residual NAPL. These objectives can be achieved through the use of conventional soil borings or direct-push methods (e.g., Geoprobe or cone penetrometer testing). All soil samples should be collected, described, analyzed, and disposed of in accordance with local, state, and federal guidance. Wiedemeier et al. (1) present suggested procedures for soil sample collection. These procedures may require modification to comply with local, state, and federal regulations or to accommodate site-specific conditions.

The analytical protocol to be used for soil sample analysis is presented in Table 1. This analytical protocol includes all of the parameters necessary to document natural attenuation, including the effects of sorption and biodegradation. Knowledge of the location, distribution, concentration, and total mass of contaminants of regulatory concern sorbed to soils or present as residual and/or mobile NAPL is required to calculate contaminant partitioning from NAPL into ground water. Knowledge of the TOC content of the aquifer matrix is important for sorption and solute-retardation calculations. TOC samples should be collected from a background location in the stratigraphic horizon(s) where most contaminant transport is expected to occur. Oxygen and carbon dioxide measurements of soil gas can be used to find areas in the unsaturated zone where biodegradation is occurring. Knowledge of the distribution of contaminants in soil gas can be used as a cost-effective way to estimate the extent of soil contamination.

Ground-Water Characterization

To adequately determine the amount and three-dimensional distribution of dissolved contamination and to document the occurrence of natural attenuation, ground-water samples must be collected and analyzed. Biodegradation of organic compounds, whether natural or anthropogenic, brings about measurable changes in the chemistry of ground water in the affected area. By measuring these changes, documentation and quantitative evaluation of natural attenuation's importance at a site are possible.

Ground-water sampling is conducted to determine the concentrations and distribution of contaminants, daughter products, and ground-water geochemical parameters. Ground-water samples may be obtained from monitoring wells or with point-source sampling devices such as a Geoprobe, Hydropunch, or cone penetrometer. All ground-water samples should be collected in accordance with local, state, and federal guidelines. Wiedemeier et al. (1) suggest procedures for ground-water sample collection. These procedures may need to be modified to comply with local, state, and federal regulations or to accommodate site-specific conditions.

The analytical protocol for ground-water sample analysis is presented in Table 1. This analytical protocol includes all of the parameters necessary to document natural attenuation, including the effects of sorption and biodegradation. Data obtained from the analysis of ground water for these analytes is used to scientifically document natural attenuation and can be used as input into a solute fate-and-transport model. The following paragraphs describe each ground-water analytical parameter and the use of each analyte in the natural attenuation demonstration.

Volatile organic compound analysis (by Method SW8260a) is used to determine the types, concentrations, and distributions of contaminants and daughter products in the aquifer. DO is the electron acceptor most thermodynamically favored by microbes for the biodegradation of organic carbon, whether natural or anthropogenic. Reductive dechlorination will not occur, however, if DO concentrations are above approximately 0.5 milligrams per liter. During aerobic biodegradation of a substrate, DO concentrations decrease because of the microbial oxygen demand. After DO depletion, anaerobic microbes will use nitrate as an electron acceptor, followed by iron(III), then sulfate, and finally carbon dioxide (methanogenesis). Each sequential reaction drives the oxidation-reduction potential of the ground water further into the realm where reductive dechlorination can occur. The oxidation-reduction potential range of sulfate reduction and methanogenesis is optimal, but reductive dechlorination may occur under nitrate- and iron(III)-reducing conditions as well. Because reductive dechlorination works best in the sulfate-reduction and methanogenesis oxidation-reduction potential range, competitive exclusion between microbial sulfate reducers, methanogens, and reductive dechlorinators can occur.

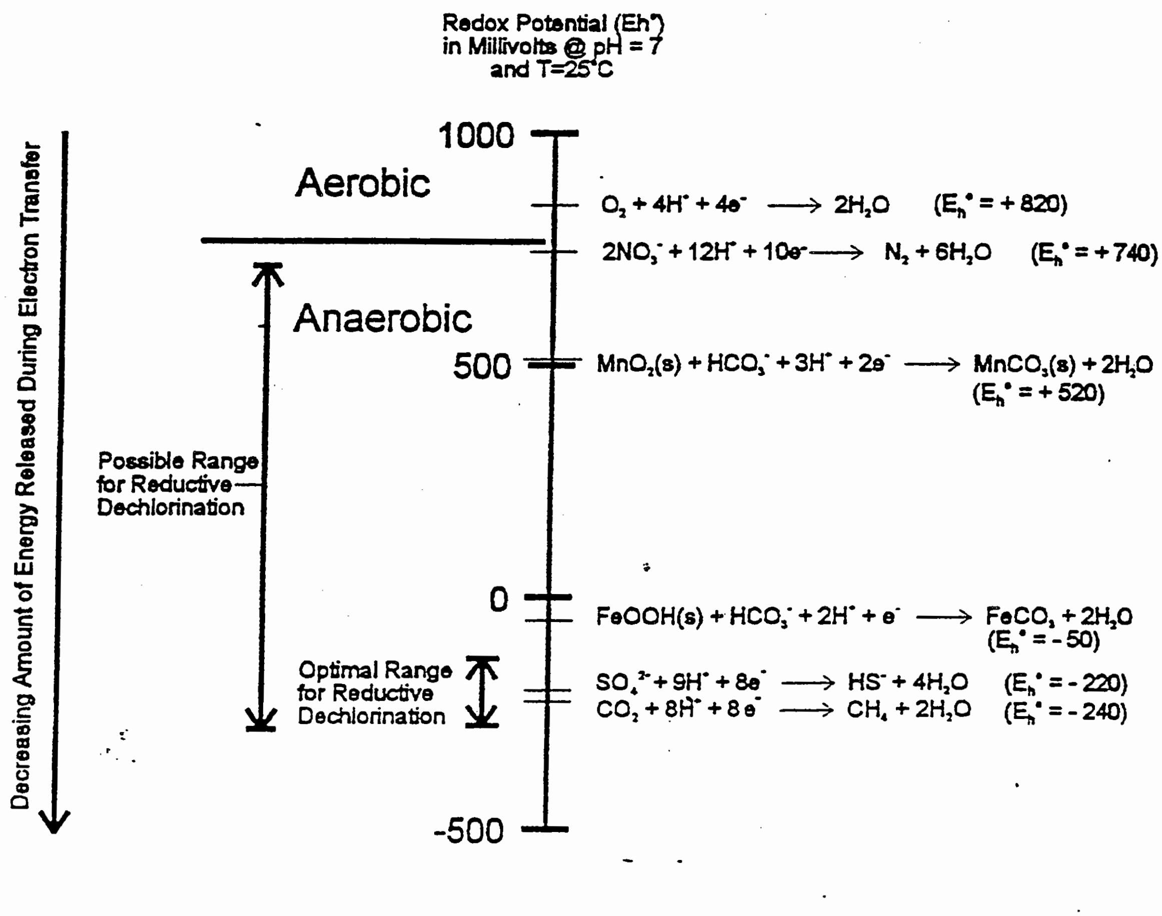
After DO has been depleted in the microbiological treatment zone, nitrate may be used as an electron acceptor for anaerobic biodegradation via denitrification. In some cases iron(III) is used as an electron acceptor during anaerobic biodegradation of electron donors. During this process, iron(III) is reduced to iron(II), which may be soluble in water. Iron(II) concentrations can thus be used as an indicator of anaerobic degradation of fuel compounds. After DO, nitrate, and bioavailable iron(III) have been depleted in the microbiological treatment zone, sulfate may be used as an electron acceptor for anaerobic biodegradation. This process is termed sulfate reduction and results in the production of sulfide. During methanogenesis (an anaerobic biodegradation process), carbon dioxide (or acetate) is used as an electron acceptor, and methane is produced. Methanogenesis generally occurs after oxygen, nitrate, bioavailable iron(III), and sulfate have been depleted in the treatment zone. The presence of methane in ground water is indicative of strongly reducing conditions. Because methane is not present in fuel, the presence of methane in ground water above background concentrations in contact with fuels is indicative of microbial degradation of fuel hydrocarbons.

The total alkalinity of a ground-water system is indicative of a water's capacity to neutralize acid. Alkalinity is defined as "the net concentration of strong base in excess of strong acid with a pure CO_2-water system as the point of reference" (39). Alkalinity results from the presence of hydroxides, carbonates, and bicarbonates of elements such as calcium, magnesium, sodium, potassium, or ammonia. These species result from the dissolution of rock (especially carbonate rocks), the transfer of carbon dioxide from the atmosphere, and the respiration of microorganisms. Alkalinity is important in the maintenance of ground-water pH because it buffers the ground-water system against acids generated during both aerobic and anaerobic biodegradation.

In general, areas contaminated by fuel hydrocarbons exhibit a total alkalinity that is higher than that seen in background areas. This is expected because the microbially mediated reactions causing biodegradation of fuel hydrocarbons cause an increase in the total alkalinity in the system. Changes in alkalinity are most pronounced during aerobic respiration, denitrification, iron reduction, and sulfate reduction, and are less pronounced during methanogenesis (40). In addition, Willey et al. (41) show that short-chain aliphatic acid ions produced during biodegradation of fuel hydrocarbons can contribute to alkalinity in ground water.

The oxidation-reduction potential of ground water is a measure of electron activity and an indicator of the relative tendency of a solution to accept or transfer electrons. Redox reactions in ground water containing organic compounds (natural or anthropogenic) are usually biologically mediated; therefore, the oxidation-reduction potential of a ground-water system depends on and influences rates of biodegradation. Knowledge of the oxidation-reduction potential of ground water also is important because some biological processes operate only within a prescribed range of redox conditions. The oxidation-reduction potential of ground water generally ranges from -400 to 800 millivolts (mV). Figure 4 shows the typical redox conditions for ground water when different electron acceptors are used.

Oxidation-reduction potential can be used to provide real-time data on the location of the contaminant plume, especially in areas undergoing anaerobic biodegradation. Mapping the oxidation-reduction potential of the ground water while in the field helps the field scientist to determine the approximate location of the contaminant plume. To perform this task, it is important to have at least one redox measurement (preferably more) from a well located upgradient from the plume. Oxidation-reduction potential measurements should be taken during well purging and immediately before and after sample acquisition using a direct-reading meter. Because most well purging techniques can allow aeration of collected ground-water samples (which can affect oxidation-reduction



Modified From Bouwer (1994)

Figure 4. Redox potentials for various electron acceptors.

potential measurements), it is important to minimize potential aeration.

Dissolved hydrogen concentrations can be used to determine the dominant terminal electron-accepting process in an aquifer. Because of the difficulty in obtaining hydrogen analyses commercially, this parameter should be considered optional at this time. Table 4 presents the range of hydrogen concentrations for a given terminal electron-accepting process. Much research has been done on the topic of using hydrogen measurements to delineate terminal electron-accepting processes (42-44). Because the efficiency of reductive dechlorination differs for methanogenic, sulfate-reducing, iron(III)-reducing, or denitrifying conditions, it is helpful to have hydrogen concentrations to help delineate redox conditions when evaluating the potential for natural attenuation of chlorinated ethenes in ground-water systems. Collection and analysis of ground-water samples for dissolved hydrogen content is not yet commonplace or standardized, however, and requires a relatively expensive field laboratory setup.

Table 4. Range of Hydrogen Concentrations for a Given Terminal Electron-Accepting Process

Terminal Electron-Accepting Process	Hydrogen Concentration (nanomoles per liter)
Denitrification	< 0.1
Iron(III) reduction	0.2 to 0.8
Sulfate reduction	1 to 4
Methanogenesis	> 5

Because the pH, temperature, and conductivity of a ground-water sample can change significantly shortly following sample acquisition, these parameters must be measured in the field in unfiltered, unpreserved, "fresh" water collected by the same technique as the samples taken for DO and redox analyses. The measurements should be made in a clean glass container separate from those intended for laboratory analysis, and the measured values should be recorded in the ground-water sampling record.

The pH of ground water has an effect on the presence and activity of microbial populations in the ground water. This is especially true for methanogens. Microbes capable of degrading chlorinated aliphatic hydrocarbons and petroleum hydrocarbon compounds generally prefer pH values varying from 6 to 8 standard units. Ground-water temperature directly affects the solubility of oxygen and other geochemical species. The solubility of DO is temperature dependent, being more soluble in cold water than in warm water. Ground-water temperature also affects the metabolic activity of bacteria. Rates of hydrocarbon biodegradation roughly double for every 10°C increase in temperature ("Q"$_{10}$ rule) over the temperature range between 5°C and 25°C. Ground-water temperatures less than about 5°C tend to inhibit biodegradation, and slow rates of biodegradation are generally observed in such waters.

Conductivity is a measure of the ability of a solution to conduct electricity. The conductivity of ground water is directly related to the concentration of ions in solution; conductivity increases as ion concentration increases. Conductivity measurements are used to ensure that ground water samples collected at a site are representative of the water in the saturated zone containing the dissolved contamination. If the conductivities of samples taken from different sampling points are radically different, the waters may be from different hydrogeologic zones.

Elemental chlorine is the most abundant of the halogens. Although chlorine can occur in oxidation states ranging from Cl^- to Cl^{+7}, the chloride form (Cl^-) is the only form of major significance in natural waters (45). Chloride forms ion pairs or complex ions with some of the cations present in natural waters, but these complexes are not strong enough to be of significance in the chemistry of fresh water (45). The chemical behavior of chloride is neutral. Chloride ions generally do not enter into oxidation-reduction reactions, form no important solute complexes with other ions unless the chloride concentration is extremely high, do not form salts of low solubility, are not significantly adsorbed on mineral surfaces, and play few vital biochemical roles (45). Thus, physical processes control the migration of chloride ions in the subsurface.

Kaufman and Orlob (46) conducted tracer experiments in ground water and found that chloride moved through most of the soils tested more conservatively (i.e., with less retardation and loss) than any of the other tracers tested. During biodegradation of chlorinated hydrocarbons dissolved in ground water, chloride is released into the ground water. This results in chloride concentrations in the ground water of the contaminant plume that are elevated relative to background concentrations. Because of the neutral chemical behavior of chloride, it can be used as a conservative tracer to estimate biodegradation rates using methods similar to those discussed by Wiedemeier et al. (36).

Field Measurement of Aquifer Hydraulic Parameters

The properties of an aquifer that have the greatest impact on contaminant fate and transport include hydraulic conductivity, hydraulic gradient, porosity, and dispersivity. Estimating hydraulic conductivity and gradient in the field is fairly straightforward, but obtaining field-scale information on porosity and dispersivity can be difficult.

Therefore, most investigators rely on field data for hydraulic conductivity and hydraulic gradient and on literature values for porosity and dispersivity for the types of sediments present at the site. Methods for field measurement of aquifer hydraulic parameters are described by Wiedemeier et al. (1, 37).

Microbiological Laboratory Data

Microcosm studies are used to show that the microorganisms necessary for biodegradation are present and to help quantify rates of biodegradation. If properly designed, implemented, and interpreted, microcosm studies can provide very convincing documentation of the occurrence of biodegradation. Such studies are the only "line of evidence" that allows an unequivocal mass balance determination based on the biodegradation of environmental contaminants. The results of a well-designed microcosm study will be easy for decision-makers with nontechnical backgrounds to interpret. Results of such studies are strongly influenced by the nature of the geological material submitted for study, the physical properties of the microcosm, the sampling strategy, and the duration of the study. Because microcosm studies are time-consuming and expensive, they should be undertaken only at sites where there is considerable skepticism concerning the biodegradation of contaminants.

Biodegradation rate constants determined by microcosm studies often are much greater than rates achieved in the field. Microcosms are most appropriate as indicators of the potential for natural bioremediation and to prove that losses are biological, but it may be inappropriate to use them to generate rate constants. The preferable method of contaminant biodegradation rate-constant determination is in situ field measurement. The collection of material for the microcosm study, the procedures used to set up and analyze the microcosm, and the interpretation of the results of the microcosm study are presented by Wiedemeier et al. (1).

Refine the Conceptual Model, Complete Premodeling Calculations, and Document Indicators of Natural Attenuation

Site investigation data should first be used to refine the conceptual model and quantify ground-water flow, sorption, dilution, and biodegradation. The results of these calculations are used to scientifically document the occurrence and rates of natural attenuation and to help simulate natural attenuation over time. Because the burden of proof is on the proponent, all available data must be integrated in such a way that the evidence is sufficient to support the conclusion that natural attenuation is occurring.

Conceptual Model Refinement

Conceptual model refinement involves integrating newly gathered site characterization data to refine the preliminary conceptual model that was developed based on previously existing site-specific data. During conceptual model refinement, all available site-specific data should be integrated to develop an accurate three-dimensional representation of the hydrogeologic and contaminant transport system. This conceptual model can then be used for contaminant fate-and-transport modeling. Conceptual model refinement consists of several steps, including preparation of geologic logs, hydrogeologic sections, potentiometric surface/water table maps, contaminant contour (isopleth) maps, and electron acceptor and metabolic byproduct contour (isopleth) maps. Refinement of the conceptual model is described by Wiedemeier et al. (1).

Premodeling Calculations

Several calculations must be made prior to implementation of the solute fate-and-transport model. These calculations include sorption and retardation calculations, NAPL/water-partitioning calculations, ground-water flow velocity calculations, and biodegradation rate-constant calculations. Each of these calculations is discussed in the following sections. Most of the specifics of each calculation are presented in the fuel hydrocarbon natural attenuation technical protocol by Wiedemeier et al. (1), and all will be presented in the protocol incorporating chlorinated aliphatic hydrocarbon attenuation (37).

Biodegradation Rate Constant Calculations

Biodegradation rate constants are necessary to simulate accurately the fate and transport of contaminants dissolved in ground water. In many cases, biodegradation of contaminants can be approximated using first-order kinetics. To calculate first-order biodegradation rate constants, the apparent degradation rate must be normalized for the effects of dilution and volatilization. Two methods for determining first-order rate constants are described by Wiedemeier et al. (36). One method involves the use of a biologically recalcitrant compound found in the dissolved contaminant plume that can be used as a conservative tracer. The other method, proposed by Buscheck and Alcantar (47) involves interpretation of a steady-state contaminant plume and is based on the one-dimensional steady-state analytical solution to the advection-dispersion equation presented by Bear (48). The first-order biodegradation rate constants for chlorinated aliphatic hydrocarbons are also presented (J. Wilson et al., this volume).

Simulate Natural Attenuation Using Solute Fate-and-Transport Models

Simulating natural attenuation using a solute fate-and-transport model allows prediction of the migration and attenuation of the contaminant plume through time. Natural attenuation modeling is a tool that allows site-specific data to be used to predict the fate and transport of solutes under governing physical, chemical, and biological processes. Hence, the results of the modeling effort are not in themselves sufficient proof that natural attenuation is occurring at a given site. The results of the modeling effort are only as good as the original data input into the model; therefore, an investment in thorough site characterization will improve the validity of the modeling results. In some cases, straightforward analytical models of contaminant attenuation are adequate to simulate natural attenuation.

Several well-documented and widely accepted solute fate-and-transport models are available for simulating the fate-and-transport of contaminants under the influence of advection, dispersion, sorption, and biodegradation. The use of solute fate-and-transport modeling in the natural attenuation investigation is described by Wiedemeier et al. (1).

Identify Potential Receptors, and Conduct an Exposure-Pathway Analysis

After the rates of natural attenuation have been documented and predictions of the future extent and concentrations of the contaminant plume have been made using the appropriate solute fate-and-transport model, the proponent of natural attenuation should combine all available data and information to negotiate for implementation of this remedial option. Supporting the natural attenuation option generally will involve performing a receptor exposure-pathway analysis. This analysis includes identifying potential human and ecological receptors and points of exposure under current and future land and ground-water use scenarios. The results of solute fate-and-transport modeling are central to the exposure pathways analysis. If conservative model input parameters are used, the solute fate-and-transport model should give conservative estimates of contaminant plume migration. From this information, the potential for impacts on human health and the environment from contamination present at the site can be estimated.

Evaluate Supplemental Source Removal Options

Source removal or reduction may be necessary to reduce plume expansion if the exposure-pathway analysis suggests that one or more exposure pathways may be completed before natural attenuation can reduce chemical concentrations below risk-based levels of concern. Further, some regulators may require source removal in conjunction with natural attenuation. Several technologies suitable for source reduction or removal are listed in Figure 1. Other technologies may also be used as dictated by site conditions and local regulatory requirements. The authors' experience indicates that source removal can be very effective at limiting plume migration and decreasing the remediation time frame, especially at sites where biodegradation is contributing to natural attenuation of a dissolved contaminant plume. The impact of source removal can readily be evaluated by modifying the contaminant source term if a solute fate-and-transport model has been prepared for a site; this will allow for a reevaluation of the exposure-pathway analysis.

Prepare a Long-Term Monitoring Plan

Ground-water flow rates at many Air Force sites studied to date are such that many years will be required before contaminated ground water could potentially reach Base property boundaries. Thus, there frequently is time and space for natural attenuation alone to reduce contaminant concentrations in ground water to acceptable levels. Experience at 40 Air Force sites contaminated with fuel hydrocarbons using the protocol presented by Wiedemeier et al. (1) suggests that many fuel hydrocarbon plumes are relatively stable or are moving very slowly with respect to ground-water flow. This information is complemented by data collected by Lawrence Livermore National Laboratories in a study of over 1,100 leaking underground fuel tank sites performed for the California State Water Resources Control Board (49). These examples demonstrate the efficacy of long-term monitoring to track plume migration and to validate or refine modeling results. There is not a large enough database available at this time to assess the stability of chlorinated solvent plumes, but in the authors' experience chlorinated solvent plumes are likely to migrate further downgradient than fuel hydrocarbon plumes before reaching steady-state equilibrium or before receding.

The long-term monitoring plan consists of locating ground-water monitoring wells and developing a ground-water sampling and analysis strategy. This plan is used to monitor plume migration over time and to verify that natural attenuation is occurring at rates sufficient to protect potential downgradient receptors. The long-term monitoring plan should be developed based on site characterization data, the results of solute fate-and-transport modeling, and the results of the exposure-pathway analysis.

The long-term monitoring plan includes two types of monitoring wells: long-term monitoring wells are intended to determine whether the behavior of the plume is changing; point-of-compliance wells are intended to detect movements of the plume outside the negotiated perimeter of containment, and to trigger an action to manage the risk associated with such expansion. Figure 5 depicts 1) an upgradient well in unaffected ground water, 2) a well in the NAPL source area, 3) a well downgradient of the NAPL source area in a zone of anaerobic treatment, 4) a well in the zone of aerobic treatment, along the periphery of the plume, 5) a well located downgradient from the plume where contaminant concentrations are below regulatory acceptance levels and soluble electron acceptors are depleted with respect to unaffected ground water, and 6) three point-of-compliance wells.

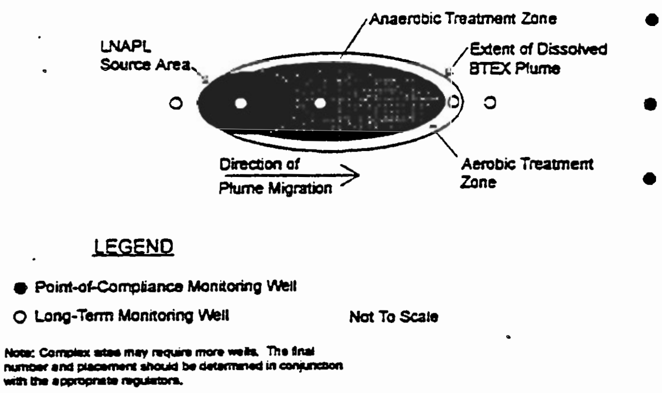


Figure 5. Hypothetical long-term monitoring strategy.

Although the final number and placement of long-term monitoring and point-of-compliance wells is determined through regulatory negotiation, the following guidance is recommended. Locations of long-term monitoring wells are based on the behavior of the plume as revealed during the initial site characterization and on regulatory considerations. Point-of-compliance wells are placed 500 feet downgradient from the leading edge of the plume or the distance traveled by the ground water in 2 years, whichever is greater. If the property line is less than 500 feet downgradient, the point-of-compliance wells are placed near and upgradient from the property line. The final number and location of point-of-compliance monitoring wells also depends on regulatory considerations.

The results of a solute fate-and-transport model can be used to help site the long-term monitoring and point-of-compliance wells. To provide a valid monitoring system, all monitoring wells must be screened in the same hydrogeologic unit as the contaminant plume. This generally requires detailed stratigraphic correlation. To facilitate accurate stratigraphic correlation, detailed visual descriptions of all subsurface materials encountered during borehole drilling should be prepared prior to monitoring-well installation.

A ground-water sampling and analysis plan should be prepared in conjunction with point-of-compliance and long-term monitoring well placement. For long-term monitoring wells, ground-water analyses should include volatile organic compounds, DO, nitrate, iron(II), sulfate, and methane. For point-of-compliance wells, ground-water analyses should be limited to determining volatile organic compound and DO concentrations. Any state-specific analytical requirements also should be addressed in the sampling and analysis plan to ensure that all data required for regulatory decision-making are collected. Water level and LNAPL thickness measurements must be made during each sampling event. Except at sites with very low hydraulic conductivity and gradients, quarterly sampling of long-term monitoring wells is recommended during the first year to help determine the direction of plume migration and to determine baseline data. Based on the results of the first year's sampling, the sampling frequency may be reduced to annual sampling in the quarter showing the greatest extent of the plume. Sampling frequency depends on the final placement of the point-of-compliance monitoring wells and ground-water flow velocity. The final sampling frequency should be determined in collaboration with regulators.

Present Findings to Regulatory Agencies, and Obtain Approval for Remediation by Natural Attenuation

The purpose of regulatory negotiations is to provide scientific documentation that supports natural attenuation as the most appropriate remedial option for a given site. All available site-specific data and information developed during the site characterization, conceptual model development, premodeling calculations, biodegradation rate calculation, ground-water modeling, model documentation, and long-term monitoring plan preparation phases of the natural attenuation investigation should be presented in a consistent and complementary manner at the regulatory negotiations. Of particular interest to the regulators will be proof that natural attenuation is occurring at rates sufficient to meet risk-based corrective action criteria at the point of compliance and to protect human health and the environment. The regulators must be presented with a "weight-of-evidence" argument in support of this remedial option. For this reason, all model assumptions should be conservative, and all available evidence in support of natural attenuation must be presented at the regulatory negotiations.

A comprehensive long-term monitoring and contingency plan also should be presented to demonstrate a commitment to proving the effectiveness of natural attenuation as a remedial option. Because long-term monitoring and contingency plans are very site specific, they should be addressed in the individual reports generated using this protocol.

References

1. Wiedemeier, T.H., J.T. Wilson, D.H. Kampbell, R.N. Miller, and J.E. Hansen. 1995. Technical protocol for implementing intrinsic remediation with long-term monitoring for natural attenuation of fuel contamination dissolved in groundwater. San Antonio, TX: U.S. Air Force Center for Environmental Excellence.
2. National Research Council. 1993. In-situ bioremediation: When does it work? Washington, DC: National Academy Press.

3. Bouwer, E.J., B.E. Rittman, and P.L. McCarty. 1981. Anaerobic degradation of halogenated 1- and 2-carbon organic compounds. Environ. Sci. Technol. 15 (5):596-599.

4. Wilson, J.T., and B.H. Wilson. 1985. Biotransformation of trichloroethylene in soil. Appl. Environ. Microbiol. 49(1):242-243.

5. Miller, R.E., and F.P. Guengerich. 1982. Oxidation of trichloroethylene by liver microsomal cytochrome P-450: Evidence for chlorine migration in a transition state not involving trichloroethylene oxide. Biochemistry 21:1090-1097.

6. Nelson, M.J.K., S.O. Montgomery, E.J. O'Neille, and P.H. Pritchard. 1986. Aerobic metabolism of trichloroethylene by a bacterial isolate. Appl. Environ. Microbiol. 52 (2):949-954.

7. Bouwer, E.J., and J.P. Wright. 1988. Transformations of trace halogenated aliphatics in anoxic biofilm columns. J. Contam. Hydrol. 2:155-169.

8. Lee, M.D. 1988. Biorestoration of aquifers contaminated with organic compounds. CRC Crit. Rev. Environ. Control 18:29-89.

9. Little, C.D., A.V. Palumbo, S.E. Herbes, M.E. Lidstrom, R.L. Tyndall, and P.J. Gilmer. 1988. Trichloroethylene biodegradation by a methane-oxidizing bacterium. Appl. Environ. Microbiol. 54(4):951-956.

10. Mayer, K.P., D. Grbi-Gali, L. Semprini, and P.L. McCarty. 1988. Degradation of trichloroethylene by methanotrophic bacteria in a laboratory column of saturated aquifer material. Water Sci. Tech. 20(11/12):175-178.

11. Arciero, D., T. Vannelli, M. Logan, and A.B. Hooper. 1989. Degradation of trichloroethylene by the ammonia-oxidizing bacterium *Nitrosomonas europaea*. Biochem. Biophys. Res. Commun. 159:640-643.

12. Cline, P.V., and J.J. Delfino. 1989. Transformation kinetics of 1,1,1-trichloroethane to the stable product 1,1-dichloroethene. In: Biohazards of drinking water treatment. Chelsea, MI: Lewis Publishers.

13. Freedman, D.L., and J.M. Gossett. 1989. Biological reductive dechlorination of tetrachloethylene and trichloroethylene to ethylene under methanogenic conditions. Appl. Environ. Microbiol. 55:2144-2151.

14. Folsom, B.R., P.J. Chapman, and P.H. Pritchard. 1990. Phenol and trichloroethylene degradation by *Pseudomonas cepacia* G4: Kinetics and interactions between substrates. Appl. Environ. Microbiol. 56(5):1279-1285.

15. Harker, A.R., and Y. Kim 1990. Trichloroethylene degradation by two independent aromatic-degrading pathways in *Alcaligenes eutrophus* JMP134. Appl. Environ. Microbiol. 56(4):1179-1181.

16. Alvarez-Cohen, L.M., and P.L. McCarty. 1991. Effects of toxicity, aeration, and reductant supply on trichloroethylene transformation by a mixed methanotrophic culture. Appl. Environ. Microbiol. 57(1):228-235.

17. Alvarez-Cohen, L.M., and P.L. McCarty. 1991. Product toxicity and cometabolic competitive inhibition modeling of chloroform and trichloroethylene transformation by methanotrophic resting cells. Appl. Environ. Microbiol. 57(4):1031-1037.

18. DeStefano, T.D., J.M. Gossett, and S.H. Zinder. 1991. Reductive dehalogenation of high concentrations of tetrachloroethene to ethene by an anaerobic enrichment culture in the absence of methanogenesis. Appl. Environ. Microbiol. 57(8):2287-2292.

19. Henry, S.M. 1991. Transformation of trichloroethylene by methanotrophs from a groundwater aquifer. Ph.D. thesis. Stanford University, Palo Alto, CA.

20. McCarty, P.L., P.V. Roberts, M. Reinhard, and G. Hopkins. 1992. Movement and transformations of halogenated aliphatic compounds in natural systems. In: Schnoor, J.L., ed. Fate of pesticides and chemicals in the environment. New York, NY: John Wiley & Sons.

21. Hartmans, S., and J.A.M. de Bont 1992. Aerobic vinyl chloride metabolism in *Mycobacterium aurum* Li. Appl. Environ. Microbiol. 58(4):1220-1226.

22. McCarty, P.L., and L. Semprini. 1994. Ground-water treatment for chlorinated solvents, In: Norris, R.D., R.E. Hinchee, R. Brown, P.L. McCarty, L. Semprini, J.T. Wilson, D.H. Kampbell, M. Reinhard, E.J. Bouwer, R.C. Borden, T.M. Vogel, J.M. Thomas, and C.H. Ward, eds. Handbook of bioremediation. Boca Raton, FL: Lewis Publishers.

23. Vogel, T.M. 1994. Natural bioremediation of chlorinated solvents. In: Norris, R.D., R.E. Hinchee, R. Brown, P.L. McCarty, L. Semprini, J.T. Wilson, D.H. Kampbell, M. Reinhard, E.J. Bouwer, R.C. Borden, T.M. Vogel, J.M. Thomas, and C.H. Ward, eds. Handbook of bioremediation. Boca Raton, FL: Lewis Publishers.

24. Bouwer, E.J. 1994. Bioremediation of chlorinated solvents using alternate electron acceptors. In: Norris, R.D., R.E. Hinchee, R. Brown, P.L. McCarty, L. Semprini, J.T. Wilson, D.H. Kampbell, M. Reinhard, E.J. Bouwer, R.C. Borden, T.M. Vogel, J.M. Thomas, and C.H. Ward, eds. Handbook of bioremediation. Boca Raton, FL: Lewis Publishers.

25. Vogel, T.M., and P.L. McCarty. 1985. Biotransformation of tetrachloroethylene to trichloroethylene, dichloroethylene, vinyl chloride, and carbon dioxide under methanogenic conditions. Appl. Environ. Microbiol. 49(5):1080-1083.

26. Murray, W.D., and M. Richardson. 1993. Progress toward the biological treatment of C1 and C2 halogenated hydrocarbons. Crit. Rev. Environ. Sci. Technol. 23(3):195-217.

27. Bradley, P.M., and F.H. Chapelle. 1996. Anaerobic mineralization of vinyl chloride in Fe(III)-reducing aquifer sediments. Environ. Sci. Technol. 40:2084-2086.

28. Wiedemeier, T.H., L.A. Benson, J.T. Wilson, D.H. Kampbell, J.E. Hansen, and R. Miknis. 1996. Patterns of natural attenuation of chlorinated aliphatic hydrocarbons at Plattsburgh Air Force Base, New York. Platform abstracts presented at the Conference on Intrinsic Remediation of Chlorinated Solvents, Salt Lake City, UT, April 2.

29. U.S. EPA. 1986. Test methods for evaluating solid waste, physical and chemical methods, 3rd ed. SW-846. Washington, DC.

30. U.S. EPA. 1983. Methods for chemical analysis of water and wastes. EPA/16020-07-71. Cincinnati, OH.

31. Hach Co. 1990. Hach Company Catalog: Products for Analysis. Ames, IA.

32. American Public Health Association. 1992. Standard methods for the examination of water and wastewater, 18th ed. Washington, DC.

33. AFCEE. 1993. Handbook to support the Installation Restoration Program (IRP) remedial investigations and feasibility studies (RI/FS). U.S. Air Force Center for Environmental Excellence. September. Brooks Air Force Base, TX.

34. AFCEE. 1992. Environmental chemistry function Installation Restoration Program analytical protocols. June.

35. Kampbell, D.H., J.T. Wilson, and S.A. Vandegrift. 1989. Dissolved oxygen and methane in water by a GC headspace equilibrium technique. Int. J. Environ. Anal. Chem. 36:249-257.

36. Wiedemeier, T.H., M.A. Swanson, J.T. Wilson, D.H. Kampbell, R.N. Miller, and J.E. Hansen. 1996. Approximation of biodegradation rate constants for monoaromatic hydrocarbons (BTEX) in groundwater. Ground Water Monitoring and Remediation. In press.

37. Wiedemeier, T.H., M.A. Swanson, D.E. Moutoux, J.T. Wilson, D.H. Kampbell, J.E. Hansen, P. Haas, and F.H. Chapelle. 1996. Technical protocol for natural attenuation of chlorinated solvents in groundwater. San Antonio, TX: U.S. Air Force Center for Environmental Excellence. In preparation.

38. Domenico, P.A. 1987. An analytical model for multidimensional transport of a decaying contaminant species. J. Hydrol. 91:49-58.

39. Domenico, P.A., and F.W. Schwartz. 1990. Physical and chemical hydrogeology. New York, NY: John Wiley and Sons.

40. Morel, F.M.M., and J.G. Hering. 1993. Principles and applications of aquatic chemistry. New York, NY: John Wiley & Sons.

41. Willey, L.M., Y.K. Kharaka, T.S. Presser, J.B. Rapp, and I. Barnes. 1975. Short chain aliphatic acid anions in oil field waters and their contribution to the measured alkalinity. Geochim. Cosmochim. Acta 39:1707-1711.

42. Lovley, D.R., and S. Goodwin. 1988. Hydrogen concentrations as an indicator of the predominant terminal electron-accepting reaction in aquatic sediments. Geochim. Cosmochim. Acta 52:2993-3003.

43. Lovley, D.R., F.H. Chapelle, and J.C. Woodward. 1994. Use of dissolved H_2 concentrations to determine distribution of microbially catalyzed redox reactions in anoxic groundwater. Environ. Sci. Technol. 28(7):1205-1210.

44. Chapelle, F.H., P.B. McMahon, N.M. Dubrovsky, R.F. Fujii, E.T. Oaksford, and D.A. Vroblesky. 1995. Deducing the distribution of terminal electron-accepting processes in hydrologically diverse groundwater systems. Water Resour. Res. 31:359-371.

45. Hem, J.D. 1985. Study and interpretation of the chemical characteristics of natural water. U.S. Geological Survey Water Supply Paper 2254.

46. Kaufman, W.J., and G.T. Orlob. 1956. Measuring ground water movement with radioactive and chemical tracers. Am. Water Works Assn. J. 48:559-572.

47. Buscheck, T.E., and C.M. Alcantar. 1995. Regression techniques and analytical solutions to demonstrate intrinsic bioremediation. In: Proceedings of the 1995 Battelle International Conference on In-Situ and On Site Bioreclamation. April.

48. Bear, J. 1979. Hydraulics of groundwater. New York, NY: McGraw-Hill.

49. Rice, D.W., R.D. Grose, J.C. Michaelsen, B.P. Dooher, D.H. MacQueen, S.J. Cullen, W.E. Kastenberg, L.G. Everett, and M.A. Marino. 1995. California leaking underground fuel tank (LUFT) historical case analyses. California State Water Resources Control Board.

APPENDIX G

TOXICOLOGICAL EVALUATION OF SURFACTANTS

TOXICOLOGICAL EVALUATION OF SURFACTANTS

Definition of Methylene Blue Active Substances (MBAS)

The MBAS test method is used to identify the presence of compounds that react with methylene blue to form a water insoluble complex (methylene blue active substances). The water insoluble MBAS complex compounds are then extracted with a chloroform solution and analyzed by spectrophotometry at a wavelength 652 nanometers. The most common MBAS compounds present in surface and ground water are anionic surfactants which consist primarily of commercial detergents. The most commonly used industrial and household anionic surfactants consist of four primary chemical compound groups: linear alkylbenzene sulfonates (LAS), alcohol ethoxy sulfates (AES), alkyl sulfates (AS) and alpha olefin sulfonates (AOS). Soaps which are the alkali salts of C_{10-20} fatty acids do not respond to the MBAS method (Standard Methods 5540C). For this reason, the natural fatty acids produced by microbes are not likely to be MBAS positive compounds.

Biodegradation of Anionic Surfactant Detergents: MBAS Compounds

Definitions of Biodegradability

There are not legal mandates in the US that require anionic surfactants to be biodegradable. However, since most industrial and household surfactant products ultimately end up in a biological wastewater treatment plant and are ultimately released into the environment, rapid biodegradation by microbes is a desired trait for most commercial products. Much of the focus on biodegradable detergents began in the early 1960's when the most commonly used detergent was alkyl aryl sulfonate (ABS), a compound that is poorly biodegraded. Undegraded ABS created treatment problems in wastewater treatment plants, and ABS accumulation in ground water and surface waters was observed. Since 1965 most if not all commonly used detergents are biodegradable.

Biodegradation may be defined on two levels for MBAS compounds, primary biodegradation where microbial transformations alter the compound until it no longer is detected by a MBAS analysis, and ultimate biodegradation where the compound is completely mineralized to inorganic constituents such as water, carbon dioxide and inorganic salts. Under Federal Trade Commission (FTC) regulations a product claim of biodegradability can be made if scientific evidence for timely biodegradation is available.

No specific test methods for testing biodegradability are defined under US law. The Europeans have further categorized ultimate biodegradation as either "ready biodegradation" or "inherent biodegradation". Ready biodegradation is defined as a material that rapidly biodegrades in a time period of under 28 days, simple test conditions and no microbial acclimation. If a material does not pass the test guidelines for ready biodegradation, further studies are conducted involving acclimated microbes and more sophisticated testing procedures. Accepted test methods have been developed through the Organization for Economic Cooperation and Development (OECD).

Aerobic Biodegradation

The results of numerous laboratory studies indicate that LAS surfactants are readily biodegradable under aerobic condition. Primary biodegradation as defined by loss of MBAS activity can occur in less than a week in many cases. Tests using surface waters are probably most similar to biodegradation rates that would be produced in ground water. Sekiguchi et al (1975) found that approximately 15 days were needed for 5 mg/l of LAS to completely biodegrade as measured by MBAS activity (NTIS PB91-212167).

Laboratory studies indicate that AES surfactants are readily biodegradable under aerobic conditions. Yoshimura and Masuda (1982) found a 100% loss of MBAS activity for AES compounds in river water within ten days (NTIS PB91-214007). Kikuchi (1985) performed die-away tests in river water at various temperatures and reported 95% - 100% degradation as defined by MBAS activity at 10 degrees Celsius within five days (NTIS PB91-214007).

Studies indicate that AS surfactants are readily biodegradable under aerobic conditions. Mauer et al (1971) reported that 5 mg/l of a C_{16}AS biodegraded as defined by MBAS activity loss after one day in a river water die-away test (NTIS PB91-214015). Huddleston and Allred (1967) observed greater than 95% removal of MBAS activity in one day of n-$C_{12-14-16}$AS compounds from an initial concentration of 10 mg/l, and complete removal was observed within two days (NTIS PB91-214015).

Biodegradation data on AOS surfactants is somewhat limited, but the data suggests that they are readily biodegradable under aerobic conditions. Kikuchi (1985) studied biodegradation of the C_{15}-$_{18}$AOS compounds in river water die-away tests and observed complete degradation as defined by loss of MBAS activity within 2-5 days at 15-27 degrees Celsius, and roughly 75% removal within 9 days at 10 degrees Celsius (NTIS PB94-102423).

Anaerobic Biodegradation

The LAS surfactant compounds are resistant to anaerobic biodegradation. Oba et al (1967) studied LAS biodegradation in an anaerobic shake flask culture system using sewage plant sludges. in a 140-day period, 18% of the MBAS activity was diminished , and after 28 days, 36% removal was observed.

Very little published information is available about the anaerobic biodegradation of AES surfactants. Most of the work has involved anaerobic sludge digester systems. Removal of surfactants $C_{12-14-16}AE_3S$ was over 95% in a six month anaerobic sludge digester study performed by Procter and Gamble (NTIS PB91-214007).

The AS surfactants appear to be readily biodegraded under anaerobic and microaerophilic conditions. Oba et al (1967) studied the degradation of C_{12ave}AS in an anaerobic sludge shake flask system. Removal of MBAS activity was very rapid with 66% the first day, 98% after 3 days and 100% after 7 days (NTIS PB91-214015). Under microaerophilic conditions (less than or equal to 1 mg/l DO) Mauer et al (1971) found that 5 mg/l of C_{16}AS was completely degraded as defined by loss of MBAS activity within 3-5 days in river water die-away tests (NTIS PB91-214015).

Biodegradation of AOS surfactants occurs relatively slowly under anaerobic conditions. Laboratory data is limited and consists primarily of anaerobic sludge studies. Oba et al (1967) studied the biodegradation of C_{15-18}AOS in an anaerobic shake culture system inoculated with sewage treatment plant sludge, and sludge from a private cesspool. In a sewage treatment plant sludge system, a MBAS activity loss of 19% was observed after 14 days and a 31% loss in 28 days. In the cesspool inoculated system, results were more rapid with 34% removal in 14 days and 43% removal in 28 days (NTIS PB94-102423).

Biodegradation of MBAS Compounds in Ground Water

The majority of references on surfactant biodegradation are focused on wastewater treatment applications or persistence in surface waters. The loss of MBAS active substances in aerobic ground water will likely be similar to the low temperature river water die-away test results. Portions of the ground water plume are microaerophilic and some portions are strongly anaerobic, producing methanogenic conditions similar to those produced in the referenced sewage sludge digester studies. Numerous surfactant compounds could be present at the site. To identify and analyze for all of the individual compounds, or even the four major classes of surfactants (LAS, AES, AS and AOS) is not practical. For this reason, we should continue to document surfactant concentrations as MBAS.

Based on the above literature information, the aerobic biodegradation rates for most, if not all, anionic surfactants likely to be present in the ground water is very rapid relative to ground water flow velocity. The assumption of an instantaneous reaction may be used in ground water biodegradation modeling with the removal of the surfactants being oxygen limited. A biodegradation model similar to the degradation of hydrocarbons in the model bioplume could be used to define aerobic biodegradation with removal rates directly linked to oxygen transport within the ground water plume.

For anaerobic conditions, that rates of removal vary by class of surfactant with only the AS class of surfactants being rapidly removed under anaerobic conditions. For this reason, the removal of anionic surfactants in the anaerobic portions of the plume will likely follow a first order decay with half-life values of several months to a year. In spite of the relatively slow biodegradation rates, the removal of anionic surfactants within the ground water plume may be significant relative to the rate of ground water transport. A first order decay rate for MBAS compounds within the plume under anaerobic conditions will be best determined from field observations of the MBAS decay along the plume flow path.