Former EMCA Site
Mamaroneck, New York

ENGINEERING EVALUATION/COST ANALYSIS (EE/CA) REPORT

prepared for:
ROHM AND HAAS COMPANY

submitted by:
URS CORPORATION

FINAL
FEBRUARY 2005

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ENGINEERING EVALUATION/COST ANALYSIS (EE/CA) REPORT

FORMER EMCA SITE

SITE NO. 360025

MAMARONECK, NEW YORK

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ACRONYMS

bgs	below ground surface
cfu/mL	colony forming units per milliliter
cm/s	centimeters per second
DCE	Dichloroethene
EE/CA	Engineering Evaluation/Cost Analysis
FID	Flame Ionization Detector
FIP	Field Investigation Plan
GZANY	Goldberg-Zoino and Associates of New York
HRC	Hydrogen Release Compound
IRM	Interim Remedial Measure
mg/L	milligrams per liter
MTBE	Methyl tert-butyl ether
mV	millivolts
NYCRR	New York Code of Rules and Regulations
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
O&M	Operation and Maintenance
ORC	Oxygen Release Compound
ORP (or Eh)	Oxidation-Reduction Potential
PCE	Perchloroethene (Tetrachloroethene)
ppm	parts per million
psig	pounds per square inch - gage
RI	Remedial Investigation
SCGs	Standards, Criteria, and Guidance Values

ACRONYMS (Continued)

TCE	Trichloroethene
TCFE	Trichlorofluoroethene
URS	URS Corporation
USEPA	United States Environmental Protection Agency
VOCs	Volatile Organic Compounds
WWC	Woodward-Clyde Consultants
µg/L	micrograms per liter
µmhos	micromhos
ZVI	Zero Valent Iron

1.0 INTRODUCTION

URS Corporation (URS) prepared this Engineering Evaluation/Cost Analysis (EE/CA) Report on behalf of Rohm and Haas Company (Rohm and Haas) to evaluate a focused list of presumptive remedial options for remnant 1,1,2-trichloro-1,2,2-trifluoroethane (Freon 113; CAS No. 76-13-1) contamination in groundwater at the former EMCA site (Site No. 360025) located in Mamaroneck, Westchester County, New York (Figure 1-1). Based on the evaluation, one option is recommended as the site remedy.

This report also presents, summarizes, and provides interpretations of additional data collected in July 2001 and a pilot study conducted between May 2003 and July 2004. Details of an Interim Remedial Measure (IRM) conducted in November 2004 are also presented. The EE/CA was performed as part of an agreement between Rohm and Haas and the New York State Department of Environmental Conservation (NYSDEC).

1.1 <u>Site Description and History</u>

The EMCA property is a 0.6-acre site located in a mixed residential/industrial area in Mamaroneck, New York (Figures 1-1 and 1-2). EMCA, formerly owned by Rohm and Haas, manufactured high conductivity precious metal paste used in circuits by the electronics industry. Manufacturing at the EMCA site began in 1960, Rohm and Haas purchased the site in 1984, and manufacturing ceased in 1988. Rohm and Haas transferred site ownership to UA-Columbia Cablevision, who later merged with TCI Cablevision of Westchester and then with Cablevision of Westchester, the current site owner.

1.2 <u>Previous Investigations, Study and Interim Remedial Action</u>

As part of the real property transfer, UA-Continental Cablevision retained Goldberg-Zoino and Associates of New York (GZANY) to perform a preliminary site investigation. In 1988, GZANY conducted a field investigation that included advancing several soil borings and installing nine monitoring wells (GZANY 1988). Based on their investigation, GZANY identified soil and groundwater contamination at the site.

In 1989, Rohm and Haas retained Woodward-Clyde Consultants (WCC) to review GZANY's data, conduct follow-up investigations, and evaluate risks associated with site contamination. Based on these efforts, WCC concluded there is no significant risk to human health or the environment, and that remediation of groundwater and site soils is not warranted (WCC 1989).

In 1992, TCI Cable of Westchester, Inc. (the owner at that time), subcontracted ENVIRON Corporation to collect indoor and outdoor air samples to evaluate potential health risks with regard to air quality. Based on this investigation, ENVIRON concluded there was no evidence to suggest that air quality at the facility would produce any adverse health effects to the occupants of the building (ENVIRON 1992).

Based on the site history and environmental site data existing at the time (1991), NYSDEC listed the former EMCA site as a NYSDEC Class 2 Inactive Hazardous Waste Site due to the presence of Freon 113 in site groundwater. In March 1999, Rohm and Haas signed a Consent Order with the NYSDEC, agreeing to conduct additional investigations to further evaluate the nature and extent of site contamination.

Subsequent to the Consent Order, Rohm and Haas retained URS to perform a Remedial Investigation (RI) at the former EMCA site. Field work occurred in October 1999 and July 2000 and included soil gas sampling, surface soil sampling, well and piezometer installations, groundwater sampling, water level monitoring, and surveying. The RI concluded that soil gas and soil were not media of concern with respect to site contamination (URS 2000). A remnant Freon 113 groundwater plume was identified onsite with concentrations above NYSDEC Class GA standards, although there appeared to be no significant health risk associated with the plume. NYSDEC requested that Rohm and Haas evaluate remedial alternatives for the Freon 113 plume.

A supplemental field investigation was conducted in July 2001 to provide additional data for the preparation of a Draft-Final EE/CA, which was submitted to NYSDEC in June 2002 (URS 2002b). Details of the field program are provided in Section 2.1 and investigation results are presented in Section 3.0. The draft final EE/CA recommended performance of a pilot study to evaluate technologies that were shown to be promising. The injection of vegetable oil was considered the most promising technology and the injection of zero valent iron was considered to be a promising contingency.

The pilot study was conducted in 2003 to evaluate the effectiveness of vegetable (soybean) oil injection as a method to stimulate biological processes that result in the reductive dechlorination of Freon 113 in site groundwater. Sodium lactate was also injected based on evaluations that were conducted during preparation of the Pilot Study Work Plan (URS 2003). Details of the pilot study are provided in Section 2.2 and study results are presented in Section 3.0. The study confirmed that injection of soybean oil and sodium lactate was an effective method that would achieve significant reduction of Freon 113 in site groundwater.

An IRM was performed in November 2004 to continue and enhance conditions favorable for the degradation of site contaminants, which were created as a result of the pilot study. Details of the IRM are provided in Section 2.3.

1.3 Purpose of EE/CA

The purpose of the EE/CA is to select the best alternative to remediate groundwater contaminated by Freon 113 at the former EMCA site. The guideline used for preparation of the EE/CA is "Guidance on Conducting Non-Time-Critical Removal Actions Under CERCLA" (USEPA 1993). The action selection process consists of the following steps: 1) identification of remedial action objectives; 2) identification of remedial action alternatives; 3) evaluation and comparison of remedial action alternatives, and; 4) recommendation of a remedial action alternative.

The RI Report for the former EMCA site presented a preliminary list of remedial alternatives to address the area of Freon 113 contamination in groundwater, which included (URS 2000):

- Monitored Natural Attenuation
- Hydrogen Release Compound (HRC^{TM})
- Air Sparging
- Bioremediation

The preliminary list of alternatives was discussed in a letter dated May 22, 2001 from URS to NYSDEC in which three alternatives were proposed for evaluation in the EE/CA including:

- Natural Attenuation
- HRC^{TM} and an Oxygen-Releasing Compound (ORC^{TM} or PermeOx^{TM})
- HRC^{TM} with an Oxygen-Releasing Compound Contingency

Subsequently, the scope of the EE/CA and fieldwork was discussed and agreed upon between representatives of Rohm and Haas, NYSDEC, and URS. The Draft EE/CA was submitted to the NYSDEC in January 2002. Representatives of Rohm and Haas, NYSDEC, and URS conferred on April 1, 2002 to discuss the EE/CA. The parties agreed that the following additional in-situ technologies should be evaluated:

- Zero Valent Iron
- Ozone Sparging
- Vegetable Oil Injection

These alternatives were evaluated in the Draft-Final EE/CA (URS 2002b) and the pilot study was conducted based on recommendations presented in the document. The evaluation of alternatives presented in this final EE/CA has been refined based on results of the pilot study. The selection of alternatives for analysis is discussed further in Section 7.0.

1.4 Report Organization

The report is organized in seven sections: Section 1.0 is the introduction to the EE/CA which presents general background for the former EMCA site; Section 2.0 describes supplemental field activities conducted in July 2001, the pilot study conducted in 2003, and the IRM conducted in 2004; Section 3.0 characterizes the site, both physically and chemically; Section 4.0 presents results of the pilot study; Section 5.0 identifies the remedial action objectives; Section 6.0 pre-screens various potential remedial technologies; Section 7.0 identifies and analyzes the most promising remedial alternatives, and; Section 8.0 identifies and discusses the recommended remedial alternative.

2.0 SUPPLEMENTAL FIELD ACTIVITIES

2.1 July 2001 Field Activities

Supplemental field activities were conducted at the former EMCA site in July 2001 to provide additional data for the preparation of the EE/CA and to address NYSDEC requests for continued groundwater level monitoring at the site. The field activities were conducted in a manner consistent with the *Draft Final Remedial Investigation Field Investigation Plan (FIP)* (URS 1999a) and the *Site Investigation Quality Assurance Project Plan* (URS 1999b). Specific field tasks were detailed in a Technical Memorandum issued on July 6, 2001 titled *Addendum to Field Investigation Plan, Former EMCA Site, Site No. 360025, Mamaroneck, New York (DRAFT FINAL), September 1999* (URS 2001a). Based upon review comments from NYSDEC, the Addendum was revised and reissued on July 17, 2001 (URS 2001b). Field investigations proposed in the revised Addendum consisted of:

- Collecting groundwater samples from six site monitoring wells for laboratory analysis using low-flow sampling techniques.
- Recording field measurements while low-flow purging the six monitoring wells.
- Obtaining a complete round of water level measurements from existing site wells and stream gauging points in the Sheldrake River.
- Performing hydraulic conductivity tests (slug tests) on seven (7) site monitoring wells.

Detailed descriptions of the field activities are provided in the following sections.

2.1.1 Groundwater Sampling

On July 25 and 26, 2001, groundwater samples were collected from site monitoring wells MW-01, MW-02, MW-03, MW-04, MW-05, and GZ-06 using low-flow sampling techniques (Figure 1-2). Samples were collected according to the procedures outlined in Appendix B of the

Draft Final FIP (URS 1999a) and the *Revised Addendum to the FIP* (URS 2001b) with the exception that the drawdown in wells MW-01 and GZ-06 exceeded ten percent of their respective static water column heights. These wells were poor water producers and the peristaltic sampling pump was set at its lowest sustainable flow rate (approximately 100 milliliters/minute).

Dissolved oxygen, pH, temperature, specific conductivity, and oxidation/reduction potential (ORP or E_h) purge parameter readings were recorded in the field using a Geotech low volume flow cell. Turbidity and flow rate were monitored from the flow cell discharge. Purging and sampling parameters were recorded on Low Flow Groundwater Purging/Sampling Logs that were provided in the Draft-Final EE/CA (URS 2002b). Because of their instability, ferrous iron and sulfide analyses were also performed in the field using Hach test kits and a Hach DR/890 colorimeter. For all other parameters (Table 2-1), groundwater samples were collected in laboratory provided sample containers, placed on ice in coolers, and subsequently shipped under chain-of-custody control to H2M Labs, Inc. of Melville, New York for analysis.

URS conducted a review of the data quality in accordance with *Guidance for the Development of Data Usability Summary Reports* (NYSDEC 1999) and the approved project plans. The Data Usability Summary Report was provided in the Draft-Final EE/CA (URS 2002b). The July 2001 groundwater sample analytical results are presented and discussed in Section 3.0.

2.1.2 Water Level Measurements

On July 24, 2001, water level measurements were collected from site wells MW-01, MW-02, MW-03, MW-04, MW-05, GZ-03, and GZ-06, and from stream gauging points WS-01, WS-03, and WS-04. The stream gauging stake at location WS-02 was no longer present. Water level measurements were performed according to procedures detailed in the *Draft Final FIP* (URS 1999a). The water level data is presented and discussed in Section 3.0.

2.1.3 Hydraulic Conductivity Testing

On July 26 and 27, 2001, slug tests were attempted at all existing site monitoring wells to obtain data to estimate the horizontal hydraulic conductivity of the unconfined aquifer. The tests were performed according to the procedures outlined in the *Revised Addendum to the FIP* (URS 2001b) using an In Situ Inc. Hermit 3000 Data Logger with pressure transducer. All slug testing data from wells MW-01 and GZ-03 were unusable, most likely due to interference between the pressure transducer and slug since these wells had static water columns less than 3 feet in height. Rising head slug test data for wells MW-02 and MW-04 were deemed too erratic to be usable. Well MW-03 could not be tested due to a short in the pressure transducer cable. The hydraulic conductivity testing analyses are provided in Appendix A and results are presented and discussed in Section 3.0.

2.2 Pilot Study

A pilot study was performed to evaluate the effectiveness of vegetable oil injection as a method to stimulate biological processes that result in the reductive dechlorination of Freon 113 in site groundwater. The study was performed during the period May 2003 to July 2004 in accordance with a NYSDEC approved Pilot Study Work Plan (URS 2003).

Pilot study details, monitoring results and interpretations were presented in a Draft Pilot Study Report that was submitted to NYSDEC (URS 2004a). A summary is provided below.

2.2.1 Monitoring Well Installation

Monitoring wells MW-06 and MW-07 were installed on June 9 and 10, 2003 at the locations shown on Figure 1-2. Both wells were installed using Geoprobe® direct-push equipment. Subsurface logs and monitoring well construction details are provided in Appendix B.

2.2.2 Edible Oil/Sodium Lactate Injection

Commercially prepared emulsified soybean oil (Edible Oil Substrate - EOS™), manufactured by EOS Remediation, Inc. and a commercially prepared sodium lactate (WILCLEAR™ Sodium Lactate), manufactured by JRW Technologies, were injected into the subsurface during the period June 11 to 20, 2004 using twelve injection points situated around well MW-03 (Figure 2-1).

EOS™, chase water, and WILCLEAR™ Sodium Lactate were injected between 25 feet below ground surface (bgs) to 5 feet bgs using Geoprobe® direct-push equipment. Approximately 220 gallons of EOS™ and 205 gallons of WILCLEAR™ were injected. Approximately 650 gallons of chase water were also added. Subsurface injection logs are provided in Appendix C.

2.2.3 Groundwater Sampling

Groundwater samples were collected using low-flow purging and sampling procedures during five episodes, which are listed below.

Monitoring Wells	Date	Purpose
GZ-06, MW-02, MW-03, MW-04 & MW-05	May 20 – 21, 2003	Pilot Study Background
MW-06 & MW-07	June 10 – 11, 2003	Pilot Study Background
GZ-06, MW-02, MW-03, MW-06 & MW-07	July 22 – 23, 2003	1-month after injection
GZ-06, MW-02, MW-03, MW-06 & MW-07	September 17 – 18, 2003	3-months after injection
GZ-06, MW-02, MW-03, MW-04, MW-05, MW-06 & MW-07	December 17 –18, 2003	6-months after injection
GZ-06, MW-02, MW-03, MW-04, MW-05, MW-06 & MW-07	July 22 – 23, 2004	13-months after injection

Dissolved oxygen, pH, temperature, specific conductivity, and ORP were recorded in the field using a Geotech low volume flow cell. Turbidity and flow rate were monitored from the flow cell discharge. Purging and sampling parameters were recorded on Low Flow Groundwater Purging/Sampling Logs, included in the Draft Pilot Study Report (URS 2004a) and a Groundwater Sampling and Analysis Report (URS 2004b). Because of their instability, ferrous iron and sulfide analyses were also performed in the field using Hach test kits and a Hach DR/890 colorimeter. For all other parameters (Table 2-1), groundwater samples were collected in laboratory provided sample containers, placed on ice in coolers, and subsequently shipped under chain-of-custody control to Severn Trent Laboratories, Inc. of Edison, New Jersey for analysis.

Static groundwater level measurements were taken prior to purging and sampling during each monitoring episode. Water level measurements were performed according to procedures detailed in the *Draft Final FIP* (URS 1999a). The water level data is presented and discussed in Section 3.0.

2.3 Interim Remedial Action

Based on monitoring results 13 months after injection of the EOS™ and WILCLEAR™, an additional injection of both substrates was recommended as an IRM to continue and enhance conditions amenable for the degradation of site contaminants that were established during the pilot study. The IRM was performed during the period November 9 to 12, 2004 in accordance with a NYSDEC approved Interim Remedial Action Work Plan (URS 2004c).

EOS™ and WILCLEAR™ were injected between 25 feet bgs to 5 feet bgs using Geoprobe® direct-push equipment as described below. Injection locations are shown on Figure 2-2 and subsurface injection logs are presented in Appendix C.

- MW-03 area – Approximately 170 gallons of WILCLEAR™ was injected at 12 locations centered on well MW-03.

- MW-02/MW-06 area – Approximately 275 gallons of EOS™ and 30 gallons of WILCLEAR™ were injected at 10 locations that encompassed wells MW-02 and MW-06. 500 gallons of water were injected to distribute the EOS™.
- MW-07 area – Approximately 45 gallons of WILCLEAR™ was injected at 3 locations between wells MW-03 and MW-07.
- GZ-06 area – Approximately 28 gallons of WILCLEAR™ was injected at 3 locations around well GZ-06.

3.0 SITE CHARACTERIZATION

The following site characterization is based upon information presented in previous site investigative reports (see Section 1.2), data gathered during the July 2001 field activities, and data collected during the Pilot Study.

3.1 Site Topography and Land Use

The former EMCA site is located in a mixed use residential/industrial area. As shown in Figure 1-2, there are several industrial, manufacturing, and warehousing facilities within an approximate 500-foot radius of the site including: a dry cleaner, automotive and welding facilities, an auto collision shop, a furniture restoration and stripping facility, a garbage hauling facility, and other general light industrial businesses. There are also six residential properties within the 500-foot radius. Surrounding the industrialized area, the dominant land use is medium- and high-density residential.

Topography in the immediate vicinity of the site is generally flat, although the ground surface gradually slopes northwest toward the Sheldrake River (Figure 3-1). Based upon differences in elevation between site wells and stream gauging points, there is approximately 10 feet of relief between the site and the Sheldrake River. The surface of the site is almost entirely paved or covered by existing structures, although minor grassy areas exist along median strips between sidewalks and roadways.

The 1963 Village of Mamaroneck Sanborn Map indicates that the site formerly contained three residential structures and associated garages (URS 2000).

A review of local potable water supplies was previously conducted and documented in the report entitled *Risk Assessment, Former EMCA Site, Mamaroneck, New York* (WCC 1989). This review indicated that the primary water supply for Southern Westchester County was obtained from the New York City water supply system, which is taken from a reservoir greater than 8 miles from the site. There were no known domestic groundwater users within a ½-mile radius of the site, and the closest potential potable water source is the Sheldrake Reservoir, located approximately 1.5 miles upstream from the site. At the time of the study, the Sheldrake Reservoir was used as an emergency water source only.

3.2 Climate

The climate in Westchester County is characterized as humid-continental and exhibits highly variable weather systems and strong seasonal contrasts. Continental air masses provide the predominant influence on Westchester County weather systems, although maritime air masses also influence the area and provide milder temperatures than continental areas located to the west along the same latitude. Average winter temperatures vary from 20 to 30 degrees Fahrenheit, whereas summer temperatures generally average in the 80 degree Fahrenheit range. Average precipitation is approximately 45 inches per year.

3.3 Surface Water Hydrology and Site Drainage

Surface water at the former EMCA site drains into the Sheldrake River drainage basin of the lower Long Island Sound watershed. The site lies within the 100-year floodplain of the Sheldrake River (WCC 1989). The Sheldrake River discharges into the Mamaroneck River, which in turn discharges to the Atlantic Ocean at Mamaroneck Harbor (see Figures 1-1 and 3-1). The Sheldrake River is classified by NYSDEC as a "Class C" water body in Title 6 Parts 701 (Article 9) and 935 (Article 18) of the New York Code of Rules and Regulations (NYCRR). This classification indicates these waters are suitable for fishing and primary and secondary contact recreation, although other factors may limit the use for these purposes. Surface drainage is primarily controlled by a storm sewer system that likely conveys stormwater to the Sheldrake River via subsurface pipes.

3.4 Geology and Hydrogeology

Overburden stratigraphy at the site is characterized by unconsolidated glacial and alluvial deposits composed predominantly of sand, with localized zones of gravel, silt, and clay. Available logs for borings performed at the site are provided in Appendix B. The deepest site boring (GZ-8) was advanced to 32 feet bgs and did not encounter bedrock. Generally, the top 3 to 5 feet of the overburden deposits consist of sand-gravel-silt mixtures, have been disturbed (i.e., excavated or regraded), and may contain fill (i.e., asphalt, concrete, cobbles, wood, and glass). Beneath the surficial deposits lie several feet of finer textured sand-silt-clay deposits to a depth of approximately 10 feet bgs. These may represent glacial deposits or alluvial deposits within the floodplain of the Sheldrake River. From approximately 10 feet to 32 feet bgs, deposits consist of well-graded sands with minor inclusions of gravel and silt.

Based on a review of historic boring logs from nearby former industrial water wells, bedrock is anticipated to occur at a depth of approximately 40 feet bgs beneath the site (WCC 1989). Bedrock beneath the site reportedly consists of Hartland Formation basal amphibolite overlain by pelitic schists (Fisher et al. 1970). The topographic rise west of Interstate 95, shown on Figure 3-2, is mapped as Harrison Gneiss (Fisher et al. 1970).

Groundwater is encountered in the overburden deposits beneath the site at a depth of approximately 4 to 6 feet bgs. Shallow groundwater flow is generally towards the west and northwest at a horizontal gradient of approximately 0.005 foot/foot across the site (Figure 3-2). Flow is toward the Sheldrake River, which likely serves as the local discharge point for shallow groundwater in the area. The average horizontal hydraulic conductivities for the shallow portion of the water table aquifer calculated from slug tests performed on site wells in July 2001 ranged from approximately 7×10^{-3} centimeter/second (cm/s) to 2×10^{-2} cm/s (see Appendix A). Assuming an effective porosity range of between 0.2 and 0.4 for the water table aquifer, seepage velocities across the site may range from approximately 0.2 to 1.2 feet/day.

3.5 Source, Nature, and Extent of Contamination

The primary contaminant at the former EMCA site (which can be attributed to past operations at the site) is Freon 113, which has contaminated soils and groundwater beneath the site. Other contaminants detected in media at the site (e.g., solvents, chlorinated hydrocarbon compounds, and fuel-related volatile organic compounds [VOCs]) are believed to originate from upgradient offsite sources.

3.5.1 Ambient Air Contamination

In 1992, TCI Cable of Westchester, Inc. (the owner at the time) subcontracted ENVIRON Corporation to collect indoor and outdoor air samples to evaluate potential health risks with regard to air quality. ENVIRON collected eight indoor and two outdoor ambient air samples at the facility. The samples were analyzed for acetone, benzene, 2-butanone, chloroethane, chloroform, 1,1-dichloroethane, cis-1,2-dichloroethene, trans-1,2-dichloroethene, ethylbenzene, Freon 113, methylene chloride, 1,1,2,2-tetrachloroethane, tetrachloroethene, 1,1,1-trichloroethane, trichloroethene, and toluene. Trace levels of several of these compounds were detected, however, ENVIRON concluded that the level of contamination identified at the site was not a health concern to site workers (ENVIRON 1992).

On July 11, 2000, the New York State Department of Health (NYSDOH) collected indoor ambient air samples at two houses near the former EMCA site (530 Fayette Avenue and 614 Center Avenue) and within the Cablevision of Westchester facility located on the site (URS 2000). The concentrations of Freon 113 detected in the three buildings were within or slightly above the typical background range for Freon 113 in indoor and outdoor air and did not pose a health concern. NYSDOH's data indicates that Freon 113 migration into the Cablevision of Westchester facility or to offsite receptors via soil gas or volatilization from groundwater is not a concern. Ambient air is not a primary medium of concern at the former EMCA site.

3.5.2 Soil Contamination

3.5.2.1 Soil Gas

Soil gas screening and analytical samples were collected as part of the RI (URS 2000). Sampling locations and detected results are shown in Figure 3-3. A high flame ionization detector (FID) reading was recorded at soil gas probe location SG-01 indicating an off site, upgradient (with respect to groundwater flow) contaminant source south or southeast of the former EMCA site. Soil gas samples were collected at locations SG-03, SG-05, SG-06, and SG-07 for laboratory analyses. The compounds detected were primarily solvents, chlorinated hydrocarbon compounds, fuel-related VOCs, and Freon 113. The Freon 113 detections were in samples (SG-03 and SG-05) collected beneath paved areas on the north side of the former EMCA site. Freon 113 was not detected in off site soil gas. The remaining compound detections (other than Freon 113) were attributed to off site sources.

3.5.2.2 Soil

GZANY collected 26 soil samples at depths ranging from 0 to 8 feet bgs from 14 of the borings performed during the May 1988 investigation (GZANY 1988). Fourteen priority pollutant VOCs were detected in these soil samples. The boring locations and detected VOCs are shown on Figure 3-4.

Except for Freon 113, the majority of VOCs were detected at highest concentrations along the southeastern site boundary in the upgradient groundwater flow direction. This distribution suggested an offsite upgradient source for these compounds. The highest Freon 113 detections were found within the parking area along the northeastern portion of the site (B-03, B-05, and B-10). These detections in soil indicate the probable source area for the Freon 113 spills. None of the soil concentrations exceeded the standards, criteria, and guidance values (SCGs) provided in NYSDEC TAGM 4046 (NYSDEC 1994). Therefore, subsurface soil was not considered a medium of primary concern.

During the RI, two surface soil samples were collected and analyzed for select metals. The sample locations and detected results are shown on Figure 3-5. Sample SS-02 was considered to be a background sample and SS-01 was taken below a paved area that was actively used during EMCA's former industrial activities. Both samples had comparable results except for somewhat elevated concentrations of lead at the onsite location (SS-01). The lead result at SS-01 was 445 parts per million (ppm), which is well within the range of concentrations which would be considered "normal" for this industrialized area. Based on these results and given that the highest lead value was from below a paved area, surface soils were not considered a primary medium of concern at this site.

3.5.2.3 Summary

Soil is not a primary medium of concern at the former EMCA site. Freon 113 spills to unsaturated soil would be expected to rapidly volatilize to the atmosphere or leach to groundwater (Appendix D).

3.5.3 Groundwater Contamination

Ten (10) groundwater sampling/analysis events were performed at the former EMCA site. The first sampling event was performed in May 1988 and the most recent sampling event occurred in July 2004. A summary of the analytical data is provided in Table 3-1. Figure 3-6 summarizes Freon 113 results for all sampling events.

3.5.3.1 Volatile Organic Compounds

VOCs detected in groundwater around the former EMCA site consisted primarily of chlorinated hydrocarbon compounds, fuel-related compounds, solvents, and Freon 113. Chlorinated hydrocarbon compounds and their breakdown products (i.e., tetrachloroethene, trichloroethene, cis- and trans-1,2-dichloroethene, vinyl chloride, 1,1,2-trichloroethane, and chloroethane) have historically been detected at highest concentrations in upgradient monitoring wells (GZ-07 and its replacement MW-01) at the site, indicating an upgradient source for these compounds.

Fuel-related compound concentrations (i.e., benzene, ethylbenzene, toluene, isopropylbenzene, and methyl tert-butyl ether), attributed to a relatively old upgradient source, have significantly decreased over time. However, the distribution of benzene and methyl tert-butyl ether (MTBE) in the July 2000 and July 2001 sampling rounds indicates that a more recent unleaded gasoline groundwater contaminant source may be located upgradient of the site. Slower moving gasoline constituents (e.g., ethylbenzene, toluene, and xylenes) may impact groundwater beneath the site in the future.

Solvents, specifically the ketones acetone and 2-butanone, have been detected somewhat sporadically in groundwater. 2-butanone has only been detected in upgradient well GZ-07 during the March 1989 sampling event. Acetone was detected in wells along the northern periphery of the site during the March 1989, July 2000, and July 2001 sampling events. Acetone was not detected in any groundwater samples from the May 1988 and October 1999 events. Acetone is highly volatile and very miscible with water; therefore, it is doubtful that its current presence in groundwater is due to past manufacturing operations at the former EMCA site. Also, acetone was not detected in any of the May 1988 soil (Figure 3-4) or groundwater samples collected shortly after operations at the site had ceased. It is not known if acetone originates from an upgradient offsite source. The acetone detections have only occurred in wells were Freon 113 was also detected.

Chloroform has been detected sporadically at low concentrations in several wells. A common source of chloroform is chlorinated potable water. Chloroform is frequently detected in newly installed groundwater monitoring wells where potable water has been utilized during drilling/well installation. Potable water leaks and spills can also lead to the presence of chloroform in groundwater. Chloroform could also be a breakdown product of other organic chemicals in groundwater.

Freon 113 detections in groundwater were widespread following the cessation of operations at the former EMCA site in 1988. All Freon 113 detections in site groundwater samples are summarized in Figure 3-6.

In the July 2004 sampling event, Freon 113 concentrations in MW-02, MW-03, MW-06, MW-07, and GZ-06 exceeded the NYSDEC Class GA Groundwater Standard of 5 micrograms per liter (µg/L) (NYSDEC 2000).

Freon 113 concentrations in groundwater decreased after the EOS™ and WILCLEAR™ were injected for the pilot study. A discussion of the pilot study results is presented in Section 4.0.

3.5.3.2 Metals

October 1999 groundwater samples from MW-01 (upgradient) and MW-04 (downgradient) were analyzed for total (unfiltered) and dissolved (filtered) barium, copper, lead, silver, and zinc. None of the detections exceeded their respective groundwater standards. Upgradient metals concentrations were higher than downgradient metals concentrations implying that the site is not a source for these metals in groundwater.

Total and dissolved iron and manganese analyses were performed on the July 2001 groundwater samples (Appendix E). All iron and most manganese detections exceeded their respective groundwater standards. Iron concentrations were comparable in most upgradient and downgradient wells except MW-02 and MW-04. Iron concentrations in MW-02 and MW-04 were approximately one to two orders of magnitude higher than those detected in any other wells. Manganese concentrations appear to be lower in upgradient wells GZ-06 and MW-01 and increase in all downgradient wells. The increase in manganese concentrations appears to be the result of increased dissolution due to reducing groundwater conditions.

3.5.3.3 Miscellaneous Parameters

Groundwater samples from the July 2001 sampling event also were analyzed for groundwater quality parameters (Table 2-1) to provide data for evaluating remedial options for the remnant Freon 113 contamination at the site. Detected results are presented in Appendix E.

3.5.3.4 Groundwater Summary

Groundwater is the primary medium of concern at the former EMCA site. Freon 113 has migrated to groundwater. The remediation of this plume is the focus of this EE/CA.

3.6 Health Risk

In 1989, a risk assessment (WWC 1989) was performed to assess the potential for chemical contaminants from the former EMCA site to adversely impact human health or the environment. The following potential migration pathways were identified:

- Direct seepage of site groundwater to the Sheldrake River
- Off-site vaporization of VOCs from groundwater and diffusion of these compounds through the soil column into basements

The assessment concluded that there is not significant risk to human health or the environment. The RI (URS 2000) confirmed the conclusions made in the risk assessment. The conclusions were augmented by NYSDOH air sampling results from residential homes and the Cablevision of Westchester facility, which verify that there is low risk to human health from Freon 113 volatilizing into local structures.

The assessment did not consider ingestion of contaminated groundwater to be a complete pathway because the Sheldrake River is not used as a potable water supply downstream and there is no current use of groundwater in the vicinity for municipal, domestic, or industrial purposes. A qualitative human exposure assessment and calculation was performed as part of this study to evaluate potential risks to construction workers and residential users of Freon 113 contaminated groundwater from the site, given the unlikely scenario that groundwater at the site is encountered during construction or developed as a potable supply source in the future. The assessment and calculation are presented in Appendix F, which indicates that there would be no significant risk to human health from Freon 113 contaminated groundwater at the site.

4.0 PILOT STUDY RESULTS

Pilot study results, summarized below, indicate that the EOS™ and WILCLEAR™ injections were successful in stimulating in-situ anaerobic biodegradation of Freon 113. Analytical data are presented in Appendix E and shown graphically on Figure 3-6 (Summary of Freon 113 Detections in Groundwater), Figure 4-1 (Groundwater Analytical Data Plots, Freon 113 and By-Products), and Figure 4-2 (Groundwater Analytical Data Plots, Geochemical Parameters).

- During the first 6-months of the pilot study, Freon 113 concentrations decreased 1 to 2 orders of magnitude in three wells located near the injection area (i.e. MW-02, MW-03, and MW-07). The initial rapid reduction of Freon 113 in MW-03 was attributed, in part, to sorption into the injected EOSTM. The concentration of Freon 113 rebounded in MW-03 between the 6-month and 13-month sampling episodes, which was attributed to desorption from the EOSTM.
- Freon 113 was not detected in downgradient wells MW-04 and MW-05 prior to and after the pilot study injections.
- Byproducts of Freon 113 degradation were detected in the study area. The concentration of 1,2-dichloro-1,1,2-trifluoroethane (Freon 123a), a daughter product, increased in MW-03 and MW-07 during the 6-month period following the injections. The concentration of Freon 123a subsequently decreased in downgradient well MW-07 between the 6-month and 13-month sampling episodes. Chlorotrifluoroethene (Freon 1113), a suspected daughter product, was positively identified in wells GZ-06, MW-02, MW-03, MW-06, and MW-07 during the 13-month sampling episode. This compound was tentatively identified during previous sampling episodes. Chloride concentrations increased in downgradient well MW-07 and in nearby well MW-02 during the pilot study.
- Geochemical parameters indicate that the pilot study area shifted to a more reducing (anaerobic) environment after the EOS™ and WILCLEAR™ were injected. Evidence of this condition was provided by ORP and dissolved oxygen measurements that displayed a decreasing trend at MW-03, MW-06, and MW-07

during the 3-month period following injection. Furthermore, the concentrations of ferrous iron and methane increased, which were accompanied by a reduction in sulfate concentrations. Geochemical conditions at the 13-month sampling episode indicated that plume wells MW-03 and MW-07 continued to exhibit favorable anaerobic conditions, which was evidenced by elevated methane and the absence of sulfate in groundwater.

In an effort to maintain conditions favorable for reductive dechlorination of Freon 113 and its by-products that were established during the pilot study, additional injections of EOS™ and WILCLEAR™ were undertaken as an IRM. These additional injections are discussed in Section 2.3.

5.0 IDENTIFICATION OF REMEDIAL ACTION OBJECTIVE

Remedial action objectives are site-specific objectives that are developed to identify appropriate alternatives that address site contamination and protect human health and the environment.

At present, there is no significant risk posed to human health or the environment due to the presence of Freon 113 in groundwater at the former EMCA site. In addition, there appears to be no significant risk to human health given potential future potable use of the aquifer underlying the site. However, the promulgated New York State groundwater standard for Freon 113 is 5 ųg/l (NYSDEC 2000). Freon 113 is present in groundwater at the site at concentrations well above its groundwater standard. Therefore, the following remedial action objective is established for the site:

- **Reduce the maximum concentrations of Freon 113, Freon 123a, and Freon 1113 in groundwater at the site to levels at or below their respective New York State groundwater standard, which is 5 µg/L for each compound.**

6.0 PRE-SCREENING OF REMEDIAL TECHNOLOGIES

An EE/CA is used to evaluate a small set of presumptive remedies for site remediation. Alternatives are evaluated with respect to implementability, effectiveness, and cost. The following technologies were evaluated:

- natural attenuation
- injection of organic substrates
- injection of an oxygen-releasing compound
- air sparging
- ozone sparging
- installation of a subsurface permeable reactive wall(s)
- installation of zero valent iron (Ferox)
- injection of zero valent iron in a guar carrier
- in-situ bioremediation
- excavation
- groundwater collection with aboveground treatment.

The evaluation presented in this section is an expansion of technologies that were discussed in the RI (URS 2000), in a letter from URS to NYSDEC (URS 2001a), and in discussions between Rohm and Haas, NYSDEC, and URS in Albany, New York (URS 2002a). The most promising of these technologies are developed into detailed alternatives and evaluated in greater detail in Section 7.0.

6.1 Description of Preliminary Alternatives

Monitored Natural Attenuation: This technology consists of tracking the levels of Freon 113, Freon 123a, and Freon 1113 by monitoring as natural attenuation occurs. Groundwater monitoring would be used to verify that the site contaminants do not spread from the site and that they decrease with time, as natural biodegradation processes consume the contaminant. A series of monitoring wells would be sampled once per year. Groundwater monitoring would be performed until the groundwater standards (5 μg/L) are achieved. This technology is protective of human health and the environment and is relatively low cost.

Injection of Organic Substrates: This is an in-situ technology that offers a passive, low cost approach to remediate groundwater contaminated with chlorinated hydrocarbons (including Freon 113). It consists of the introduction of soluble (lactate or molasses) or insoluble (soybean oil) substrates that degrade in the aquifer to produce hydrogen, which in turn promotes anaerobic biodegradation. During this process, chlorinated hydrocarbons and their derivatives will degrade in the presence of the right bacteria. At the former EMCA site, this technology would be effective in reducing the contaminants of concern to levels approaching groundwater standards and would be protective of human health and the environment. This technology is less expensive and generally more effective than "pump and treat" technologies. Three organic substrates are evaluated for this EE/CA, Hydrogen Release Compound (HRC™), emulsified soybean oil (EOS™), and high purity sodium lactate (WILCLEAR™).

- Hydrogen Release Compound (HRC™): HRC™ is a patented, polymerized polylactate ester that when hydrated slowly releases lactic acid and glycerol in a multi-step process. According to the manufacturer, (Regenesis Bioremediation Products, Inc.) HRC™ will reside within the soil matrix fueling reductive dechlorination for up to 18 months through the slow release of lactic acid.

- Emulsified Soybean Oil (EOS™): EOS™ is a proprietary mixture of emulsified food-grade oil, lactate, and yeast extract. The product is factory-prepared as a micro-emulsion that is completely miscible with water. After injection, the emulsified oil will adhere to soil particle surfaces as the product is distributed in the aquifer by injection of a chase solution (such as water or sodium lactate). The manufacturer (EOS Remediation, Inc.) claims that the oil will remain in the aquifer for several years where it will ferment to produce acetic acid and hydrogen. This technology was successfully demonstrated at the former EMCA site during the pilot study (discussed in Section 4.0).

- Sodium Lactate (WILCLEAR™): WILCLEAR™ High Purity Sodium Lactate Concentrate is a commercially-prepared, pharmaceutical grade product that is formulated to stimulate in-situ reductive dechlorination. The manufacturer (JRW Bioremediation, LLC) claims that single injections of the product have been shown to enhance biological activity for at least two months. This technology was successfully demonstrated at the former EMCA site as a compliment to the EOS™ injection during the pilot study.

Oxygen-Releasing Compound: Anaerobic degradation of higher order chlorinated hydrocarbons, such as tetrachloroethene (PCE), trichloroethene (TCE), and/or dichloroethene (DCE) may produce vinyl chloride, which tends to accumulate in anaerobic environments. However, vinyl chloride produced under these conditions can be degraded in an aerobic environment that can be created or maintained by using an oxygen-releasing compound, such as ORC™ manufactured by Regenesis Bioremediation Products, Inc., or PermeOx™ manufactured by FMC Corporation. Injection of an oxygen-releasing compound is an in-situ technology that offers a passive, low cost approach to clean up groundwater contaminated with aerobically biodegradable chemicals. It includes the introduction to the groundwater of a patented chemical compound that slowly releases oxygen in the aquifer for up to a year. This slow release of oxygen stimulates naturally occurring microbes to rapidly degrade aerobically degradable contaminants, including vinyl chloride. Because TCE is present in groundwater at the former EMCA site (from an upgradient source), this technology would be applied in conjunction with HRC™, EOS™, or WILCLEAR™.

Air Sparging: This is an in-situ remedial technology that reduces the concentrations of volatile chemicals (including Freon 113) that are dissolved in the groundwater. This technology involves the injection of ambient air into the subsurface, enabling dissolved volatile chemicals to transfer from the liquid phase to the vapor phase. The air is then vented through the unsaturated zone where it is captured by a vacuum extraction process. The extracted, contaminant-laden, air passes through an activated carbon adsorption unit, which captures the contaminants, before the treated air is released to the atmosphere. This technology would be effective in protecting human health and the environment and is less expensive than “pump and treat” technologies.

Ozone Sparging: Ozone is a highly reactive chemical that can destroy various organic chemicals, including chlorinated VOCs, through chemical oxidation. Carbon dioxide and water are produced as by-products of the reaction. With in-situ ozone sparging, ozone is injected to the groundwater through a microporous sparge point that generates very small bubbles. Contaminants in groundwater volatize into the ozone bubbles, where they are oxidized (destroyed). This technology can substantially decrease the mass contaminants in a relatively short time period and does not require vapor control since the contaminants are destroyed rather than transferred from one phase to another. This technology has a relatively moderate cost, is expected to be effective in remediating groundwater contaminated with Freon 113, Freon 123a, and Freon 1113 and would be protective of human health and environment.

Subsurface Permeable Reactive Walls: This technology consists of installing a permeable reactive wall across the flow path of contaminated groundwater. The wall allows groundwater to pass through and impedes the movement of contaminants by either degrading or retaining them. An iron treatment wall consists of iron minerals for the treatment of chlorinated contaminants. As the groundwater flows through the wall, iron is oxidized and supplies electrons for the reductive dechlorination of contaminants. The process slowly dissolves iron and, therefore, this treatment method is expected to remain effective for many years, possibly even decades. Subsurface permeable reactive walls would be effective in treating groundwater contamination at the former EMCA site but they would not be practical, since construction would significantly disrupt current business activities and the construction zone would extend onto public roadways. This process is proprietary and relatively expensive.

Zero Valent Iron (Ferox): Ferox is a patented remediation process that, similar to the permeable reactive walls described above, utilizes reactive iron to supply electrons for the reductive dechlorination of chlorinated groundwater contaminants. However, instead of placement in a wall, iron powder is injected in water-slurry using nitrogen gas as a carrier fluid. This process has an advantage over placement of iron in a wall in that the desired chemical reaction can be induced actively within the plume. Thus, the remediation time frame would likely be shorter for Ferox than for a permeable treatment wall. The disadvantage of the process is that the nitrogen-slurry is injected at relatively high pressures (around 100 pounds per square inch – gage [psig]); which is a concern given the close proximity of building foundations and utilities to the Freon 113 plume at the former EMCA Site. This method has a similar level of expected effectiveness as other in-situ technologies (such as the injection of organic substrates) and would be protective of human health and the environment.

Zero Valent Iron (Guar): An alternative way to apply reactive iron, to induce the same reaction as the permeable reactive wall and Ferox processes described above, is to inject the iron in a guar slurry using a Geoprobe®-mounted injection apparatus. In the groundwater, the guar completely dissolves/biodegrades, leaving the iron imbedded in the aquifer. The process has the same advantages as the Ferox process, but requires more injection points. However, there are fewer concerns regarding potential damage to nearby structures since the guar-slurry is injected under much lower pressures than used in the Ferox process. This method has a similar level of expected effectiveness as other in-situ technologies (such as the injection of organic substrates) and would be protective of human health and the environment.

Excavate and Remove Subsurface Soil Below the Water Table: Groundwater contamination could be reduced if contaminated soils (onto which the site contaminants of concern are adhering below the water table) are excavated and removed. To implement this technology, more sampling would be required to verify the relation between soil and groundwater contamination and the extent and maximum depth of contamination. The contaminated soils would then be excavated, removed off-site, and replaced with contaminant-free soils. Dewatering would be necessary to excavate below the water table. Implementation of this alternative at the former EMCA site would significantly impact road traffic, neighboring residents, and current business activities. Overall, this technology would be expensive and impractical at the site.

Groundwater Collection and Aboveground Treatment: This technology consists of collecting the contaminated groundwater via extraction wells and treating the collected water using air stripping. The contaminants of concern stripped from the water would be collected by activated carbon. This technology is also known as "pump and treat." Application of pump and treat would reduce Freon 113, Freon 123a, and Freon 1113 to levels approaching groundwater standards and human health and the environment would be protected. However, this is a long-term remedial technology and the capital and operations and maintenance costs are high. Also, pumping would tend to draw in contaminants from upgradient areas toward the former EMCA site.

6.2 Selection of Technologies for the Engineering Evaluation/Cost Analysis

Each remedial technology was pre-screened with respect to effectiveness, implementability, and cost. Results of the pre-screening are discussed below and summarized in Table 6-1.

Effectiveness: Since there is no immediate or long-term threat to human health or the environment from Freon 113 in groundwater, all technologies are effective in achieving protection. Effectiveness of each remedial technology was therefore evaluated by considering the relative time frame required to achieve the remedial action objective. The following technologies are believed to result in the shortest remediation time frame:

- Injection of organic substrates (HRC™, EOS™, and WILCLEAR™)
- Ozone sparging
- Zero Valent Iron (ZVI)
- Excavation

Implementability: Subsurface permeable reactive walls are not considered practical since construction would significantly disrupt current business activities and the construction zone would extend onto public roadways. Excavation and removal of the source area are not considered further due to dust, nuisance odors, truck traffic, and high cost. Air sparging and ozone sparging are potentially feasible remedial alternatives, however, these technologies use air blowers that are generally considered to be loud. Since there are residential properties adjacent to this site, noise levels would need to be closely monitored. Although engineering controls could be used to diminish noise, it is likely that this option would cause more public concern than the injection of organic substrates. In addition, above ground equipment would need to be employed at the site for relatively long periods of time. This poses a disadvantage given space concerns and the need for security.

Cost: The following remediation technologies have the highest relative cost for the former EMCA Site:

- Permeable reactive walls
- Excavate and remove contaminated subsurface soils
- Groundwater collection and above ground treatment

Collection and aboveground treatment ("pump and treat") is not considered further because of its high cost and the relatively long period needed to achieve remedial objectives. Monitored natural attenuation is considered further because it is one of the lowest cost and most easily implemented of the technologies examined. In-situ treatment technologies including the injection of organic substrates (with oxygen-releasing compound as a contingency), ZVI (Ferox) and ZVI (Guar) are considered further because they are effective, relatively easily implemented, and typically have a low to moderate cost compared to the other technologies.

Of the technologies considered for treating Freon 113, Freon 123a, and Freon 1113 in groundwater at the former EMCA site, four are considered to be the most promising for further consideration in the EE/CA in terms of effectiveness implementability, and cost. These technologies are: 1) natural attenuation, 2) injection of organic substrates (HRC™, EOS™, and WILCLEAR™), 3) ZVI (Ferox), and 4) ZVI(Guar).

Combining the technologies, five alternatives are carried through for further analysis: 1) Monitored Natural Attenuation, 2) HRC™, 3) EOS™ and WILCLEAR™, 4) Zero Valent Iron (Ferox), and 5) Zero Valent Iron (Guar). In the Draft-Final EE/CA, some of the alternatives included use of an oxygen-releasing compound as a contingency in the event that vinyl chloride would be produced. However, significant vinyl chloride was not produced during the pilot study injections of EOS™ and WILCLEAR™ (see Appendix E) even though anaerobic conditions were created that were capable of degrading PCE, TCE, and DCE. It appears that the concentrations of these compounds were not high enough to cause significant vinyl chloride production. In addition, vinyl chloride is not an expected by-product of the reductive dechlorination of Freon 113. Therefore, use of an oxygen-releasing compound is not carried through for analysis in this Final EE/CA.

7.0 IDENTIFICATION AND ANALYSIS OF REMEDIAL ACTION ALTERNATIVES

In this section, the chemistry and biodegradation processes of Freon 113 are described. Using this information, five remedial action alternatives are developed and evaluated with respect to effectiveness, implementability, and cost.

7.1 Chemistry of Freon 113

The chemical properties of Freon 113 are presented in Appendix D. Biological degradation of Freon 113 is possible under anaerobic conditions, as demonstrated by the pilot study results. Freon 113 is in many ways similar to chlorinated solvents (whose biodegradability has been extensively demonstrated) as well as other Freon compounds. The difference between freons and chlorinated solvents is the presence of fluorine in the molecular structure. Biological defluorination has not been reported. Abiotic defluorination is also unlikely to occur at ambient temperature/pressure/pH conditions found in aquifers. Thus, end products of Freon destruction would most likely include fluorinated species. However, column treatability studies of Freon 113 with ZVI have shown that Freon 1113 rapidly degraded to acetate, hydrogen fluoride, and hydrochloric acid (Vidumsky et al. no date).

Freon 113 is a halogenated alkane that contains a single carbon-carbon bond. The pilot study demonstrated that Freon 113 in groundwater would degrade by reductive dechlorination. The predicted reductive pathways are shown on Figure 7-1. Intermediate by-products that were identified include Freon 123a and Freon 1113.

7.2 Biodegradation Processes

Many organic contaminants can be degraded biologically. Degradation mechanisms include oxidation (either aerobic or anaerobic), where the compound is used as an energy source (electron donor) by the bacteria, or reduction (strictly anaerobic), where the compound is used as an electron acceptor. Bacteria derive the most energy using oxygen as the terminal electron acceptor, but as that is used up, other electron acceptors are used, including nitrate, ferric iron, and sulfate. Lower redox potentials (i.e., greater availability of reducing power) are needed for electron acceptors other than oxygen. Figure 7-2 shows the typical redox potential ranges for use of various electron acceptors.

Halogenated organics are relatively oxidized. Halogens, being only one electron short of having a completely filled electron orbital structure, strongly harbor electrons. Thus, halogenated organics typically cannot be oxidized unless the number of halogens drops to one or two. However, halogenated organics can act as an electron acceptor in a biologically mediated redox reaction. In essence, the halogenated organics act as the "oxygen" (or nitrate, sulfate, etc.) in the biological respiration of other substrates. Relatively low redox conditions are required to transfer the electrons to the halogenated contaminant from the organic energy source used by the bacteria. Typically, the required redox levels need to be at least as low as those required for iron (III) or sulfate reduction. Use as an electron acceptor is the biological mechanism through which halogenated compounds such as Freon 113 are degraded at the former EMCA site. By accepting an electron, one of the chlorines is released as chloride, leaving a hydrogen in its place. This mechanism is known as reductive dechlorination. This reaction can only occur when sufficient amounts of electron donors (typically nonhalogenated organic compounds) are also present in the groundwater.

The presence of biological activity in groundwater can be evaluated through examining the levels of reduced compounds, including sulfide, ferrous iron, and partially reduced halogenated organics. Alternatively, localized decreases of electron acceptors (e.g., sulfate, nitrate) in the plume compared to areas outside the plume indicate elevated biological activity within the plume compared to outside the plume.

At the former EMCA site, there was strong evidence that reductive dechlorination of Freon 113 was not occurring prior to the injection of EOS™ and WILCLEAR™. Three distinct zones, discussed below, characterized the site prior to the pilot test.

1. An upgradient zone monitored by MW-01, which was contaminated by chlorinated organics (with no Freon 113), presumably from an offsite source. MW-01 showed a fairly high proportion of reduced products including partially dechlorinated organics, some (very low) sulfide, some ferrous iron (though still low), and lower sulfate levels compared to other wells. Thus, even though the total organic carbon levels were at best moderate (signifying low to moderate amounts of electron donors) and dissolved oxygen and redox potential levels were not that low (although these are difficult to measure accurately, even with a flow-through cell), bacterially moderated reductive dechlorination was occurring here. The presence of elevated methane suggests that redox conditions in the aquifer were relatively low. However, this well was upgradient of the Freon 113 plume and contained contaminants only from offsite sources.

2. The Freon 113 plume was characterized by wells MW-02 and MW-03, which showed mixed results for attenuation parameters. Previous data from MW-02 showed elevated ferrous iron, providing strong indication that iron reduction processes were occurring. Sulfate, which requires slightly lower redox conditions before it is used as an electron acceptor, was elevated compared to other wells, indicating that redox conditions were not below the iron reduction range. Dissolved oxygen and redox potential levels were low in MW-02, second only to cross gradient well MW-04. However, very few partially dechlorinated intermediate products were detected. MW-03 had the highest level of Freon 113 and was not characterized by the elevated ferrous iron levels observed in MW-02.

3. The downgradient tail of the plume, characterized by MW-05, was unremarkable with regard to attenuation parameters, although some ferrous iron and sulfide were detected.

Overall, the rate of natural biodegradation of Freon 113 at the site was slow prior to the injection of EOS™ and WILCLEAR™. Freon 113 was persistent in the plume, although it did not migrate far due to low hydraulic gradients.

Evidence of reductive dechlorination of Freon 113 was observed after the injection of EOS™ and WILCLEAR™, as discussed in Section 4.0. The concentration of Freon 113 in plume well MW-03 rebounded between the 6-month and 13-month sampling episode, presumably caused by desorption from the EOS™. However, the concentration of Freon 113 at the 13-month monitoring episode was below the background concentration measured prior to the pilot study injections.

7.3 Description of Alternatives

7.3.1 Alternative 1 – Monitored Natural Attenuation

Natural attenuation processes relate to the capacity of indigenous microorganisms to degrade organic contaminants under aerobic or anaerobic conditions. At the former EMCA site natural attenuation can effectively degrade organic chemicals that are dissolved in the groundwater, if the site geochemistry (e.g., temperature, pH, and nutrient levels) supports microbial activity under anaerobic conditions and sufficient electron donors are present. Groundwater flushing, dilution, and dispersion also reduce concentrations. Under this alternative, concentrations of Freon 113 and its degradation products would be monitored in several monitoring wells until the removal action objective is attained.

This alternative includes the following components:

- Monitoring – Groundwater would be monitored using six existing monitoring wells in the contaminated area. Samples would be analyzed for Freon 113, Freon 123a, Freon 1113, and select natural attenuation parameters once per year.
- Site Reviews – The NYSDEC and Rohm and Haas would review and assess data generated by the monitoring program at regular intervals (e.g., annually), to evaluate the effectiveness of natural attenuation in achieving the removal action objective.

7.3.2 Alternative 2 – Hydrogen Release Compound (HRC™)

HRC™ is an in-situ technology that offers a passive approach to remediate groundwater contaminated with chlorinated solvents. It includes the introduction to the ground of a polylactate ester in gel form. When this ester is hydrated, it slowly releases lactic acid that is metabolized by naturally occurring microorganisms, resulting in anaerobic aquifer conditions and the production of hydrogen. These microorganisms then use the hydrogen in a multi-step process to progressively remove chlorine atoms from chlorinated contaminants.

Components of this system include the following:

- Groundwater Treatment – HRC™ would be injected into the Freon 113 plume at approximately 20 to 30 locations. Treated groundwater would continue to flow in its natural direction. It is possible that more than one treatment of HRC™ would be necessary to achieve remedial action goals.
- Monitoring – Groundwater would be monitored annually for Freon 113, Freon 123a, Freon 1113, and select natural attenuation parameters to evaluate the effectiveness of the remedial action.
- Site Reviews – The NYSDEC and Rohm and Haas would review data generated by the monitoring program at regular intervals (e.g., annually).

7.3.3 Alternative 3 – Emulsified Soybean Oil (EOS™) and Sodium Lactate (WILCLEAR™) Injection

Injection of EOS™ and WILCLEAR™ is an alternative that offers a passive, low cost approach to remediating the Freon contaminated groundwater under anaerobic conditions. This technology includes the injection of EOS™ to groundwater followed by a supplemental injection of WILCLEAR™. Injected EOS™ would adsorb on the aquifer matrix where it would dissolve slowly into the groundwater and serve as an electron donor for an extended period of time. The WILCLEAR™ would be used to distribute the EOS™ within the aquifer and serve as an additional electron donor to quickly promote or maintain highly reducing conditions that are required for anaerobic dechlorination of the Freon compounds.

Components of this system include the following:

- Groundwater Treatment – EOS™ would be injected into the Freon 113 plume at approximately 10 to 20 locations. WILCLEAR™ would be injected at approximately 20 to 30 locations. Treated groundwater would continue to flow in its natural direction.
- Monitoring – Groundwater would be monitored annually for Freon 113, Freon 123a, Freon 1113, and select natural attenuation parameters to evaluate the effectiveness of the remedial action.
- Site Reviews – The NYSDEC and Rohm and Haas would review data generated by the monitoring program at regular intervals (e.g., annually).

7.3.4 Alternative 4 – Zero Valent Iron (Ferox)

The Ferox process is a proprietary in-situ technology that offers a passive means of remediating chlorinated hydrocarbons in groundwater. ZVI powder is injected into the contaminant plume as a water-slurry using nitrogen as a carrier fluid (at a pressure of approximately 100-psig). In sandy formations, the injection process tends to fluidize the aquifer within approximately 15 feet of the injection point, which effectively distributes the iron powder (Liskowitz 2002). Once distributed within the formation, the iron corrodes. Hydrogen gas (H_2), which is produced from the corrosion, combines with the chlorinated hydrocarbon contaminant and the contaminant is dechlorinated. The products of the reaction are ferrous iron, chloride ions, and the dechlorinated hydrocarbon. The technology has been shown to successfully treat Freon-113 in bench-scale testing (ARS Technologies 2002). Generally, a bench scale test of the process is performed using groundwater collected from the plume prior to full-scale application in the field. In addition, a structural analysis is conducted when nearby structures and/or utilities are present to evaluate potential adverse impacts of the injection process on these features.

Components of this system include the following:

- Groundwater Treatment – ZVI would be injected into the Freon 113 plume in groundwater using the Ferox process. Injection would occur at about 30 locations. Treated groundwater would continue to flow in its natural direction.
- Monitoring – Groundwater would be monitored annually for Freon 113, Freon 123a, Freon 1113, and select natural attenuation parameters to evaluate the effectiveness of the remedial action.
- Site Reviews – The NYSDEC and Rohm and Haas would review the data generated by the monitoring program at regular intervals (e.g., annually).

7.3.5 Alternative 5 – Zero Valent Iron (Guar)

ZVI can be introduced into the contaminated plume in a guar-slurry via a Geoprobe® mounted injection apparatus in a manner similar to structural grout injection. In sand, the effective radius of injection is about 7.5 feet. The guar-slurry dissolves and biologically degrades, leaving the iron distributed in the formation. Once injected, the iron corrodes producing hydrogen (H_2) gas. The hydrogen combines with the chlorinated hydrocarbons and the contaminants are dechlorinated. Generally, it is recommended that the injections be performed on a pilot-scale prior to full-scale implementation.

Components of this system include the following:

- Groundwater Treatment – ZVI would be injected into the Freon 113 plume in groundwater in a guar-slurry. Injection would occur at about 60 locations. Treated groundwater would continue to flow in its natural direction.
- Monitoring – Groundwater would be monitored annually for Freon 113, Freon 123a, Freon 1113, and select natural attenuation parameters to evaluate the effectiveness of the remedial action.
- Site Reviews – The NYSDEC and Rohm and Haas would review the data generated by the monitoring program at regular intervals (e.g., annually).

7.4 Restoration Time Frame Estimates

In order to compare the effectiveness of the alternatives in achieving the remedial action objective and to develop present worth costs, restoration time frames were evaluated using available literature and analytical calculations. As of July 2004, anaerobic conditions were present at the site and capable of sustaining reductive dechlorination of the contaminants of concern. Additional EOS™ and WILCLEAR™ were injected into groundwater in November 2004 and it is expected that anaerobic conditions will persist for approximately 3 years.

Given the current anaerobic conditions, an estimate of the restoration time frame was calculated assuming no further actions were taken. Approximate Freon 113 degradation rate constants measured from the plume area wells (MW-02, MW-03, MW-06, and MW-07) varied from approximately -4×10^{-4} day^{-1} to -1.1×10^{-2} day^{-1} during the pilot study. This data indicates that the approximate time required to reach the cleanup concentration of 5 µg/L is 4 years, and may vary from 0.4 year to 45 years.

In-situ reductive dechlorination of Freon 113 and its daughter products is a biologically mediated reaction and the addition of additional substrates (EOS™, WILCLEAR™, or HRC™) will not increase the reaction rate and decrease the time to achieve cleanup. Rather, additional substrates will serve as an electron donor in the event that the groundwater environment shifts to a less reducing condition.

It is expected that the remediation time frame for Alternative 4 (ZVI - Ferox) and Alternative 5 (ZVI - Guar) will be approximately 1 year, which would be followed by 2 years of post remediation monitoring.

7.5 Cost

The estimated costs for the five alternatives used for detailed analysis are summarized in Tables 7-1 through 7-5. The total cost for each alternative represents the capital cost plus the present worth (assuming a 7 percent rate) of the annual Operation and Monitoring (O&M) cost.

The present worth O&M cost for each alternative is based on an O&M period that is on the order of the restoration time period outlined in Section 7.4. The sources for the cost data include cost reference books, price quotations from vendors, and URS estimates. To the extent possible, URS estimates are based on contractor bids on other projects or costs derived from similar work performed by URS. The total present worth cost for each alternative is expected to provide an accuracy of +50 percent to –30 percent, in compliance with feasibility study guidance (USEPA 2000).

7.6 Analysis of Alternatives

In this section, the five alternatives are evaluated based on effectiveness, implementability, and cost.

7.6.1 Alternative 1

A. Effectiveness: This alternative is protective of public health and the environment. Based on data collected to date, Freon 113 contamination would not migrate off site, however, the plume of Freon 113 contamination would remain above groundwater standards for approximately 4 years. The monitoring program would act as a warning system to indicate whether contamination migrates downgradient. Other remedial measures (deed restrictions at minimum) would need to be implemented. Groundwater would be monitored once per year. Monitoring would cease when data conclusively shows that removal action objectives have been met and regulatory agencies accept site closure.

B. Implementability: Implementation of this alternative would require approximately six years of monitoring. Required services with contractors and laboratories can readily be obtained. There would be little or no disruption of the local community and no short-term health and safety impacts through the implementation of this alternative.

C. Cost: Costs for Alternative 1 are summarized in Table 7-1. The present worth cost of this alternative is $47,170.

7.6.2 Alternative 2

A. Effectiveness: This alternative is protective of human health and the environment. The injection of HRC™ into the plume is not expected to decrease the remediation time frame. Rather, the substrate would serve as an electron donor source in the event that the treatment area becomes less reducing. Monitoring would act as a warning system to indicate if contamination is not reduced or is migrating.

B. Implementability: Use of a Geoprobe® (direct push) is a common readily available injection method for HRC™. Additional applications of HRC™ might be required in the core area of contamination. Because only short-term construction techniques would be used over a small area, little disruption of the local community is anticipated, although coordination with onsite businesses (Cablevision) would be necessary. There would be no short-term risk posed to public safety.

C. Cost: Cost for Alternative 2 is summarized in Table 7-2. The existing groundwater wells are assumed to remain in place for the monitoring program that will last for six years. Annual samples would be collected. Approximately 25 points are assumed for injection of the HRC™ (the actual number of points would be determined during design). The present worth cost is $117,119.

7.6.3 Alternative 3

A. Effectiveness: This alternative is protective of human health and the environment. The injection of additional EOS™ and WILCLEAR™ into the plume is not expected to decrease the remediation time frame. Rather, the substrates would serve as an electron donor source in the event that the treatment area becomes less reducing.

B. Implementability: Use of the Geoprobe® (direct push) is a common readily available injection method. Additional applications of EOS™ and WILCLEAR™ might be required in the core area of contamination. Because only short-term construction techniques would be used over a small area, little disruption of the local community is expected, although coordination with onsite businesses (Cablevision) would be necessary. There would be no short-term risk posed to public safety.

C. Cost: Cost for Alternative 3 is summarized in Table 7-3. The existing groundwater wells are assumed to remain in place for the monitoring program that will last for approximately six years. Annual samples would be collected. Approximately 10 EOS™ injection points and 25 WILCLEAR™ injection points are assumed (the actual number of points would be determined during design). The present worth cost is $94,848.

7.6.4 Alternative 4

A. Effectiveness: This alternative is protective of human health and the environment. Ferox treatment of groundwater is expected to reduce Freon 113 concentrations in groundwater in a relatively short time period, thereby decreasing the potential for human exposure. It is estimated that a substantial portion of the Freon 113 in groundwater would be remediated within one year. It is not anticipated that a second injection would be necessary – the remaining iron would continue to react with time. Monitoring would act as a warning system to indicate if contamination is not reduced or is migrating.

B. Implementability: The nitrogen-iron-water slurry injection system that would be employed at the site would likely be more effective in dispersing reactive material into the formation than the Geoprobe® injection methods used for the organic substrates. Since only a small number of Ferox injection apparatus exist, a delay may occur pending injection apparatus availability. There would be no short-term risk to public safety. Because only short-term construction techniques would be used over a small area, little disruption of the local community would be expected through implementation of this alternative. However, the Ferox process requires more onsite equipment during injection and proceeds at a slower pace than Geoprobe® injection techniques. Therefore, comparatively more disruption would occur to the community for Ferox than for injection of organic substrates. A structural analysis would need to be conducted to evaluate the potential impact of the Ferox injection process to the nearby Cablevision building and utilities. Foundational movement of the Cablevision building would need to be monitored real-time during the injection period.

C. Cost: Cost for Alternative 4 is summarized in Table 7-4. The existing groundwater wells are assumed to remain in place for the monitoring program that would last for approximately four years. Annual samples would be collected. Approximately 30 points are assumed for injection of the zero valent iron; only one injection event is assumed. Costs are included for bench-scale testing and a structural evaluation. Present worth costs are based on a 3-year monitoring period. The present worth cost is $570,656.

7.6.5 Alternative 5

A. Effectiveness: This alternative is protective of human health and the environment. Injected iron in groundwater is expected to reduce Freon 113 concentrations in groundwater in a relatively short time period, thereby decreasing the potential for human exposure. It is estimated that a substantial portion of the Freon 113 in groundwater would be remediated within one year. It is not anticipated that a second injection would be necessary – the remaining iron would continue to react with time. Monitoring would act as a warning system to indicate if contamination is not reduced or is migrating.

B. Implementability: The Geoprobe® mounted injection system has been successfully used to inject ZVI to form reactive walls and for hot-spot injections in the past. Because only a small number of specialized injection apparatus exist, a delay may occur pending injection apparatus availability. There would be no short-term risk to public safety. Because only short-term construction techniques would be used over a small area, little disruption of the local community would be expected through implementation of this alternative. However, the process requires more onsite equipment during injection. Therefore, comparatively more disruption would occur to the community for Zero Valent Iron / Guar injection than for injection of organic substrates.

C. Cost: Cost for Alternative 5 is summarized in Table 7-5. The existing groundwater wells are assumed to remain in place for the monitoring program that would last for approximately four years. Annual samples would be collected. Approximately 60 points are assumed for injection of the ZVI; only one injection event is assumed. Present worth costs are based on a 3-year monitoring period. The present worth cost is $282,978.

8.0 RECOMMENDATIONS

All alternatives are protective of human health and the environment and would achieve removal action objectives. The significant difference between Alternative 1 and the four in-situ treatment alternatives is cost. A comparison of estimated cost and estimated restoration time frame is given below:

Alternative	Restoration Time Frame	Present Worth Cost
Alternative 1 (Monitored Natural Attenuation)	4 Years	\$47,170
Alternative 2 (HRC™)	4 Years	\$117,119
Alternative 3 (EOS™ with WILCLEAR™)	4 Years	\$94,848
Alternative 4 (Zero Valent Iron – Ferox)	1 Year	\$570,656
Alternative 5 (Zero Valent Iron – Guar)	1 Year	\$282,978

Based on the foregoing evaluation, remediation Alternative 3 – Emulsified Soybean Oil (EOS™) and sodium Lactate (WILCLEAR™) is recommended for the former EMCA site. This alternative builds upon the favorable site conditions that were developed during the pilot study and augmented by the recent IRM. The alternative will include continued groundwater monitoring to document the concentrations of Freon 113, Freon 123a, Freon 1113 and select attenuation parameters. Additional EOS™ and/or WILCLEAR™ will be injected in the event that natural attenuation processes are not decreasing site groundwater contamination at a satisfactory rate. Rohm and Haas will determine the need for and scope of any additional injections in conjunction with the NYSDEC.

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TABLES

TABLE 2-1
FORMER EMCA SITE
GROUNDWATER ANALYTICAL PARAMETERS

Analytical Parameter	Sampling Event						Method	
	July 2001	May-June 2003	July 2003	Sept. 2003	Dec. 2003	July 2004	Number	Reference
Target Compound List VOCs + TICs [(1)]	X	X	X	X	X		OLM04.2	1
Freon 113	X	X	X	X	X	X	OLM04.2	1
Freon 123a		X	X	X	X	X	OLM04.2	1
Freon 1113						X	OLM04.2	1
Nitrate/Nitrite	X	X	X	X	X		353.2	1
Total Kjeldahl Nitrogen (TKN)	X	X	X	X	X		351.1	1
Total Organic Carbon (TOC)	X						415.1	1
Nitrogen as Ammonia (NH_3)	X	X	X	X	X		350.2	1
Chloride	X	X	X	X	X	X	325.2	1
Fluoride		X	X	X	X	X	300.0	1
Alkalinity	X						310.2	1
Sulfate	X	X	X	X	X	X	375.4	1
Sulfide	X						376.2	1
Total Phosphorous	X						365.4	1
Total Iron	X	X	X	X	X		6010B	1
Dissolved Iron	X	X	X	X	X		6010B	1
Ferric Iron (III) (Fe^{+3})	X	X	X	X	X		SM3500	2
Ferrous Iron (II) (Fe^{+2})	X	X	X	X	X		SM3500	2
Total Manganese	X						6010B	1
Dissolved Manganese	X						6010B	1
Methane, ethane, ethene	X	X	X	X	X	X	RSK-175	3
Heterotrophic Plate Count	X						SM9215	2
Dissolved Oxygen	X	X	X	X	X	X	360.1	2
ORP	X	X	X	X	X	X	2580B	2

Method References:

1 - NYSDEC Analytical Services Protocol, June 2000.
2 - Standard Methods for the Examination of Water and Wastewater, 20th Edition.
3 - USEPA, R.S. Kerr Environmental Research Laboratory, March 15, 1989.

Notes:

1 - TICs = Tentatively Identified Compounds

TABLE 3-1
FORMER EMCA SITE
ANALYTICAL DATA SUMMARY

GROUNDWATER	Contaminants of Concern	Concentration Range Detected (ppb)[a]	Maximum Concentration Dec. 2003 - July 2004 (ppb)	SCG[b] (ppb)	Frequency of Exceeding SCG
Volatile Organic Compounds	Acetone	ND - 2,000	ND	50	13 of 53
	Benzene	ND - 74	14	1	14 of 64
	Methyl ethyl ketone (2-Butanone)	ND - 130	38.5	50	3 of 26
	Chloroethane	ND - 55	ND	5	4 of 30
	Chloroform	ND - 10	ND	7	1 of 19
	1,1-Dichloroethene	ND - 68	ND	5	5 of 41
	1,2-Dichloroethene (total)	ND - 1,600	1.3	5	6 of 64
	Ethylbenzene	ND - 49	49	5	2 of 58
	Tetrachloroethene	ND - 380	4.75	5	4 of 64
	1,1,1-Trichloroethane	ND - 15	ND	5	2 of 30
	Trichloroethene	ND - 258	ND	5	9 of 36
	1,1,2-Trichloro-1,2,2-trifluoroethane	ND - 18,208	4,900	5	53 of 71
	1,2-Dichloro-1,2,2-trifluoroethane	ND - 3,900	3,900	5	26 of 35
	Chlorotrifluoroethene	ND - 210	210	5	5 of 7
	Vinyl Chloride	ND - 49	ND	2	7 of 64
	Xylene (total)	ND - 11	ND	5	2 of 41
	Methyl tert-butyl ether	ND - 51	NA	10	1 of 6
Inorganic Elements	Iron	ND - 187,000	160,000	300	58 of 62
	Manganese	77.6 - 6,120	NA	300	4 of 6
	Chloride	60.5 - 839,000	1,610	250,000	14 of 41

Notes:
a ppb = parts per billion
b SCG = standards, criteria, and guidance values
ND = None Detected
NA = Not Analyzed

References:

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TABLE 6 – 1
FORMER EMCA SITE
SUMMARY OF PRE-SCREENING OF REMEDIAL TECHNOLOGIES

Technology	Effectiveness	Implementability	Cost
Monitored Natural Attenuation	Short Time Frame to Achieve Goals	Easily Implemented - No Impact to Community	Low
HRC™ Injection	Short Time Frame to Achieve Goals	Easily Implemented - No Impact to Community	Low to Moderate
EOS™ and WILCLEAR™ Injection	Short Time Frame to Achieve Goals	Easily Implemented – No Impact to Community	Low to Moderate
Application of an Oxygen-Releasing Compound	Short Time Frame to Achieve Goals	Easily Implemented - No Impact to Community	Moderate
Air Sparging	Intermediate Time Frame to Achieve Goals	Moderate Level of Complexity - Potential Inconvenience to Community	Moderate
Ozone Sparging	Short Time Frame to Achieve Goals	Moderate Level of Complexity – Potential Inconvenience to Community	Moderate
Permeable Reactive Walls	Long Time Frame to Achieve Goals	Relatively High Level of Complexity - Potential Short Term Disruption to Community	High
Zero Valent Iron (Ferox)	Short Time Frame to Achieve Goals	Moderate Level of Complexity – Potential Impact of Nearby Structures	Moderate to High
Zero Valent Iron (Guar)	Short Time Frame to Achieve Goals	Easily Implemented – No Impact to Community	Moderate
Excavate and Remove Contaminated Subsurface Soils	Short Time Frame to Achieve Goals	Moderately Difficult to Implement Due to Dewatering and Traffic Considerations - Potential Short Term Disruption to Community	High
Groundwater Collection and Aboveground Treatment	Long Time Frame to Achieve Goals	Moderate Level of Complexity - Potential Inconvenience to Community due to Noise	High

TABLE 7-1

FORMER EMCA SITE

ALTERNATIVE 1 - MONITORED NATURAL ATTENUATION

Description	Unit	Quantity	Unit Cost	Cost
O&M COST - Annual Monitoring				
Sampling [(1)] [(2)]	EA	1	$4,225	$4,225
Analytical [(3)]	EA	11	$145	$1,595
Report	Estimate			$3,175
Contingency (10%)				$900
TOTAL ANNUAL O&M				**$9,895**
PRESENT WORTH O&M [(4)]				**$47,170**
TOTAL COST				**$47,170**

NOTES:

(1) 6 wells will be sampled annually
(2) Based on recent URS project information
(3) Includes QC samples
(4) Based on a 7% interest rate and 6 year duration.

TABLE 7-2

FORMER EMCA SITE

ALTERNATIVE 2 - HRC^{TM}

Description	Unit	Quantity	Unit Cost	Cost
CAPITAL COST				
HRC^{TM} Placement				
HRC^{TM} Material Cost [1]	Lb	4,000	$8.00	$32,000
Substrate Injection [2]	Day	5	$2,500	$12,500
Expenses [2]	LS	1	$2,500	$2,500
Construction Management [2]	Day	5	$885	$4,425
Engineering	Estimate			$9,400
Contingency	15%			$9,124
Subtotal				**$69,949**
O&M COST - Annual Monitoring				
Sampling [2] [3]	EA	1	$4,225	$4,225
Analytical [4]	EA	11	$145	$1,595
Report	Estimate			$3,175
Contingency	10%			$900
TOTAL ANNUAL O&M				**$9,895**
PRESENT WORTH O&M [5]				**$47,170**
TOTAL COST				**$117,119**

NOTES:

(1) Regenesis Time Release Compound Design Software (US Ver. 3.1)
(2) Based on recent URS project information
(3) 6 wells will be sampled annually
(4) Includes QC samples
(5) Based on 7% interest rate and 6 year duration

TABLE 7-3

FORMER EMCA SITE

ALTERNATIVE 3 - EOS™ and WILCLEAR™

Description	Unit	Quantity	Unit Cost	Cost
CAPITAL COST				
EOS™/WILCLEAR™ Placement				
EOS™ Material Cost (1)	Lb	1,725	$2.99	$5,158
WILCLEAR™ Material Cost (1)	Lb	3,273	$1.25	$4,091
Substrate Injection (1)	Day	6	$2,500	$15,000
Expenses (1)	LS	1	$2,500	$2,500
Construction Management (1)	Day	6	$885	$5,310
Engineering	Estimate			$9,400
Contingency	15%			$6,219
Subtotal				**$47,678**
O&M COST - Annual Monitoring				
Sampling (1) (2)	EA	1	$4,225	$4,225
Analytical (3)	EA	11	$145	$1,595
Report	Estimate			$3,175
Contingency	10%			$900
TOTAL ANNUAL O&M				**$9,895**
PRESENT WORTH O&M (5)				**$47,170**
TOTAL COST				**$94,848**

NOTES:

(1) Based on recent URS project information
(2) 6 wells will be sampled annually
(3) Includes QC samples
(5) Based on 7% interest rate and 6 year duration

TABLE 7-4

FORMER EMCA SITE

ALTERNATIVE 4 - ZERO VALENT IRON (FEROX)

Description	Unit	Quantity	Unit Cost	Cost
CAPITAL COST				
Zero Valent Iron (ZVI) Placement				
Bench Scale Testing (1) (2)	LS	1	$16,550	$16,550
Pilot Test (2)	LS	1	$125,000	$125,000
Structural Analysis	LS	1	$16,550	$16,550
Injection Point Drilling (2)	Ea	60	$165	$9,900
ZVI Material Cost (1)	Lbs	90,000	$2.2	$198,000
Construction Management (2)	Day	20	$885	$17,700
Ferox Injection (1) (2)	Day	20	$3,000	$60,000
Mobilization	Estimate			$11,025
Engineering	Estimate			$12,350
Contingency	15%			$70,061
Subtotal				**$537,136**
O&M COST - Annual Monitoring				
Sampling (2) (3)	EA	1	$4,225	$4,225
Analytical (4)	EA	11	$145	$1,595
Report	Estimate			$3,175
Contingency	10%			$900
TOTAL ANNUAL O&M				**$9,895**
PRESENT WORTH O&M (5)				**$33,520**
TOTAL COST				**$570,656**

NOTES:

(1) Based on Vendor (ARS Technologies)
(2) Based on recent URS project information
(3) 6 wells will be sampled annually
(4) Includes QC samples
(5) Based on 7% interest rate and 4 year duration

TABLE 7-5

FORMER EMCA SITE

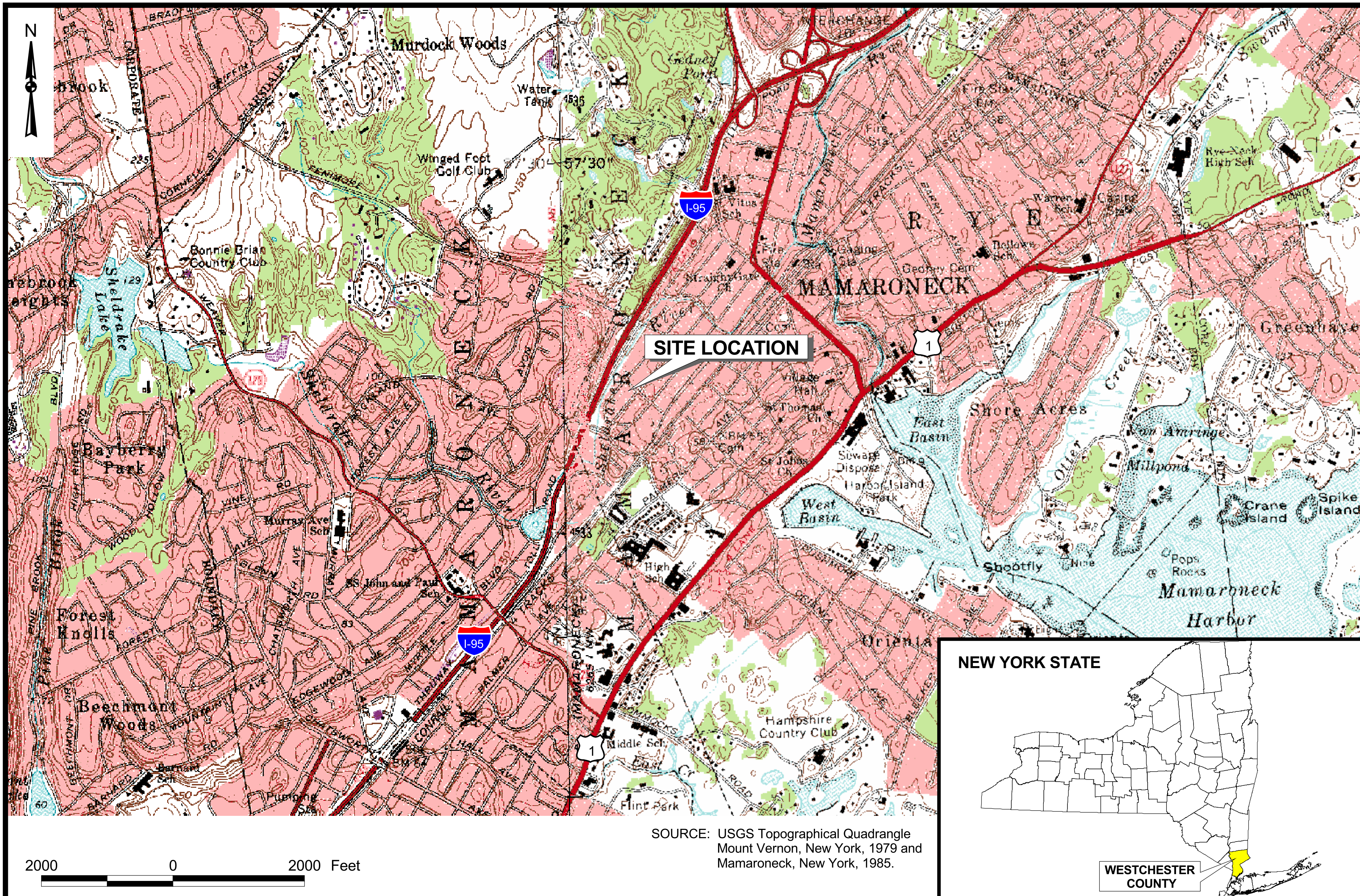
ALTERNATIVE 5 - ZERO VALENT IRON (GUAR)

Description	Unit	Quantity	Unit Cost	Cost
CAPITAL COST				
Zero Valent Iron (ZVI) Placement				
Pilot Test (1)	LS	1	$87,000	$87,000
ZVI-Guar Injection (1)	Day	7	$7,225	$50,575
ZVI Material Cost (1)	Lbs	180,000	$0.24	$43,200
Construction Management (1)	Day	7	$885	$6,195
Mobilization	Estimate			$14,300
Engineering	Estimate			$15,650
Contingency	15%			$32,538
Subtotal				**$249,458**
O&M COST - Annual Monitoring				
Sampling (1) (2)	EA	1	$4,225	$4,225
Analytical (3)	EA	11	$145	$1,595
Report	Estimate			$3,175
Contingency	10%			$900
TOTAL ANNUAL O&M				**$9,895**
PRESENT WORTH O&M (4)				**$33,520**
TOTAL COST				**$282,978**

NOTES:

(1) Based on recent URS project information
(2) 6 wells will be sampled annually
(3) Includes QC samples
(4) Based on 7% interest rate and 4 year duration

FIGURES



SOURCE: USGS Topographical Quadrangle
Mount Vernon, New York, 1979 and
Mamaroneck, New York, 1985.

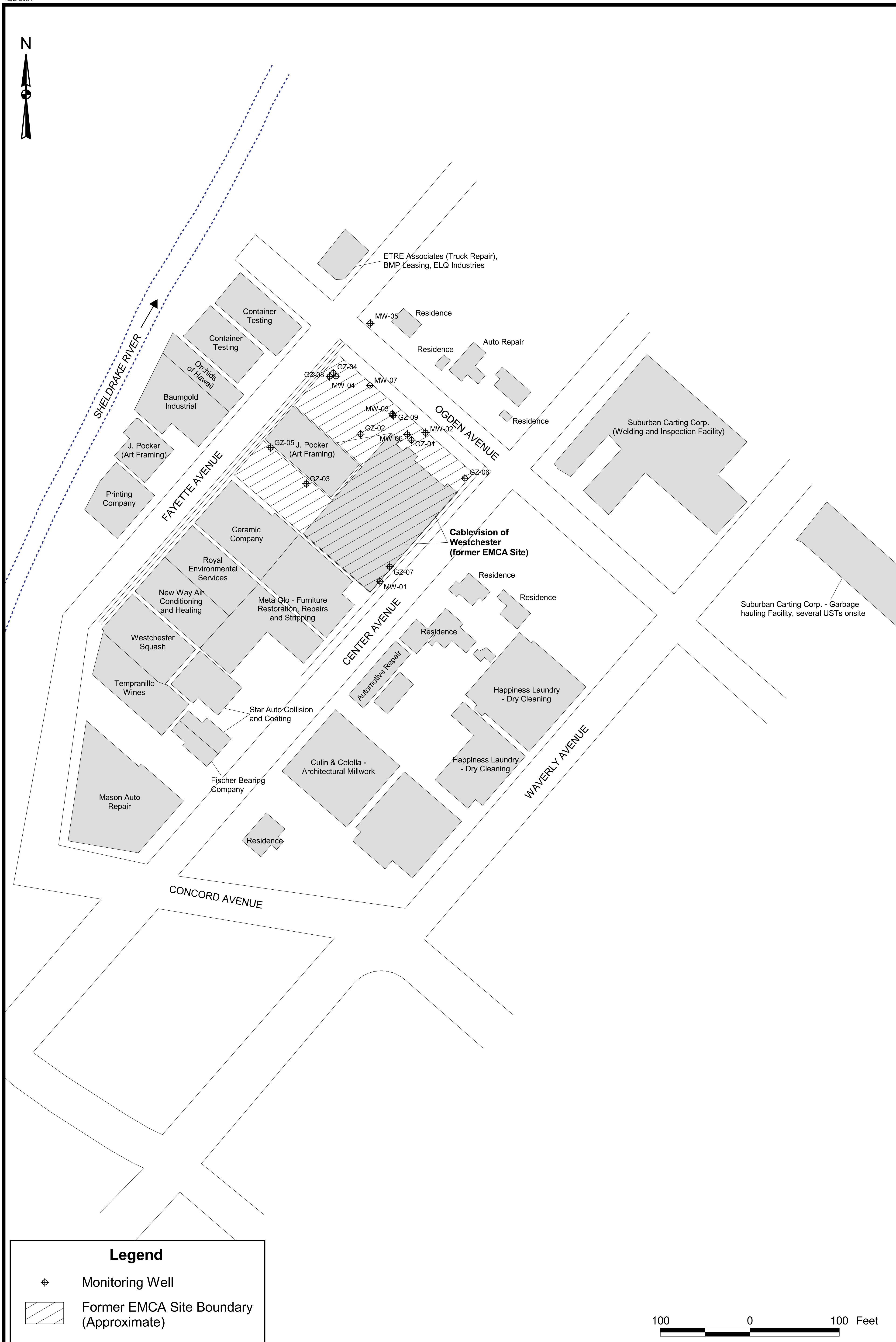
2000 0 2000 Feet

URS

FORMER EMCA SITE
LOCATION MAP

FIGURE 1

N:\11172730.00000\DB\GIS\2001\report00.apr SITE PLAN WITH WELLS
12/2/2004

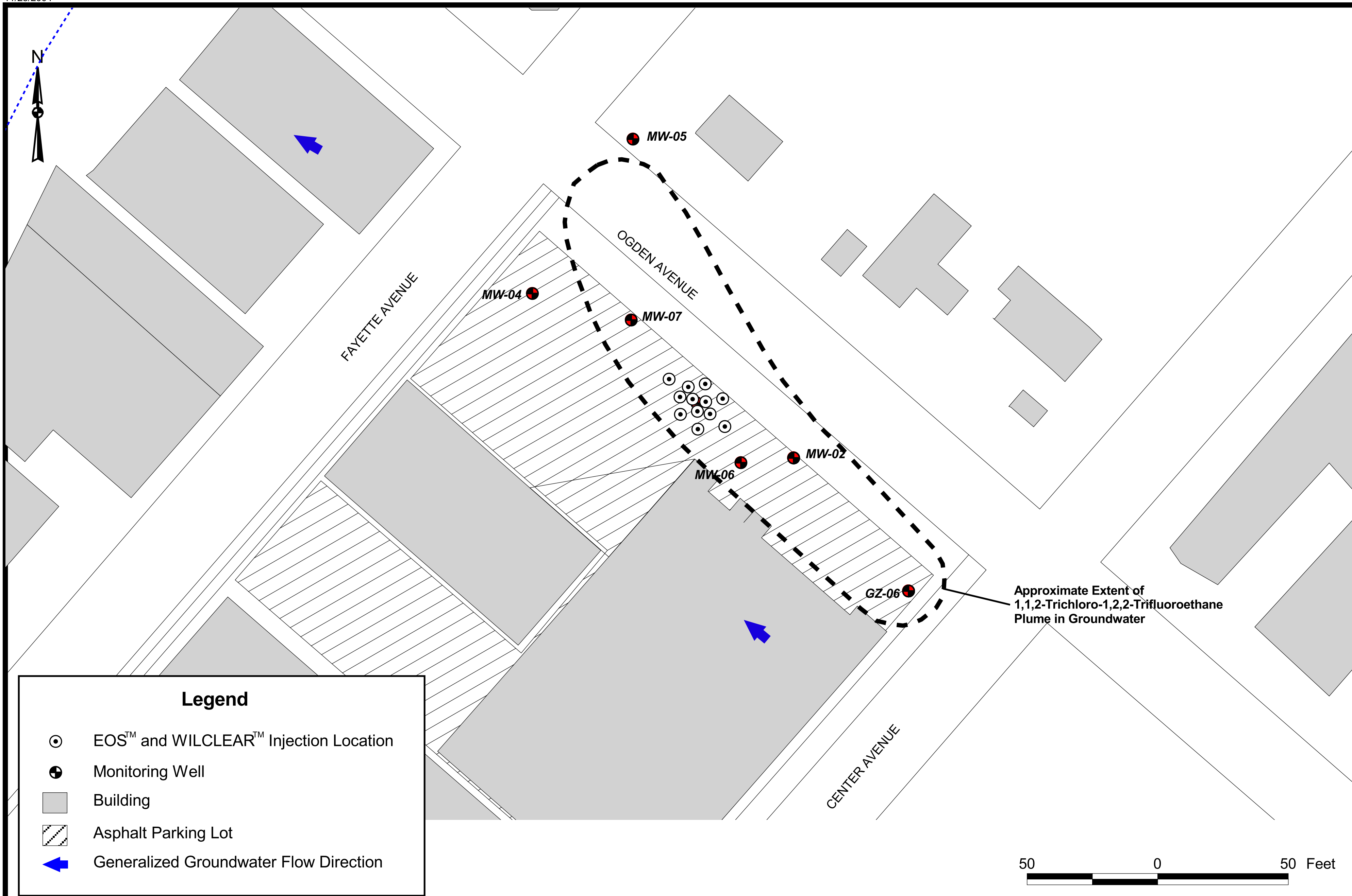


URS

FORMER EMCA SITE
PLAN WITH WELLS

FIGURE 1-2

N:\11172730.00000\DB\GIS\2001\chemical.apr PILOT STUDY INJECTION LOCATIONS
11/23/2004

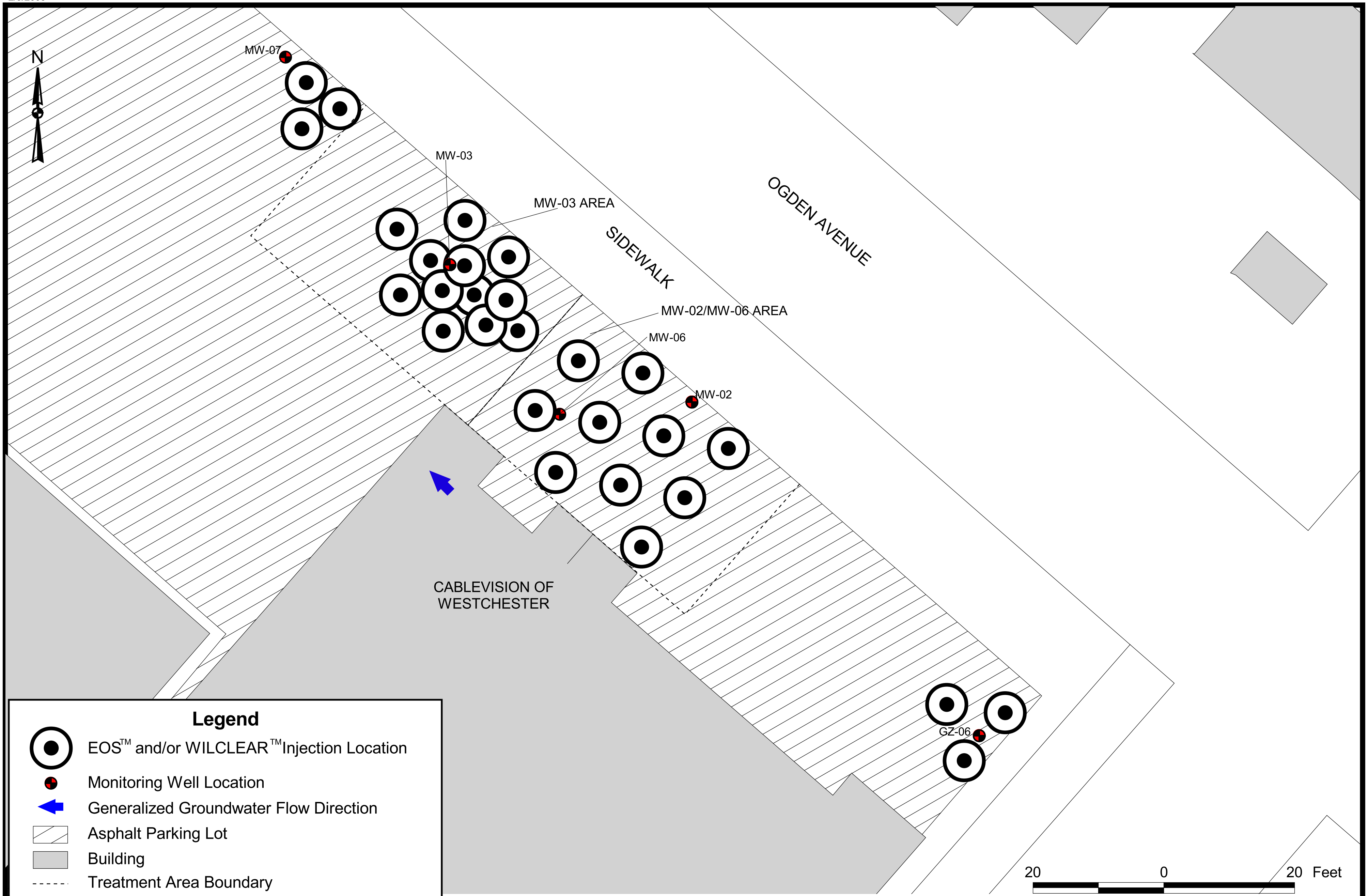


URS

FORMER EMCA SITE
PILOT STUDY INJECTION LOCATIONS (JUNE 2003)

FIGURE 2-1

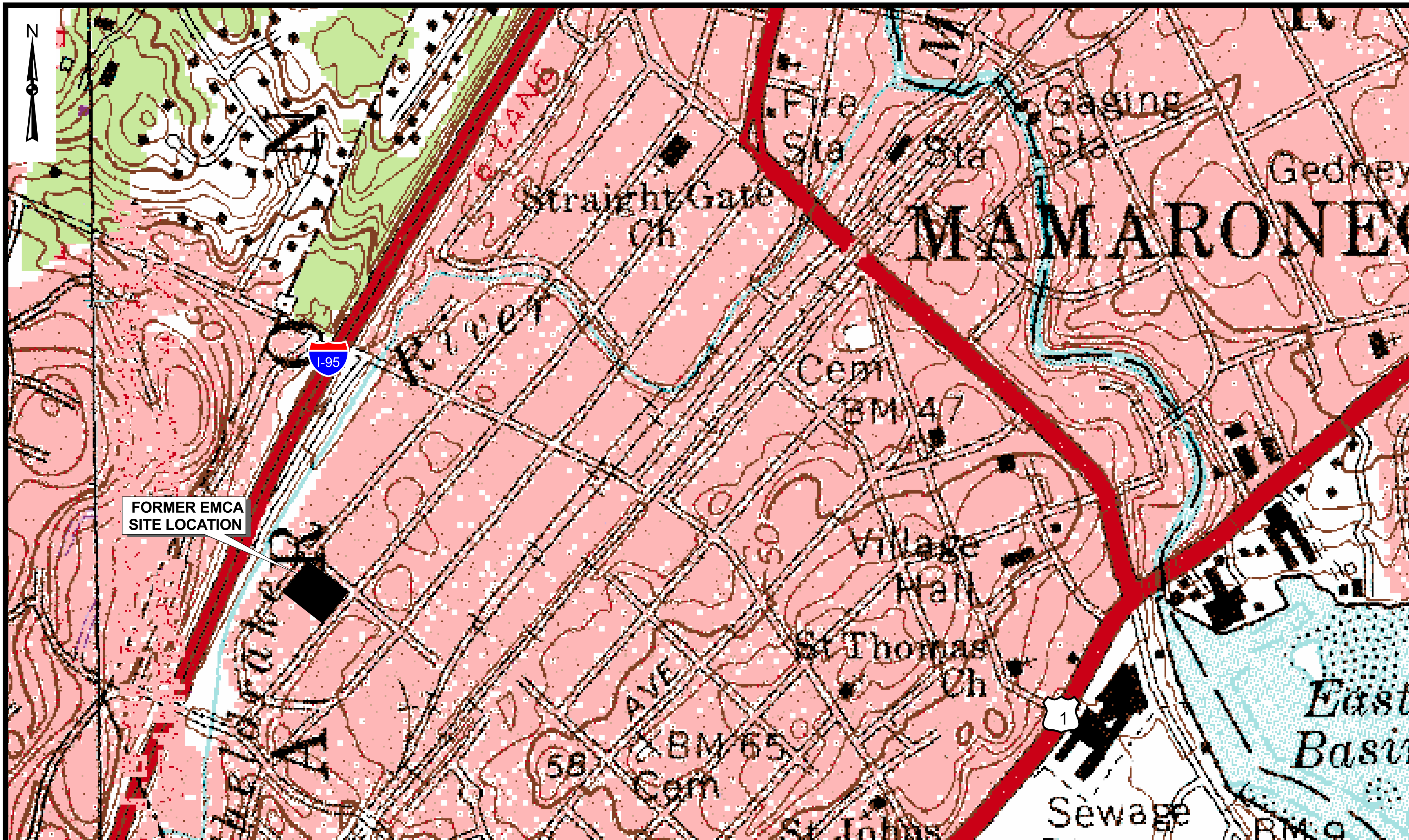
N:\11172730.00000\DB\GIS\2001\chemical.apr (ZOOM) IRM INJECTION LOCATIONS
2/9/2005



URS

FORMER EMCA SITE
IRM INJECTION LOCATIONS (NOVEMBER 2004)

FIGURE 2-2



SOURCE: USGS Topographical Quadrangle Mount Vernon, New York, 1979 and Mamaroneck, New York, 1985.

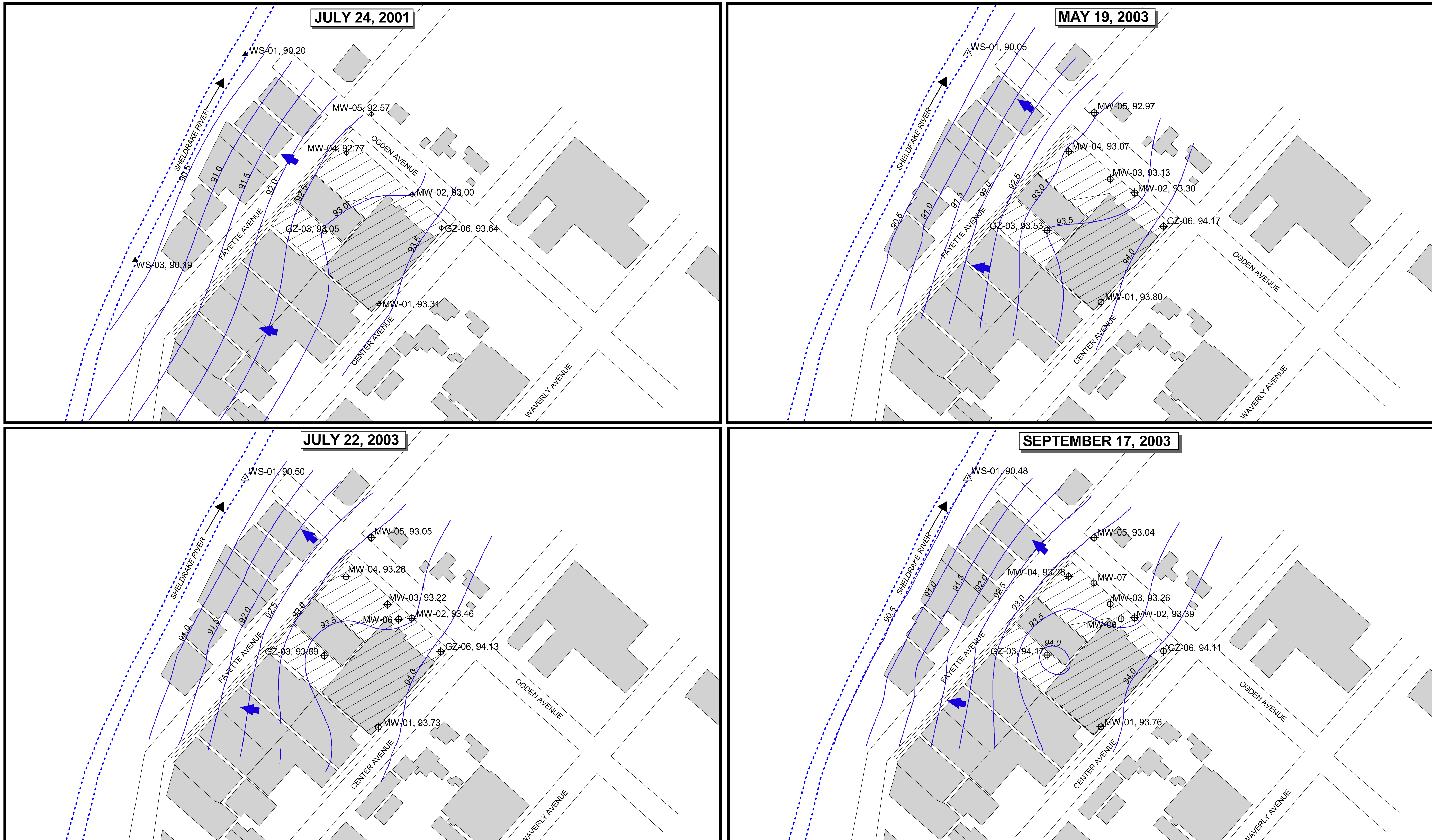
NOTE: Contour Interval = 10 feet

600 0 600 Feet

URS

FORMER EMCA SITE
TOPOGRAPHY IN VICINITY OF SITE

FIGURE 3-1



Legend

- Monitoring Well Location
- Stream Gauge Location
- 92.0 Groundwater Elevation Contour
- Groundwater Flow Direction
- Former EMCA Site Boundary (Approximate)
- NM - Not Monitored
- MW-01, 93.76 — Location ID; Groundwater Elevation ft)

NOTE:
- WS-04 is located approximately 900 feet upstream of WS-01.

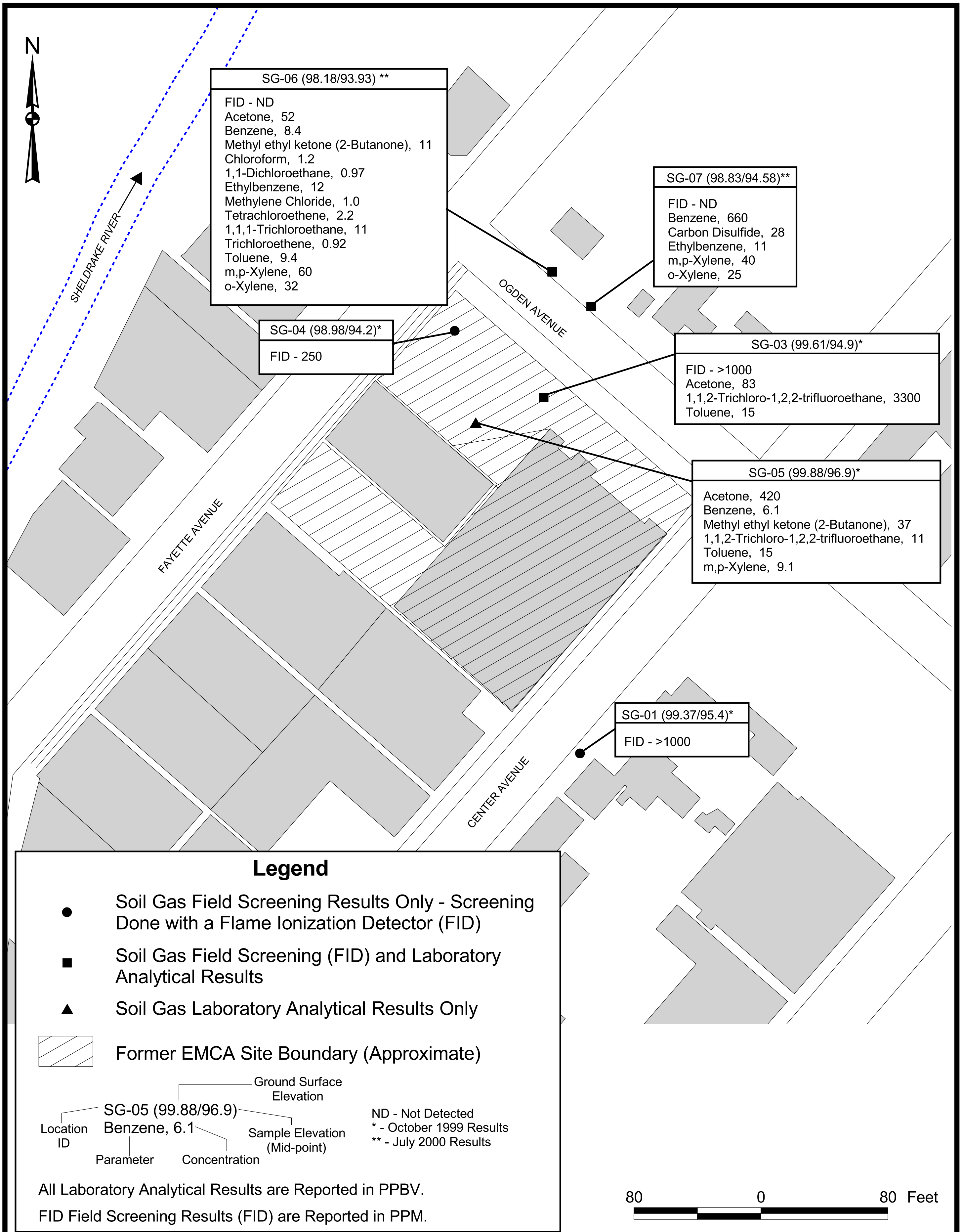
200 0 200 Feet

FORMER EMCA SITE
GROUNDWATER ELEVATION CONTOURS

URS

FIGURE 3-2

N:\11172730.00000\DB\GIS\2001\welev.apr (2003) GROUNDWATER ELEVATION CONTOURS COMPARISON
12/2/2004

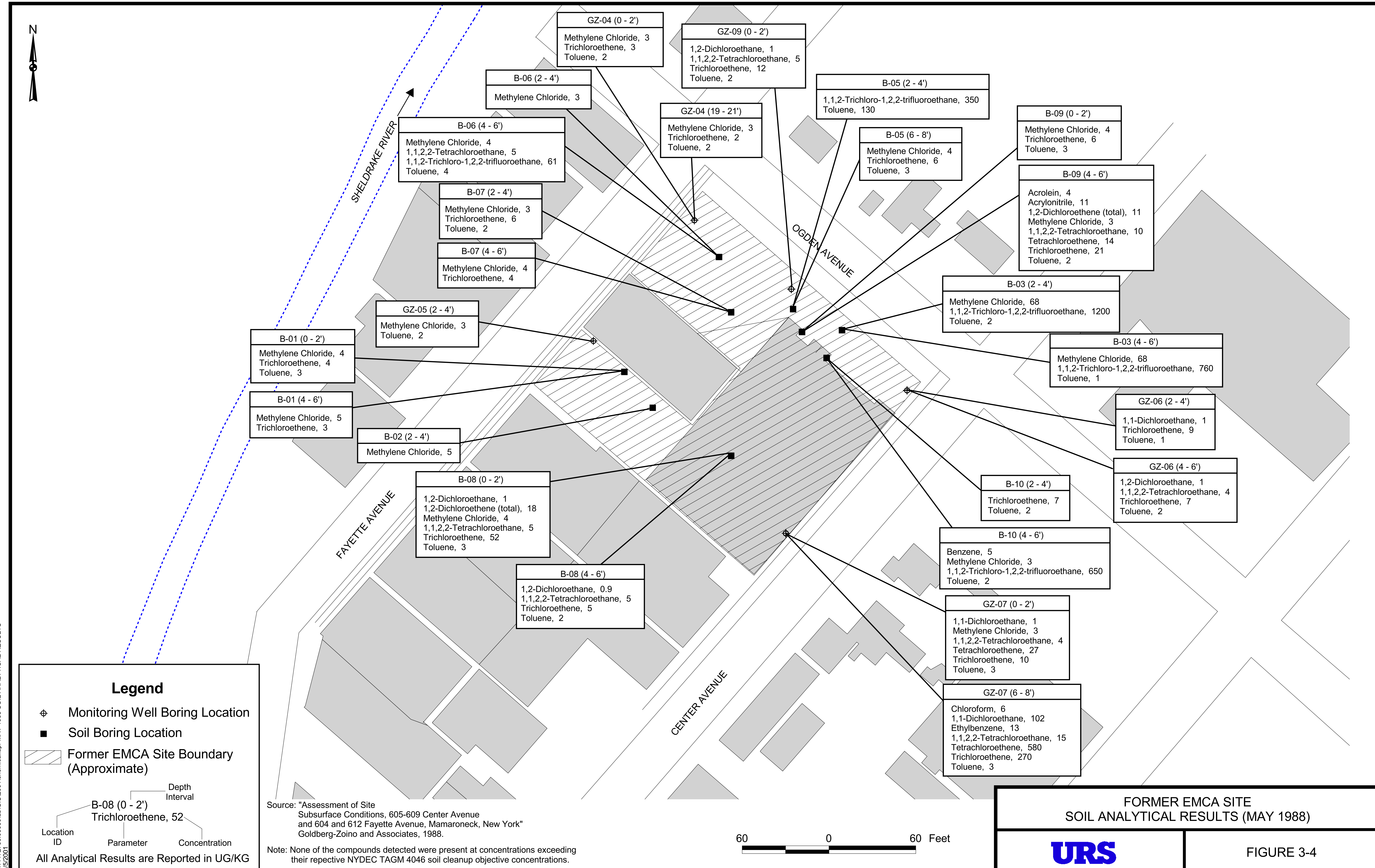


URS

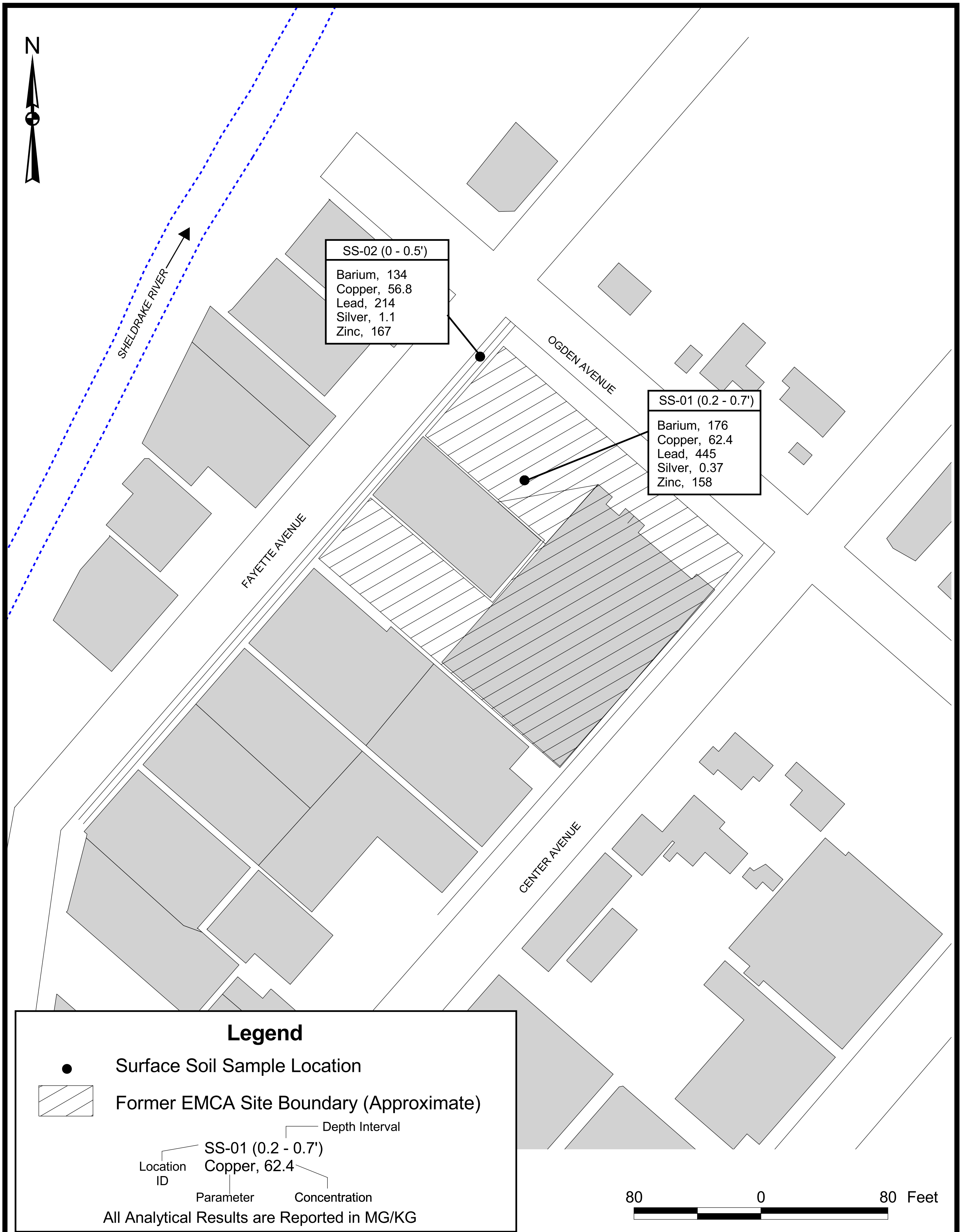
FORMER EMCA SITE
RI SOIL GAS FIELD SCREENING AND LABORATORY ANALYTICAL RESULTS (OCTOBER 1999 AND JULY 2000)

FIGURE 3-3

N:\11172730.00000\db\GIS\2001\chemical.apr SOIL GAS ANALYTICAL RESULTS
11/22/2004



N:\11172730.00000\db\GIS\2001\chemical.apr MAY 1988 SOIL ANALYTICAL RESULTS
11/5/2001

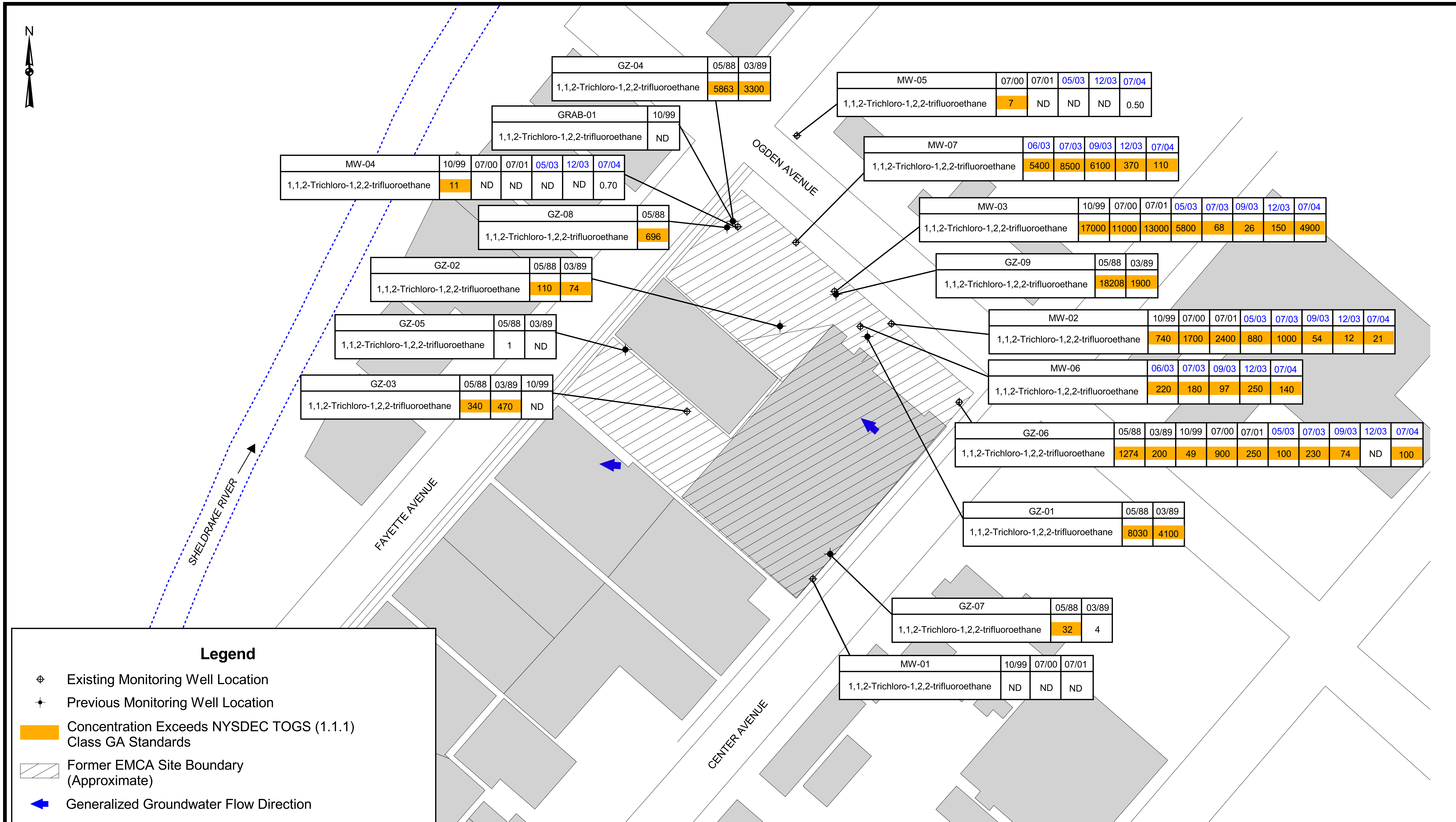


URS

FORMER EMCA SITE
RI SURFACE SOIL ANALYTICAL RESULTS
(OCTOBER 1999)

FIGURE 3-5

N:\11172730.00000\db\GIS\2001\chemical.apr SURFACE SOIL ANALYTICAL RESULTS
11/1/2001



GZ-04	05/88	03/89
1,1,2-Trichloro-1,2,2-trifluoroethane	5863	3300

GRAB-01	10/99
1,1,2-Trichloro-1,2,2-trifluoroethane	ND

MW-04	10/99	07/00	07/01	05/03	12/03	07/04
1,1,2-Trichloro-1,2,2-trifluoroethane	11	ND	ND	ND	ND	0.70

GZ-08	05/88
1,1,2-Trichloro-1,2,2-trifluoroethane	696

GZ-02	05/88	03/89
1,1,2-Trichloro-1,2,2-trifluoroethane	110	74

GZ-05	05/88	03/89
1,1,2-Trichloro-1,2,2-trifluoroethane	1	ND

GZ-03	05/88	03/89	10/99
1,1,2-Trichloro-1,2,2-trifluoroethane	340	470	ND

MW-05	07/00	07/01	05/03	12/03	07/04
1,1,2-Trichloro-1,2,2-trifluoroethane	7	ND	ND	ND	0.50

MW-07	06/03	07/03	09/03	12/03	07/04
1,1,2-Trichloro-1,2,2-trifluoroethane	5400	8500	6100	370	110

MW-03	10/99	07/00	07/01	05/03	07/03	09/03	12/03	07/04
1,1,2-Trichloro-1,2,2-trifluoroethane	17000	11000	13000	5800	68	26	150	4900

GZ-09	05/88	03/89
1,1,2-Trichloro-1,2,2-trifluoroethane	18208	1900

MW-02	10/99	07/00	07/01	05/03	07/03	09/03	12/03	07/04
1,1,2-Trichloro-1,2,2-trifluoroethane	740	1700	2400	880	1000	54	12	21

MW-06	06/03	07/03	09/03	12/03	07/04
1,1,2-Trichloro-1,2,2-trifluoroethane	220	180	97	250	140

GZ-06	05/88	03/89	10/99	07/00	07/01	05/03	07/03	09/03	12/03	07/04
1,1,2-Trichloro-1,2,2-trifluoroethane	1274	200	49	900	250	100	230	74	ND	100

GZ-01	05/88	03/89
1,1,2-Trichloro-1,2,2-trifluoroethane	8030	4100

GZ-07	05/88	03/89
1,1,2-Trichloro-1,2,2-trifluoroethane	32	4

MW-01	10/99	07/00	07/01
1,1,2-Trichloro-1,2,2-trifluoroethane	ND	ND	ND

Legend

- Existing Monitoring Well Location
- Previous Monitoring Well Location
- Concentration Exceeds NYSDEC TOGS (1.1.1) Class GA Standards
- Former EMCA Site Boundary (Approximate)
- Generalized Groundwater Flow Direction

GZ-03 05/88 (Sample Date)
1,1,2-Trichloro-1,2,2-trifluoroethane, 340
Location ID — Parameter — Concentration

ND - Not Detected

All Analytical Results are Reported in UG/L

60 0 60 Feet

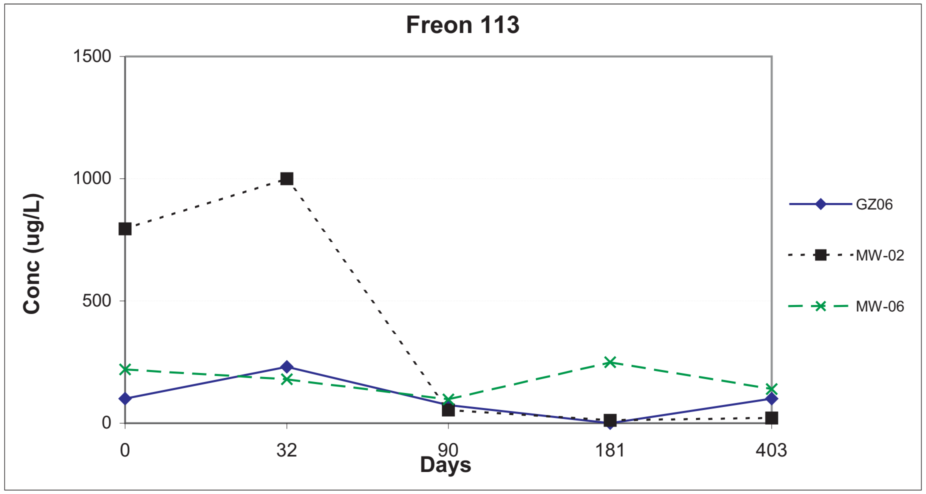
FORMER EMCA SITE
SUMMARY OF FREON 113 DETECTIONS IN GROUNDWATER

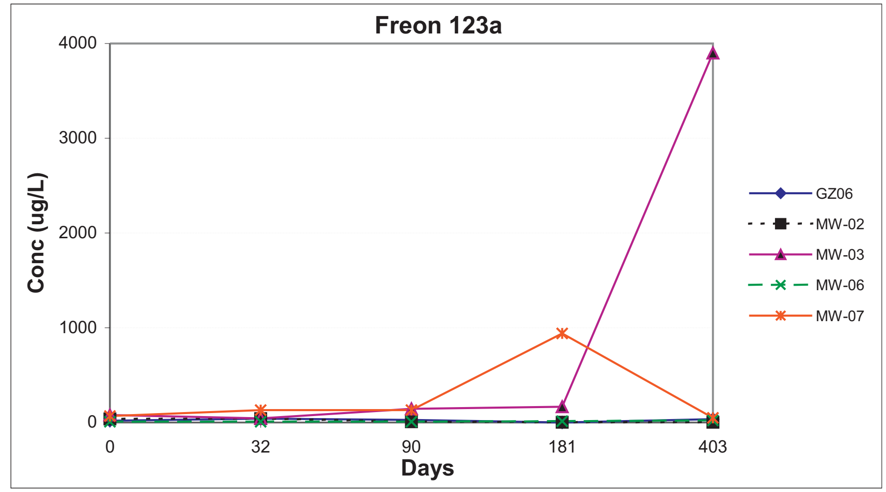
URS

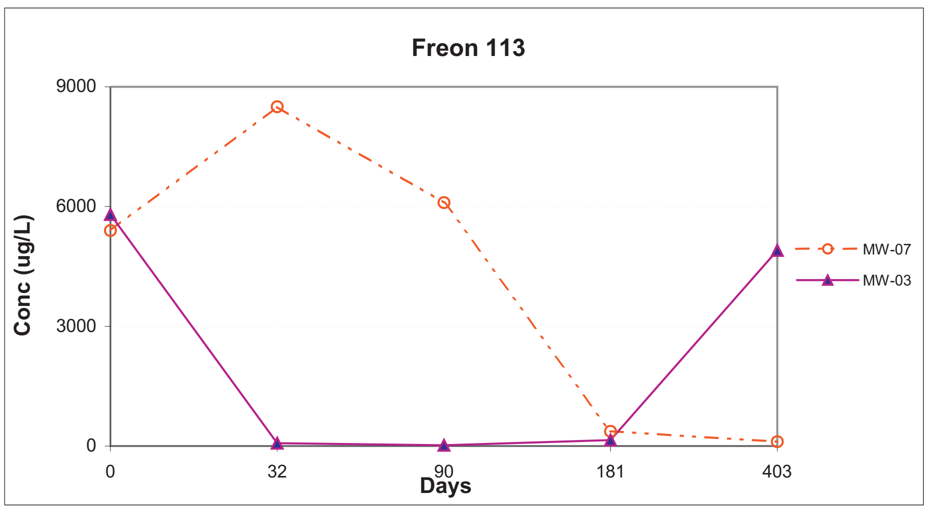
FIGURE 3-6

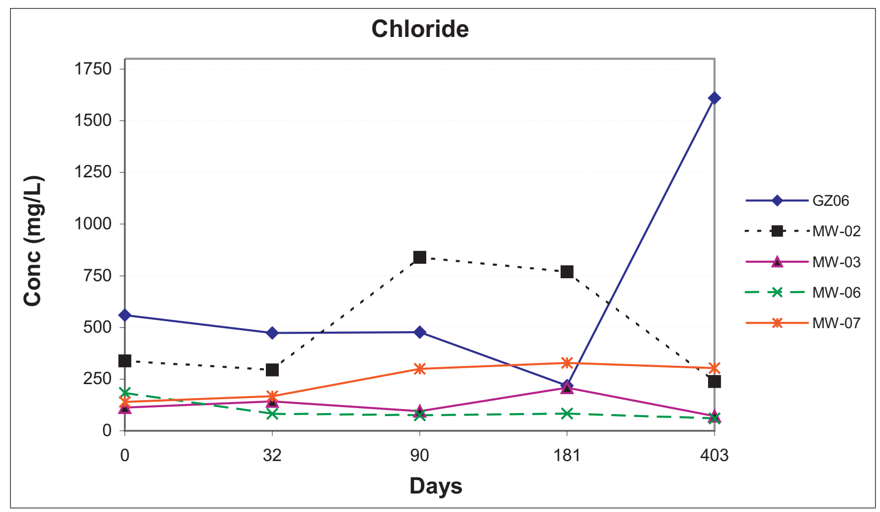
N:\11172730.00000\DB\GIS\2001\chemical.apr SUMMARY OF FREON 113 DETECTIONS (2)
11/23/2004

AG18827-11173570-113004-GCM









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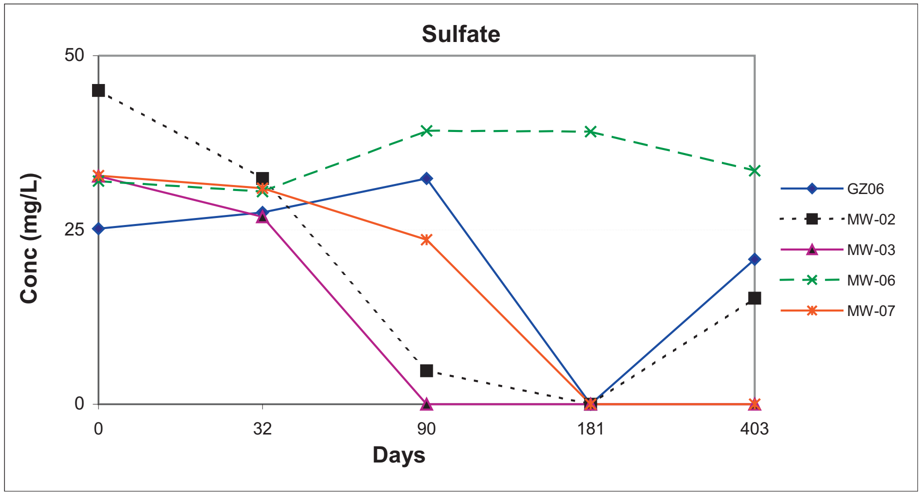
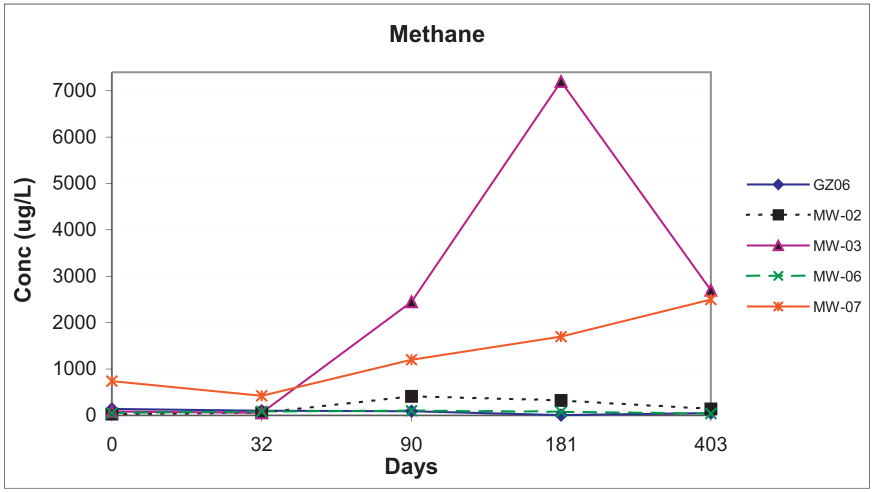
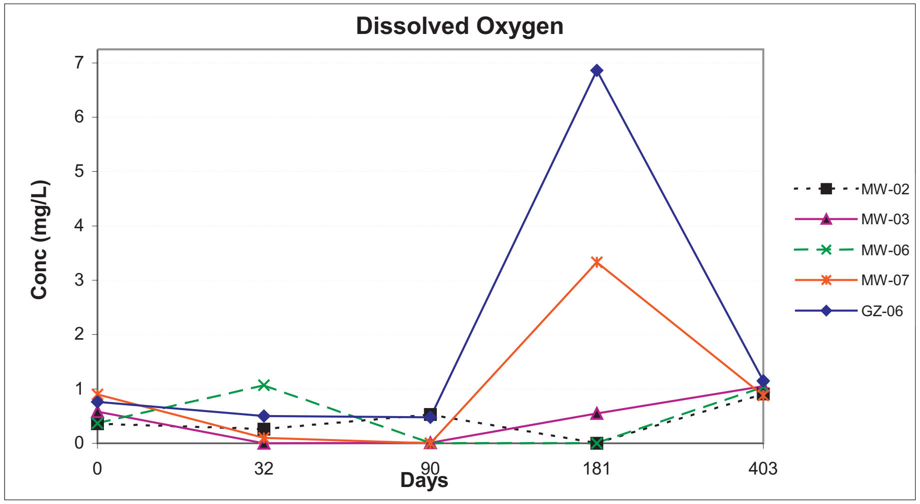
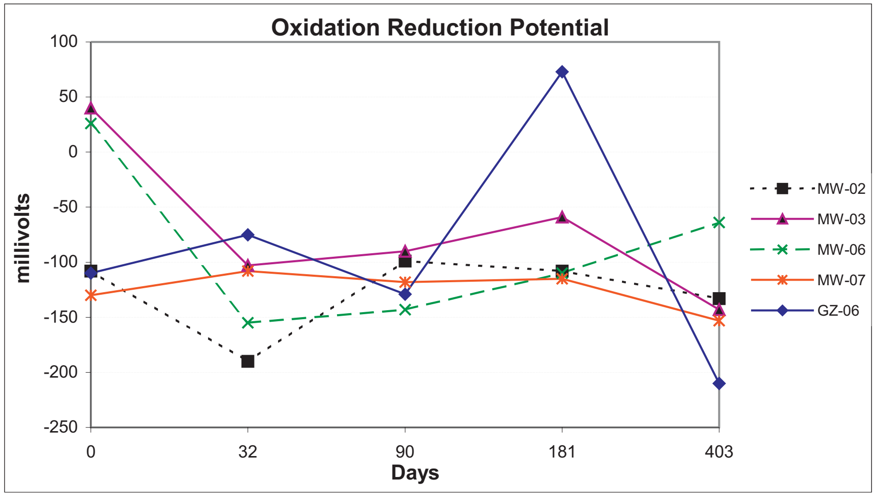
FORMER EMCA SITE
GROUNDWATER ANALYTICAL DATA PLOTS
FREON 113 AND DEGRADATION BY-PRODUCTS

FIGURE 4-1





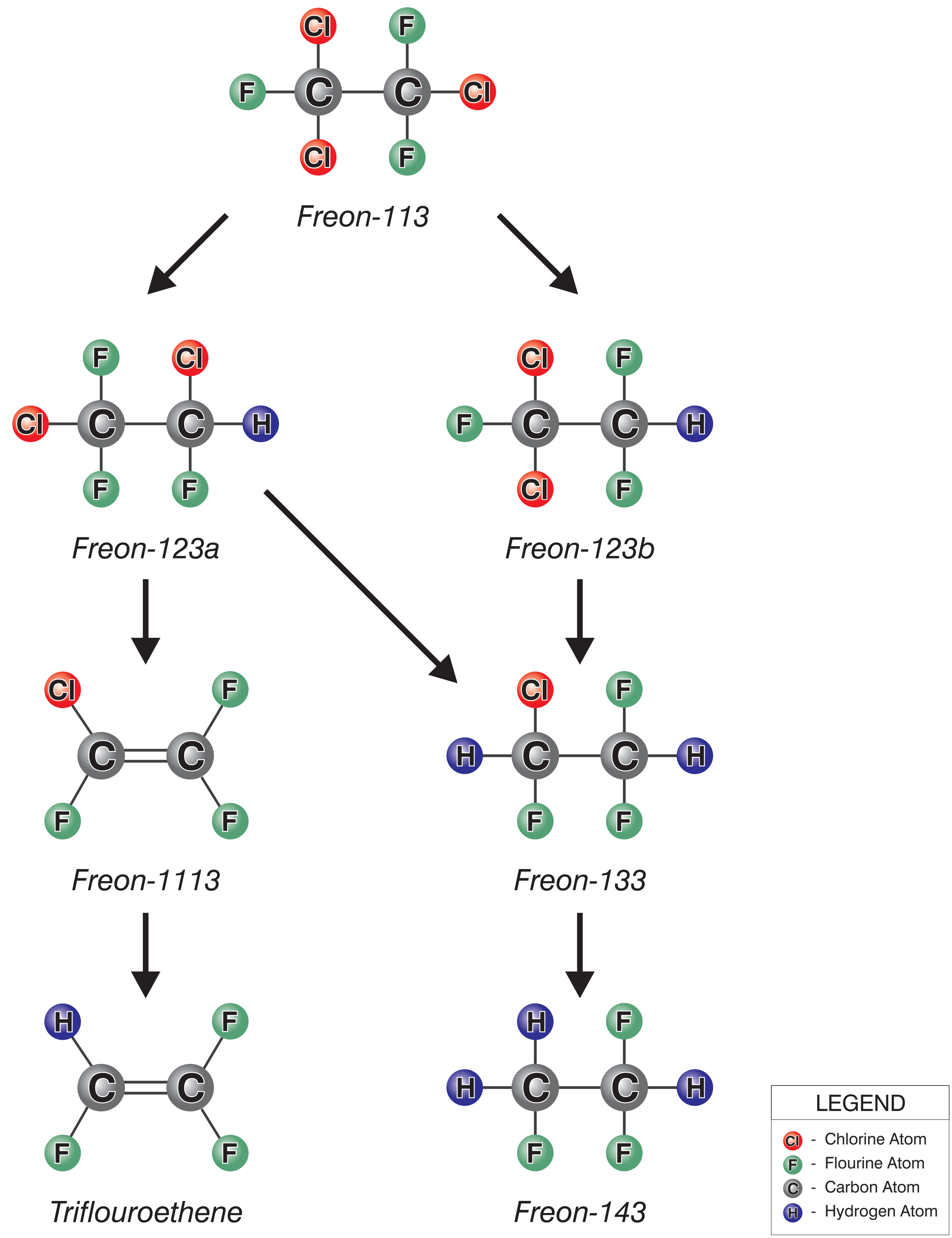




URS

FORMER EMCA SITE
GROUNDWATER ANALYTICAL DATA PLOTS
GEOCHEMICAL PARAMETERS

FIGURE 4-2



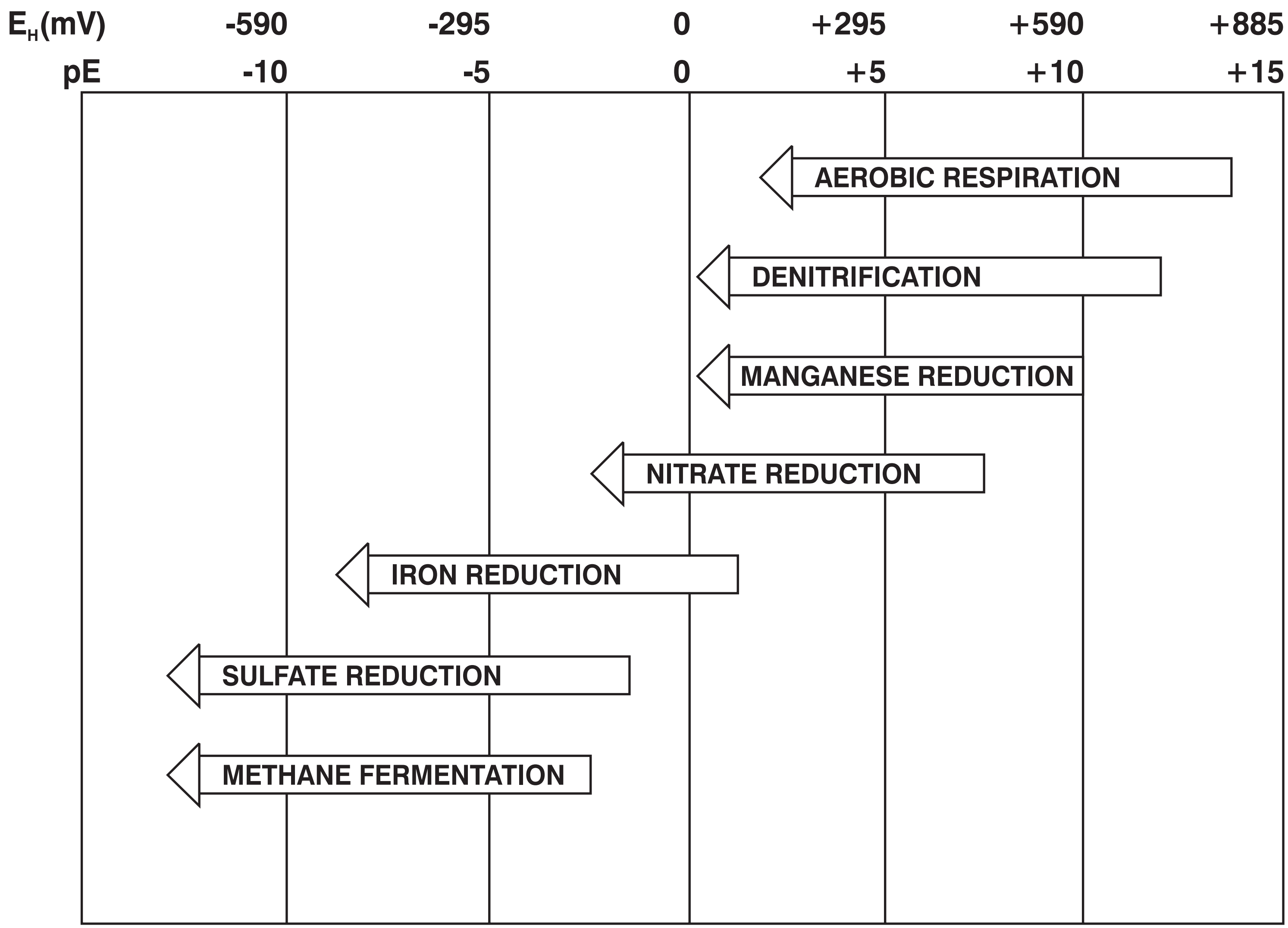
URS

FORMER EMCA SITE
PREDICTED REDUCTIVE PATHWAYS
FOR FREON 113

FIGURE 7-1

AG18814-11172730-112404-GCM

AG18815-11172730-112404-GCM



E_H = Redox Potential

pE = -log (electron activity)

$E_H = \frac{2.3\ RT}{F}\ pE$

R = Gas Constant

T = Temperature

F = Faraday Constant

NOTES:

Adapted from Wiedemeier et al., 1995

1. These reactions would be expected to occur in sequence if the system is moving toward equilibrium.

2. These redox processes occur in order of their energy-yielding potential (provided microorganisms are available to mediate a specific reaction). Reduction of a highly oxidized species decreases the pE of the system.

3. Redox sequence is paralleled by an ecological succession of biological mediators.

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SEQUENCE OF MICROBIALLY MEDIATED REDOX REACTIONS BASED ON pE

FIGURE 7-2

APPENDIX A

HYDRAULIC CONDUCTIVITY TESTING (SLUG TEST) ANALYSES

URS Corporation

CALCULATION COVER SHEET

Client: Rohm & Haas

Project Name: Former ECMA Site

Project/Calculation Number: Former ECMA Site / ST#1

Title: Hydraulic Conductivity Calculations

Total Number of Pages (incl. Cover sheet):

Total Number of Computer Runs: 1

Prepared by: Martha DeLozier — Date: 14-Aug-01

Checked by: Craig Taylor — Date: 10-Oct-01

Description and Purpose:

Estimate hydraulic conductivity of local aquifer.

Design basis/references/assumptions:

1) Bouwer, H., 1989. The Bouwer and Rice slug test--an update, Ground Water, vol. 27, no. 3, pp. 304-309.
2) Bouwer, H. and R.C. Rice, 1976. A slug test method for determining hydraulic conductivity of unconfined aquifers with completely or partially penetrating wells, Water Resources Research, vol. 12, no. 3, pp. 423-428

Remarks/conclusions:

1) Data provided required correction/editing prior to analysis.
2) Test results and assumptions provided on Analysis Summary pages.
3) As conductivity rises, (typically greater than 10-2) the uncertainty of the analysis increases. This may be attributable to influence by the well's sandpack.

Calculation Approved by: ______________________

Project Manager/Date

Revision No.:	Description of Revision:	Approved by:

J:\35673.00\Excel\Slug Tests\[Calc Cover Sheet - Slug Tests 2001.xls]

ANALYSIS SUMMARY (Results)

Well	cm/sec			ft/min			ft/day		
	Average	Falling	Rising	Average	Falling	Rising	Average	Falling	Rising
GZ-06	1.76E-02	3.00E-02	5.18E-03	3.46E-02	5.90E-02	1.02E-02	49.8	84.9	14.7
MW-05	1.09E-02	3.60E-03	1.83E-02	2.15E-02	7.08E-03	3.60E-02	31.0	10.2	51.8
MW-04	6.80E-03	6.80E-03	NA	1.34E-02	1.34E-02	NA	19.3	19.3	NA
MW-02	6.68E-03	6.68E-03	NA	1.32E-02	1.32E-02	NA	18.9	18.9	NA

Well	Average		
	cm/sec	ft/min	ft/day
GZ-06	1.76E-02	3.46E-02	49.8
MW-05	1.09E-02	2.15E-02	31.0
MW-04	6.80E-03	1.34E-02	19.3
MW-02	6.68E-03	1.32E-02	18.9

J:\35673.00\Excel\Slug Tests\[SlugTest Summary.xls]Set-Up

ANALYSIS SUMMARY (Assumptions)

Well	Max Displacement (ft)	Depth to Water (ft bgs)	Total Depth (ft bgs)	Height of Water Column (ft)	Aquifer Thickness (ft)	Screen Length (ft)	Top of Water above Top of Screen (Y/N)	Well (Casing) Radius (ft)	Borehole (Wellbore) Radius (ft)
GZ-06f	1	6.23	13.70	7.47	7.47	10.0	N	0.0833	0.417
GZ-06r	1	6.23	13.70	7.47	7.47	10.0	N	0.0833	0.417
MW-05f	1	5.58	15.68	10.10	10.10	13.0	N	0.0417	0.083
MW-05r	1	5.58	15.68	10.10	10.10	13.0	N	0.0417	0.083
MW-04f	1	5.89	10.60	4.71	4.71	10.0	N	0.0417	0.083
MW-02f	1	6.18	11.81	5.63	5.63	13.0	N	0.0417	0.083

Assume 10-inch borehole for 2" wells.

Assume 2-inch borehole for 1" wells.

GZ-06= Assume 1.65 ft of stick-up therefore DTW= 7.88 ft (measured) - 1.65 ft stickup. Additionally 1.65 ft was subtracted from the total depth of the well.

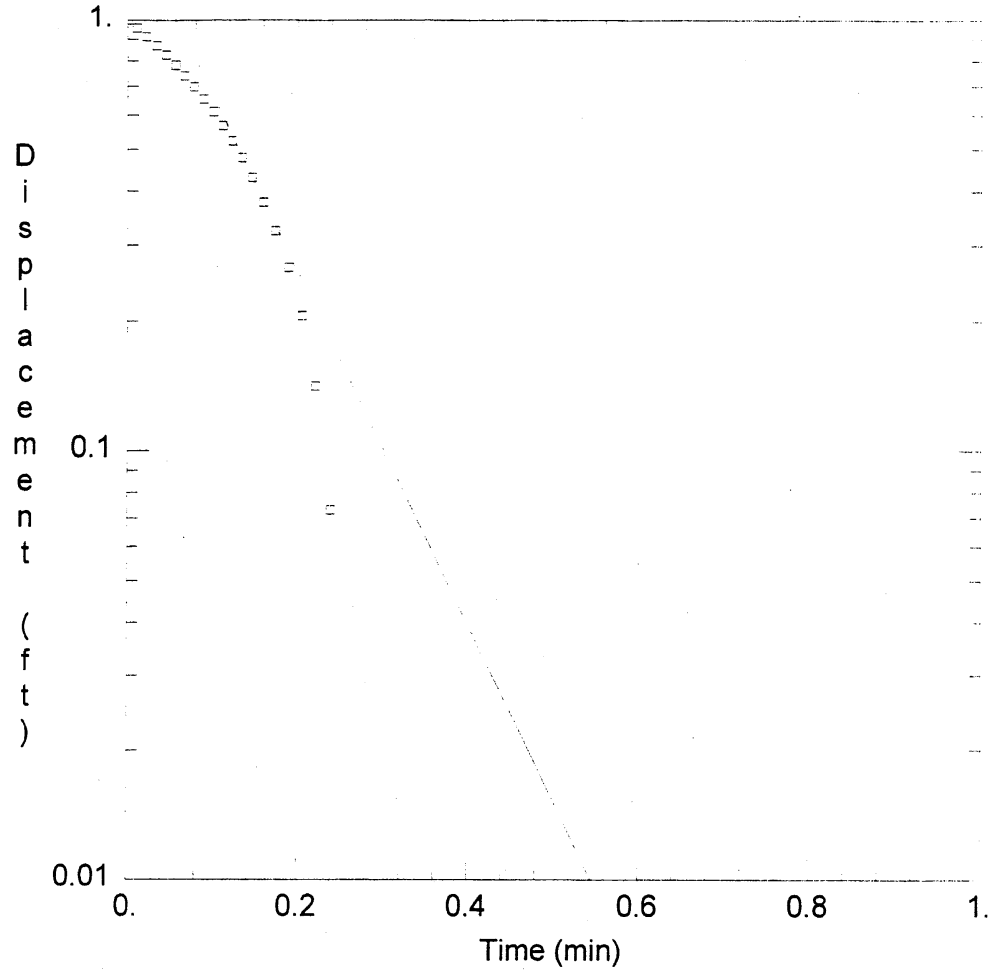
Wells MW-02 and MW-04 appear to have a significant amount of buildup of material within the screen.

Screen lengths were determined from well construction diagrams.

Total depth was measured below top of riser (all wells flush mount except GZ-06).

The remainder of the wells tested (GZ-03, MW-04r, and MW-02r) were not analyzed due to poor test data or no data was recorded at all.

J:\35673.00\Excel\Slug Tests\[SlugTest Summary.xls]Set-Up



FORMER EMCA SITE

Data Set: J:\35673.00\Excel\Slug Tests\GZ-06f.aqt
Date: 10/10/01 Time: 09:12:57

PROJECT INFORMATION

Company: URS Corporation
Client: Rohm & Haas Company
Project: 05-00035673.00
Test Location: Mamaroneck, New York

AQUIFER DATA

Saturated Thickness: 7.47 ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (GZ-06)

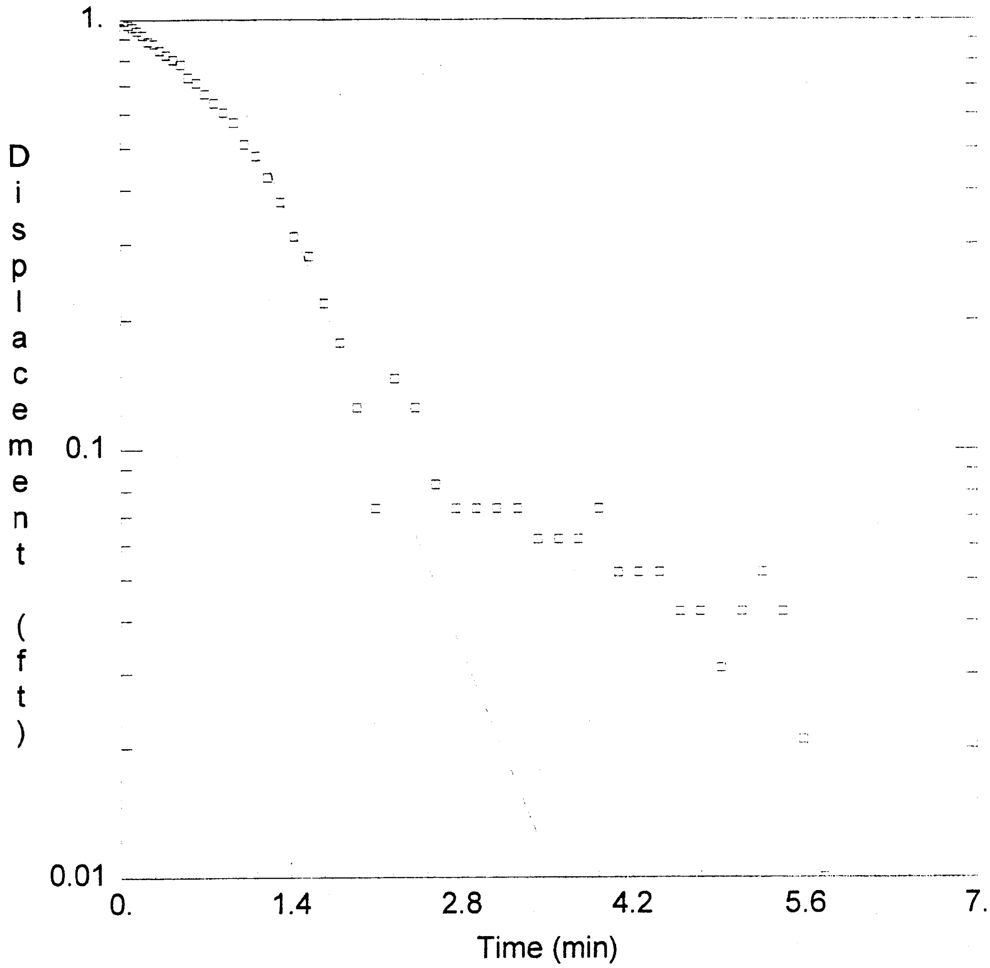
Initial Displacement: 1. ft
Wellbore Radius: 0.417 ft
Screen Length: 10. ft
Gravel Pack Porosity: 0.3

Casing Radius: 0.0833 ft
Well Skin Radius: 0.417 ft
Total Well Penetration Depth: 7.47 ft

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 0.05897 ft/min y0 = 1.71 ft



FORMER EMCA SITE

Data Set: J:\35673.00\Excel\Slug Tests\GZ-06r.aqt
Date: 10/10/01 Time: 09:13:03

PROJECT INFORMATION

Company: URS Corporation
Client: Rohm & Haas Company
Project: 05-00035673.00
Test Location: Mamaroneck, New York

AQUIFER DATA

Saturated Thickness: 7.47 ft
Anisotropy Ratio (Kz/Kr): 1.

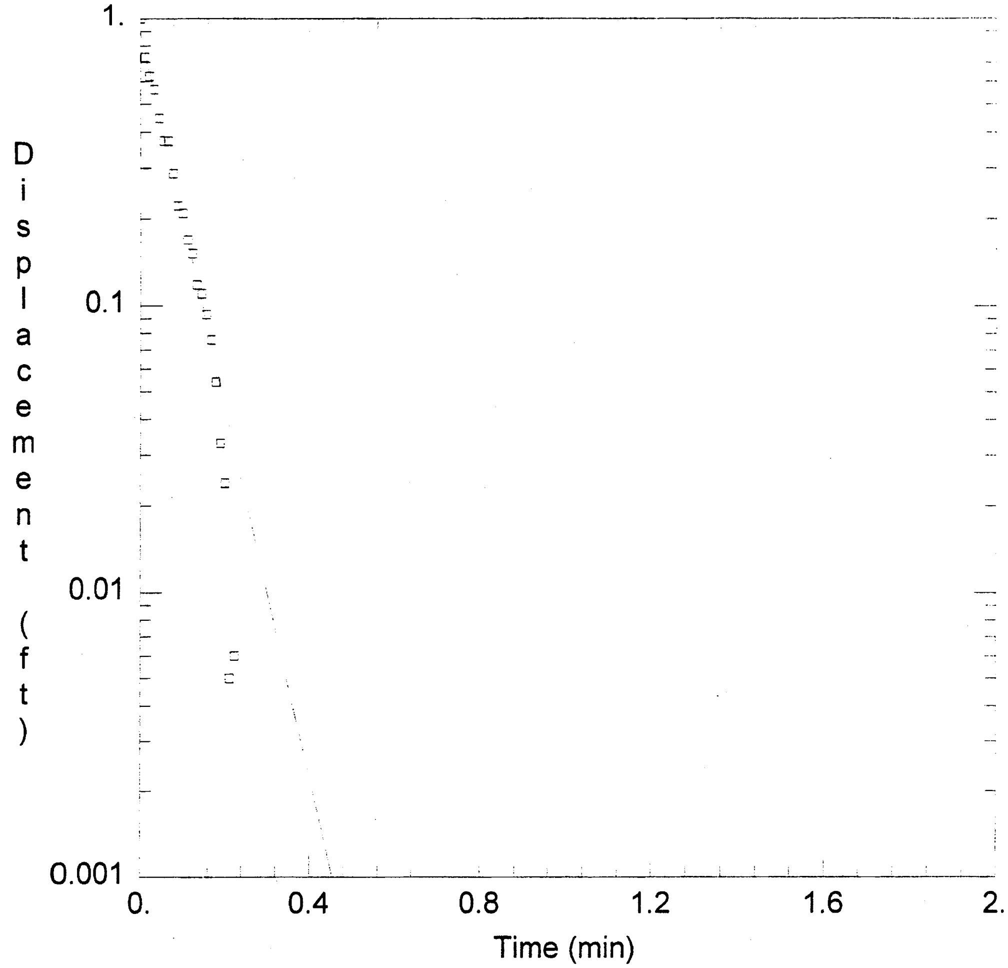
WELL DATA (GZ-06)

Initial Displacement: 1. ft
Wellbore Radius: 0.417 ft
Screen Length: 10. ft
Gravel Pack Porosity: 0.3
Casing Radius: 0.0833 ft
Well Skin Radius: 0.417 ft
Total Well Penetration Depth: 7.47 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 0.0102 ft/min
y0 = 3.276 ft



FORMER EMCA SITE

Data Set: J:\35673.00\Excel\Slug Tests\MW-05f2.aqt
Date: 10/08/01 Time: 08:38:26

PROJECT INFORMATION

Company: URS Corporation
Client: Rohm & Haas Company
Project: 05-00035673.00
Test Location: Mamaroneck, New York

AQUIFER DATA

Saturated Thickness: 10.1 ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW-05)

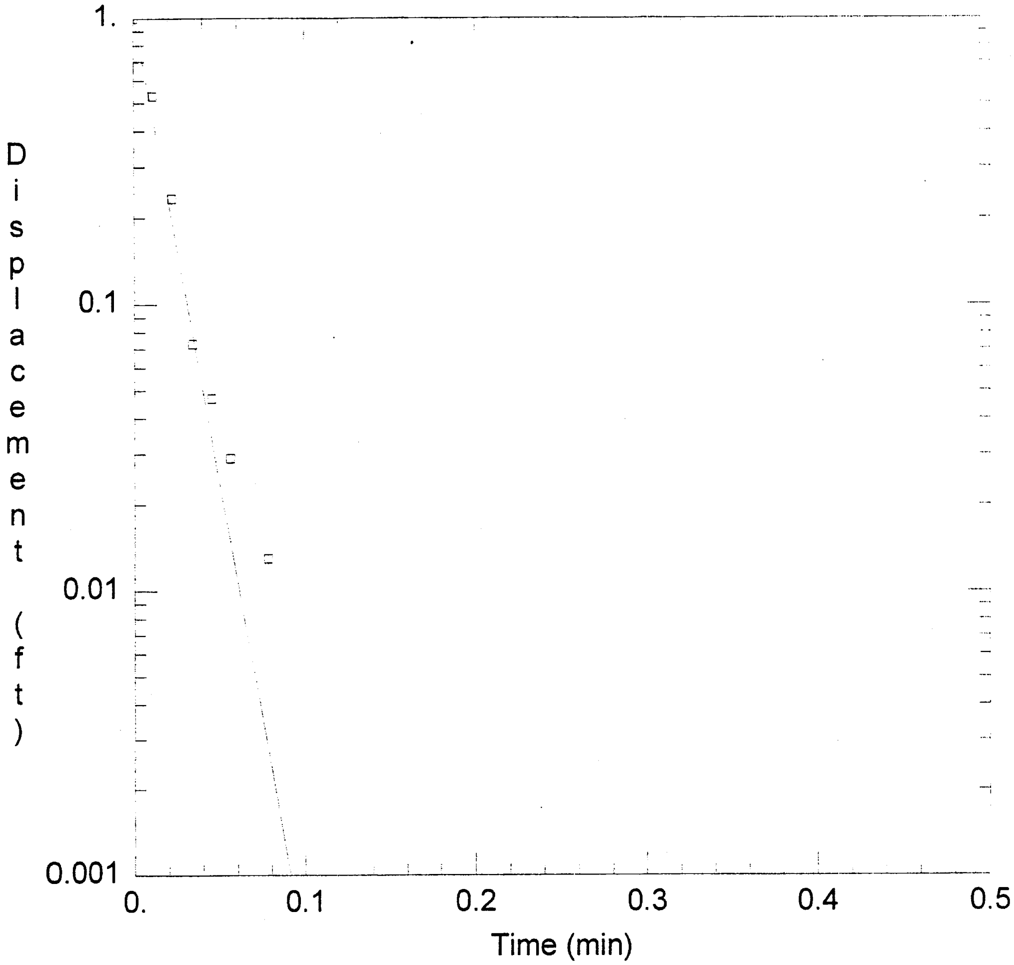
Initial Displacement: 1. ft
Wellbore Radius: 0.083 ft
Screen Length: 13. ft
Gravel Pack Porosity: 0.3

Casing Radius: 0.0417 ft
Well Skin Radius: 0.083 ft
Total Well Penetration Depth: 10.1 ft

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 0.007084 ft/min y0 = 0.897 ft



FORMER EMCA SITE

Data Set: J:\35673.00\Excel\Slug Tests\MW-05r.aqt
Date: 10/08/01 Time: 08:36:49

PROJECT INFORMATION

Company: URS Corporation
Client: Rohm & Haas Company
Project: 05-00035673.00
Test Location: Mamaroneck, New York

AQUIFER DATA

Saturated Thickness: 10.1 ft
Anisotropy Ratio (Kz/Kr): 1.

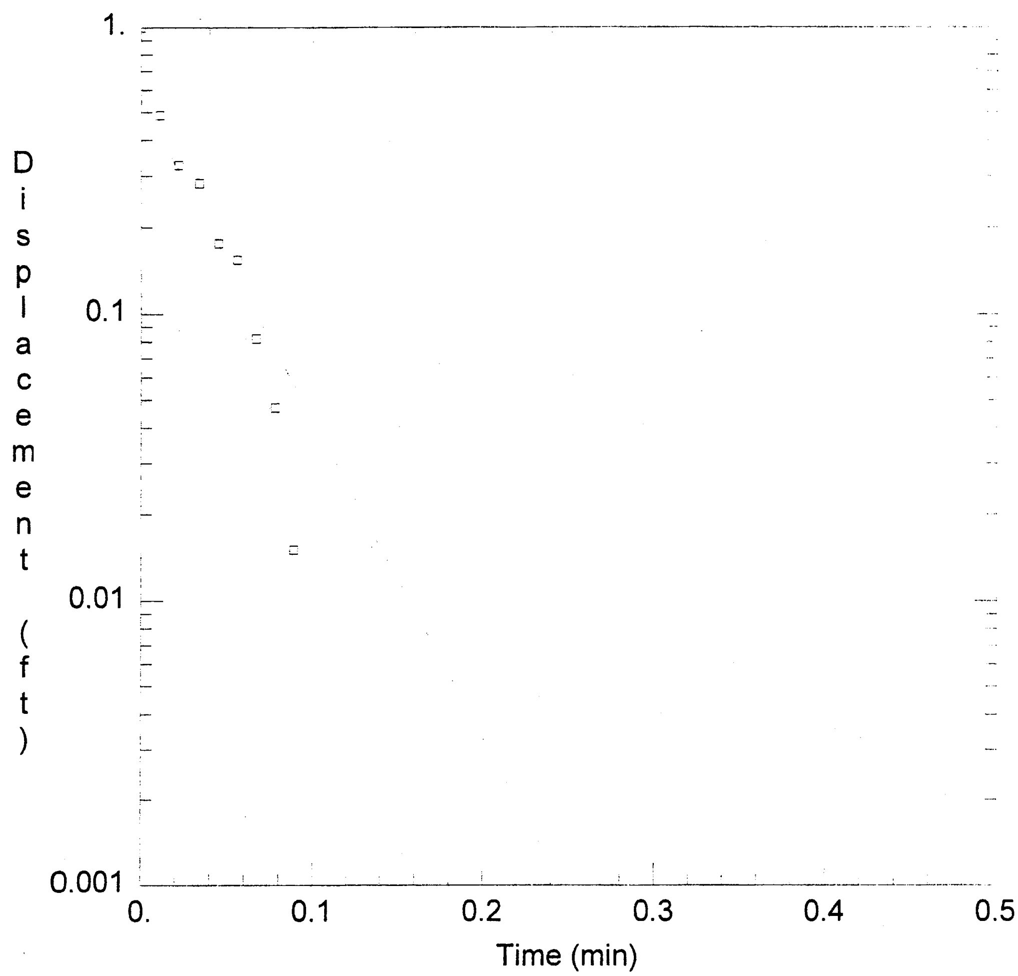
WELL DATA (MW-05)

Initial Displacement: 1. ft
Wellbore Radius: 0.083 ft
Screen Length: 13. ft
Gravel Pack Porosity: 0.3
Casing Radius: 0.0417 ft
Well Skin Radius: 0.083 ft
Total Well Penetration Depth: 10.1 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 0.03597 ft/min
y0 = 1.039 ft



FORMER EMCA SITE

Data Set: J:\35673.00\Excel\Slug Tests\MW-04f.aqt
Date: 10/08/01 Time: 08:34:40

PROJECT INFORMATION

Company: URS Corporation
Client: Rohm & Haas Company
Project: 05-00035673.00
Test Location: Mamaroneck, New York

AQUIFER DATA

Saturated Thickness: 4.71 ft
Anisotropy Ratio (Kz/Kr): 1.

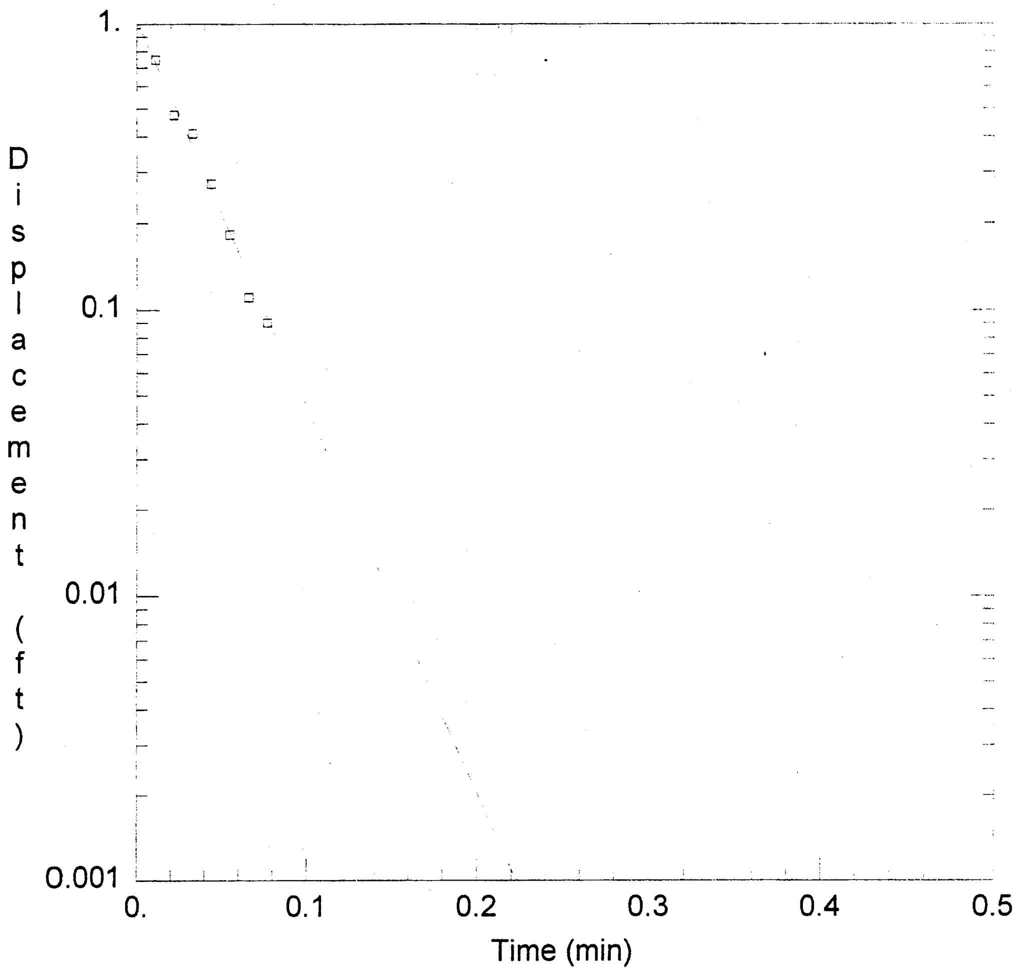
WELL DATA (MW-04)

Initial Displacement: 1. ft
Wellbore Radius: 0.083 ft
Screen Length: 10. ft
Gravel Pack Porosity: 0.3
Casing Radius: 0.0417 ft
Well Skin Radius: 0.083 ft
Total Well Penetration Depth: 4.71 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 0.01339 ft/min
y0 = 0.5506 ft



FORMER EMCA SITE

Data Set: J:\35673.00\Excel\Slug Tests\MW-02f.aqt
Date: 10/08/01 Time: 08:33:04

PROJECT INFORMATION

Company: URS Corporation
Client: Rohm & Haas Company
Project: 05-00035673.00
Test Location: Mamaroneck, New York

AQUIFER DATA

Saturated Thickness: 5.63 ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW-02)

Initial Displacement: 1. ft
Wellbore Radius: 0.083 ft
Screen Length: 13. ft
Gravel Pack Porosity: 0.3
Casing Radius: 0.0417 ft
Well Skin Radius: 0.083 ft
Total Well Penetration Depth: 5.63 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 0.01315 ft/min
y0 = 1.024 ft

FIELD BOREHOLE LOG

BOREHOLE NUMBER: MW-05

PROJECT NUMBER: 050035673.00
PROJECT NAME: FORMER EMCA SITE 360025
LOACATION: MAMARONECK, NY
DRILLING CO: ADT
DRILLING METHOD: GEOPROBE: 2" MACRO-CORE
FIELD PARTY: T. HEBERT
GEOLOGIST: J. VOUGHT
DATE BEGUN: 7/11/00 DATE COMPLETED: 7/11/00

FIELD BOOK NO: —
TOTAL DEPTH: 16
GROUND SURFACE ELEVATION: —

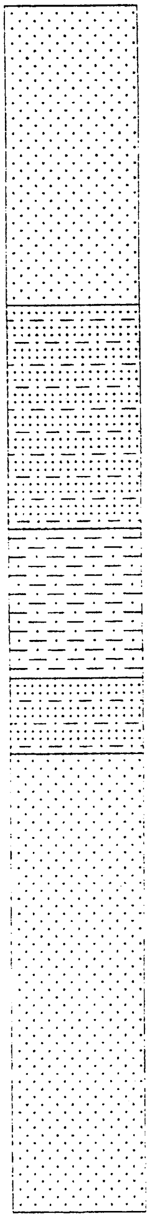
STATIC WATER LEVEL (BLS)

Depth (ft)		

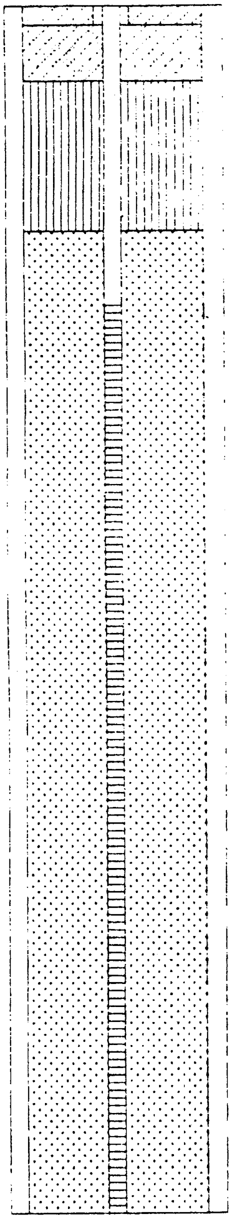
NOTE: Well secured with flushmount casing and locking cap.

DEPTH	SAMPLING METHOD	SAMPLE NUMBER	MOISTURE	FID	USCS	% RECOVERY	DESCRIPTION	Well Construct. Details
0.0	Post Hole Digger	NA	DRY	0.0 ppm		NA	SAND: Fine to medium sand, some silt, some fine to course gravel, trace cobbles	GROUTED ANNULUS: Cement/Bentonite
-1.0								BENTONITE: Bentonite Seal
-2.0					FILL			
-3.0								SAND: No. 2 Silica Sandpack (3' to 16' bgs). PVC Screen (4'-16') 1" diameter 0.010" slot
-4.0	4' MAC COR	C-1	MST			90	SAND AND SILT: Fine sand and silt, trace clay	
-5.0					SM			
-6.0								
-7.0			WET		ML		SILT: Silt, some clay	
-8.0	4' MAC COR	C-2				100		
-9.0					SM		SAND AND SILT: Fine to medium sand and silt	
-10.0							SAND: Fine to course sand, trace silt	
-11.0								
-12.0	4' MAC COR	C-3				100		
-13.0								
-14.0								
-15.0								
-16.0								

LITHOLOGY



WELL INSTALLATION



FIELD BOREHOLE LOG

BOREHOLE NUMBER: MW-04

PROJECT NUMBER: 050035673.00
PROJECT NAME: FORMER EMCA SITE 360025
LOACATION: MAMARONECK, NY
DRILLING CO: ADT
DRILLING METHOD: GEOPROBE: 2" MACRO-CORE
FIELD PARTY: LLOYD/VICTOR
GEOLOGIST: J. VOUGHT
DATE BEGUN: 10/5/99 DATE COMPLETED: 10/5/99

FIELD BOOK NO: —
TOTAL DEPTH: 31.0
GROUND SURFACE ELEVATION: —

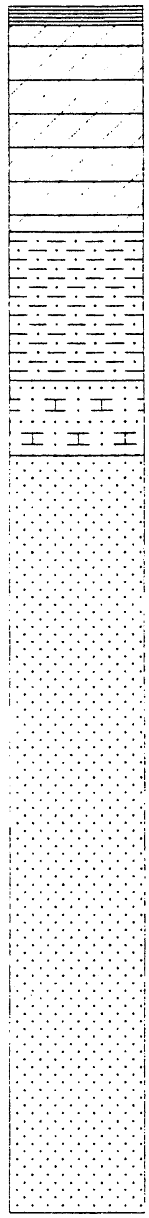
STATIC WATER LEVEL (BLS)

Depth (ft)		

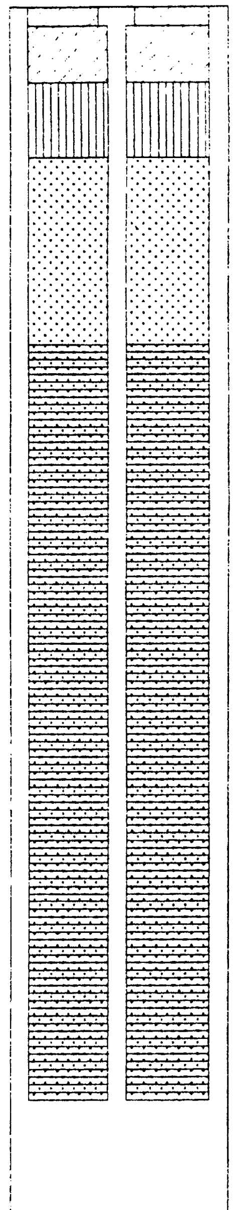
NOTE: Well secured with flushmount casing and locking cap.

DEPTH	SAMPLING METHOD	SAMPLE NUMBER	MOISTURE	FID	USCS	% RECOVERY	DESCRIPTION	Well Construct. Details
0.0	4' MAC COR	G-1 0-4'	DRY	12.0 ppm	FILL	71	ASPHALT: First 3" asphalt.	Cement/Bentonite
-1.0							FILL: Brown fill material consisting of fine to medium sand, some silt, trace gravel.	Bentonite Seal
-2.0								No. 2 Silica Sandpack (2' to 14.5' bgs). PVC Screen (4.5'-14.5') 1" diameter 0.010" slot
-3.0			MST		ML		SILT: Brown silt, some fine sand.	
-4.0	4' MAC COR	G-2 4'-8'		8.0 ppm		100		
-5.0					CL		CLAY AND SILT: Gray silt and clay.	
-6.0			WET		SM		SAND: Fine to coarse sand, trace fine to medium gravel.	
-7.0								
-8.0	4' MAC COR	G-3 8'-12'		3.0 ppm		100		
-9.0								
-10.0					SW			
-11.0								
-12.0	4' MAC COR	G-4 12'-16'		3.0 ppm		100		
-13.0								
-14.0								
-15.0								
-16.0								

LITHOLOGY



WELL INSTALLATION



FIELD BOREHOLE LOG

BOREHOLE NUMBER: MW-02

PROJECT NUMBER: 050035673.00
PROJECT NAME: FORMER EMCA SITE 360025
LOACATION: MAMARONECK, NY
DRILLING CO: ADT
DRILLING METHOD: GEOPROBE: 2" MACRO-CORE
FIELD PARTY: LLOYD/VICTOR
GEOLOGIST: J. VOUGHT
DATE BEGUN: 10/5/99 DATE COMPLETED: 10/5/99

FIELD BOOK NO: ---
TOTAL DEPTH: 16.0'
GROUND SURFACE ELEVATION: ---

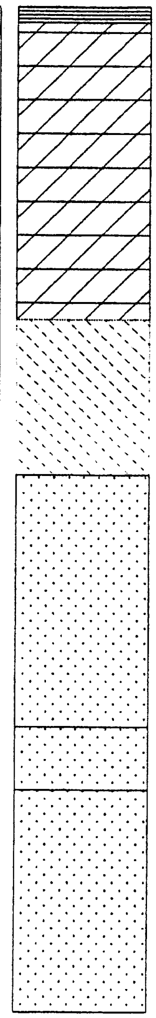
STATIC WATER LEVEL (BLS)

Depth (ft)	6'	

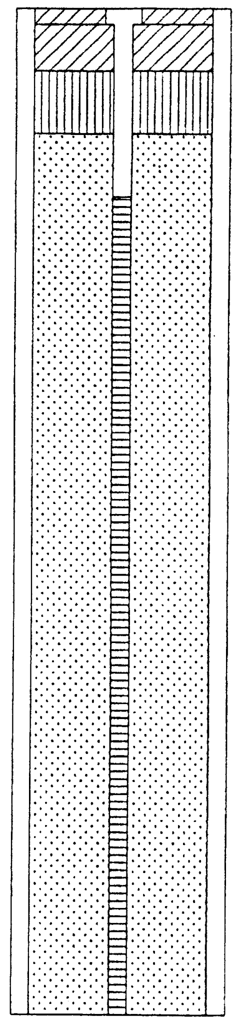
NOTE: Well secured with flushmount casing and locking cap.

DEPTH	SAMPLING METHOD	SAMPLE NUMBER	MOISTURE	FID	USCS	% RECOVERY	DESCRIPTION	Well Construct. Details
0.0	4' MAC COR	G-1 0-4'	DRY	10.0 ppm	FILL	58	ASPHALT: First 3" asphalt.	Cement/Bentonite
-1.0							FILL: Brown fill material consisting of fine to medium sand, some silt, trace gravel.	Bentonite Seal
-2.0								No. 2 Silica Sandpack (1' to 16' bgs).
-3.0			MST					PVC Screen (3'-16') 1" diameter 0.010" slot
-4.0	4' MAC COR	G-2 4'-8'		20.0 ppm		100		
-5.0					CL		CLAY: Gray clay, some silt.	
-6.0			WET					
-7.0								
-8.0	4' MAC COR	G-3 8'-12'		50.0 ppm	SP	100	SAND: Gray fine to coarse sand, trace silt.	
-9.0								
-10.0								
-11.0								
-12.0	4' MAC COR	G-4 12'-16'		100.0 ppm	SM	100	SAND: Brown fine to coarse sand, trace silt.	
-13.0							SAND: Gray fine to medium sand, trace to some silt, laminations.	
-14.0								
-15.0								
-16.0								

LITHOLOGY



WELL INSTALLATION



APPENDIX B

SOIL BORING LOGS AND MONITORING WELL CONSTRUCTION DETAILS

GOLDBERG-ZOINO & ASSOCIATES, INC.
955 CONNECTICUT AVE., BRIDGEPORT, CT
GEOTECHNICAL/GEOHYDROLOGICAL CONSULTANTS

PROJECT
U.A. Cablevision
Mamaroneck, New York

REPORT OF BORING No. G2-1
SHEET 1 OF 1
FILE No. M-50152
CHKD. BY

BORING Co. General Borings, Inc.
FOREMAN Dan Tuccillo, Jr.
GZA ENGINEER Tony Caprari

BORING LOCATION Former gas tank
GROUND SURFACE ELEVATION DATUM
DATE START 2/5/88 DATE END 2/5/88

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 in.

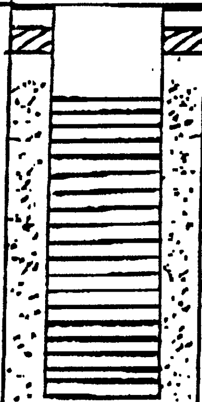
CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING A 300 lb. HAMMER FALLING 24 in.

CASING SIZE: OTHER:

GROUNDWATER READINGS

DATE	TIME	WATER	CASING	STABILIZATION TIME
2/5/88		±4'	OUT	0 Hrs
2/9/88		4.73		4 Days

DEPTH	CASING BLOWS	SAMPLE No.	PEN./REC.	DEPTH (Ft.)	BLOWS/6"	SAMPLE DESCRIPTION Burmister CLASSIFICATION	STRATUM DESCRIPTION	EQUIPMENT INSTALLED	FIELD TESTING	REMARKS
						Asphalt - No Sample			HNU	
5		S-1	24/4	5.0-7.0	7/12/6/3	Dark brown, medium to coarse SAND and GRAVEL, some Cobbles.	SAND AND GRAVEL		ND	1
10		S-2	24/10	10.0-12.0	12/7/4/9	Dark brown, fine to medium SAND, some Silt.	FINE SAND		0.4 ppm	
15		S-3	24/14	14.0-16.0	9/8/9/7	Dark brown, fine to medium SAND.	±16.0' E.O.B.		ND	2
20										
25										
30										
35										
40										



1. Soil samples field screened for volatile organic compounds using an HNU Model PI 101 Photoionization Detector. ND = Not Detected.
2. Equipment Used:
Screen - 10' of 2" 10-slot schedule 40 threaded flush joint PVC. Completed with 4' 2" PVC riser.
Setting - 3.5' to 13.5' below grade. #10 Ottawa sand to ±1' above screen. ±1' Bentonite Seal. Cement Seal to grade.

NOTES: 1) STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE AT TIMES AND UNDER CONDITIONS STATED, FLUCTUATIONS OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE

BORING No. G2-1

GOLDBERG-ZOINO & ASSOCIATES, INC.
955 CONNECTICUT AVE., BRIDGEPORT, CT
GEOTECHNICAL/GEOHYDROLOGICAL CONSULTANTS

PROJECT
U.A. Cablevision
[illegible]

REPORT OF BORING No. GZ-2
SHEET 1 OF 1
FILE No. [illegible]
CHKD. BY

BORING Co. General Borings, Inc.
FOREMAN [illegible]
GZA ENGINEER [illegible]

BORING LOCATION Adjacent to nitrogen tank
GROUND SURFACE ELEVATION DATUM
DATE START [illegible] DATE END [illegible]

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 in.

CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING A 300 lb. HAMMER FALLING 24 in.

CASING SIZE: OTHER:

GROUNDWATER READINGS

DATE	TIME	WATER	CASING	STABILIZATION TIME
2/5/88		±4'	OUT	0 Hrs
2/9/88	9:30	8.74		4 Days

DEPTH	CASING BLOWS	SAMPLE No.	PEN./REC.	DEPTH (Ft.)	BLOWS/6"	SAMPLE DESCRIPTION Burmister CLASSIFICATION	STRATUM DESCRIPTION	EQUIPMENT INSTALLED	FIELD TESTING HNu	REMARKS
		S-1	24/6	0-2.0	10/14/17/14	Brown, fine to medium SAND and SILT.	FINE SAND AND SILT		0.2 ppm	1
5		S-2	24/18	5.0-7.0	3/5/5/8	Brown-gray, fine to medium SAND and SILT, trace Clay.			ND	
10		S-3	24/24	10.0-12.0	11/11/20/25	Brown-gray, fine to medium SAND and SILT. Brown, fine to medium SAND some Cobbles.	SAND		0.2 ppm	
15		S-4	24/20	13.0-15.0	12/17/17/20	Brown, fine to medium SAND.	±15.0' E.O.B.		0.2 ppm	2
20										
25										
30										
35										
40										

1. Soil samples field screened for volatile organic compounds using an HNu Model PI 101 Photoionization Detector. ND = Not Detected
2. Equipment Used:
   Screen - 10' of 2" 10-slot schedule 40, threaded flush joint PVC. Completed with 4' 2" PVC riser.
   Setting - 2' to 12' below grade. Sand ±1' above screen. ±1' Bentonite Seal capped with 5' protective steel sleeve ±2' above grade. Cement seal to grade.

NOTES: 1) STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES. TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE AT TIMES AND UNDER CONDITIONS STATED. FLUCTUATIONS OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE

GZA BORING No. GZ-2

GOLDBERG-ZOINO & ASSOCIATES, INC. 955 CONNECTICUT AVE., BRIDGEPORT, CT GEOTECHNICAL/GEOHYDROLOGICAL CONSULTANTS	**PROJECT** U.A. Cablevision Mamaroneck, New York	REPORT OF BORING No. GZ-3 SHEET 1 of 1 FILE No. H-30152 CHKD. BY

BORING Co. General Borings, Inc.
FOREMAN Dan Tuozzolo, Jr.
GZA ENGINEER Tony Carnell

BORING LOCATION Southwest corner of building
GROUND SURFACE ELEVATION DATUM
DATE START 2/5/88 DATE END 2/5/88

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 in.

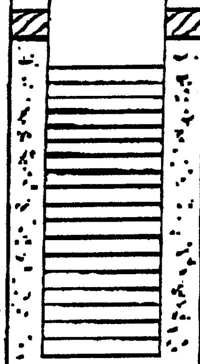
CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING A 300 lb. HAMMER FALLING 24 in.

CASING SIZE: OTHER:

GROUNDWATER READINGS

DATE	TIME	WATER	CASING	STABILIZATION TIME
2/5/88		±4'	OUT	0 Hrs
2/9/88	11:15	8.38'		4 Days

DEPTH	CASING BLOWS	SAMPLE No.	PEN./REC.	DEPTH (Ft.)	BLOWS/6"	SAMPLE DESCRIPTION Burmister CLASSIFICATION	STRATUM DESCRIPTION	EQUIPMENT INSTALLED	FIELD TESTING	REMARKS
						Asphalt - No Sample			HNu	
5		S-1	24/18	5.0-7.0	7/4/6/11	Brown, fine to medium SAND and SILT.	FINE SAND AND SILT		ND	1
10		S-2	24/20	10.0-12.0	24/17/15/26	Brown, fine to medium SAND.	SAND		0.6 ppm	
15		S-3	24/18	13.0-15.0	18/16/16/16	Brown, fine to medium SAND.	±15.0' E.O.B.		0.2 ppm	2
20										
25										
30										
35										
40										



1. Soil samples field screened for volatile organic compounds using an HNu Model PI 101 Photoionization Detector.
   ND = Not Detected
2. Equipment Used:
   Screen - 10' of 2" 10-slot schedule 40, threaded flush joint PVC. Completed with 6' 2" PVC riser.
   Setting - 3' to 13' below grade. Sand ±1' above screen. ±1' Bentonite Seal. Cement seal to grade.
   5' protective sleeve ±2' above grade. Capped with Cement seal to grade.

NOTES: 1) STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES. TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE AT TIMES AND UNDER CONDITIONS STATED. FLUCTUATIONS OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE

GZA

BORING No. GZ-3

GOLDBERG-ZOINO & ASSOCIATES, INC. 955 CONNECTICUT AVE., BRIDGEPORT, CT GEOTECHNICAL/GEOHYDROLOGICAL CONSULTANTS	PROJECT UA Cablevision Mamaroneck, NY	REPORT OF BORING No. GZ-4 SHEET 1 OF 1 FILE No. H-50190 CHKD. BY

BORING Co. East Coast Drilling
FOREMAN Tom Cotter
GZA ENGINEER Tony Carmelli

BORING LOCATION South of Ogden and Fayette corner
GROUND SURFACE ELEVATION DATUM
DATE START 5/12/88 DATE END 5/12/88

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 in.

CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING A 300 lb. HAMMER FALLING 24 in.

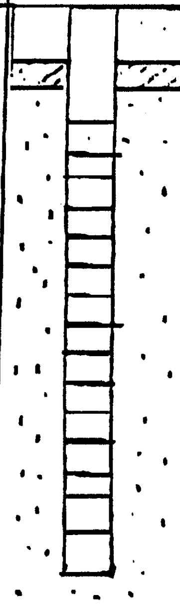
CASING SIZE: OTHER:

GROUNDWATER READINGS

DATE	TIME	WATER	CASING	STABILIZATION TIME
5/12	---	±5'	OUT	0 hrs.
5/31	---	6.46		19 days

DEPTH	CASING	BLOWS	SAMPLE No.	PEN./REC.	DEPTH (Ft.)	BLOWS/6"	SAMPLE DESCRIPTION Burmister CLASSIFICATION	STRATUM DESCRIPTION	FIELD TESTING	REMARKS
			S-1	24/12	0-2	3/3/4/6	Brown fine to medium SAND and SILT some Organic Matter.	SAND AND SILT	11.7 HNu 5.3 ppm	1
			S-2	24/12	2-4	2/2/3/2	Brown-Grey fine to medium SILT; trace Sand.		[illegible].2 ppm [illegible].0 ppm	
5			S-3	24/15	4-6	3/3/4/2	Brown-Grey fine to medium SILT and SAND.		[illegible].8 ppm [illegible].0 ppm	
			S-4	24/18	6-8	3/4/2/3	Brown fine to medium SAND, trace Silt.		[illegible].0 ppm	
10			S-5	24/20	9-11	2/2/4/5	Brown medium to coarse SAND.	SAND	7.4 ppm	
15			S-6	24/20	14-16	4/4/5/4	Brown medium to coarse SAND.		6.4 ppm	
20			S-7	24/18	19-21	3/8/6/4	Brown medium to coarse SAND.	±21' E.O.B.	6.8 ppm	2, 3
25										
30										
35										

EQUIPMENT INSTALLED



1. Soil samples field screened for volatile organic compounds using HNu Model PI 101 11.7 EV Photoionization Detector.
2. Equipment used: Screen: 15' 2" 10 slot Schedule 40 Threaded flush joint PVC completed 6' 2" PVC riser. Setting: 4-19' below grade. Clean sand backfilled from 19-3 feet below grade; Bentonite seal from 3-2 feet below grade. Clean sand backfilled to 1 foot below grade. 5' locking steel protective sleeve cemented secure ±2' above grade.
3. Well developed on 5/13/88 with 1/4-inch triloc hand pump. Approx. 10 gallons evacuated from the well.

NOTES: 1) STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES. TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE AT TIMES AND UNDER CONDITIONS STATED. FLUCTUATIONS OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE

GZA

BORING No. GZ-4

GOLDBERG-ZOINO & ASSOCIATES, INC. 955 CONNECTICUT AVE., BRIDGEPORT, CT GEOTECHNICAL/GEOHYDROLOGICAL CONSULTANTS	PROJECT UA Cablevision Mamaroneck, NY	REPORT OF BORING No. GZ-5 SHEET 1 OF 1 FILE No. W-50196 CHKD. BY

BORING Co. East Coast Drilling
FOREMAN Ken Speer
GZA ENGINEER Linda McKee

BORING LOCATION
GROUND SURFACE ELEVATION DATUM
DATE START 5/12/88 DATE END 5/12/88

PLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 in.

CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING A 300 lb. HAMMER FALLING 24 in.

CASING SIZE: OTHER:

GROUNDWATER READINGS

DATE	TIME	WATER	CASING	STABILIZATION TIME
5/12	----	± 8'	OUT	None
5/31	----	4.65		19 Days

DEPTH	CASING BLOWS	SAMPLE No.	PEN./REC.	DEPTH (Ft.)	BLOWS/6"	SAMPLE DESCRIPTION Burmister CLASSIFICATION	STRATUM DESCRIPTION	EQUIPMENT INSTALLED	FIELD TESTING	REMARKS
		S-1	24/6	0-2	3/4/3/4	Dark brown SILT, little fine sand, trace medium to coarse Sand.	SILT		10.2 EV HNU	1
		S-2	24/6	2-4	4/6/4/8	Brown-tan SILT, little Clay.	SILT		0.0 ppm	
									0.2 ppm	1
5		S-3	24/18	4-6	2/4/6/8	Brown-tan-orange SILT, little Clay trace fine Sand.			0.0 ppm	1
		S-4	24/18	6-8	9/11/12/14	Top 8" Brown orange SILT, little Clay, trace fine Sand. Bottom 10" Grey fine to medium SAND, trace Silt.			0.0 ppm	1
							SAND			2
10		S-5	24/24	10-12	6/8/22/22	Top 14" Brown-orange SILT, little clay, trace fine Sand. Bottom 10" Grey fine to coarse SAND, little Gravel, trace Silt.	SILT SAND		0.0 ppm	1
		S-6	0/0	13-13	100-0"	No sample. Auger refusal on possible boulder.	±13' E.O.B.			3, 4, 5

Soil samples field-screened with 10.2 EV HNu Photoionizer to detect volatile organic compounds.
...ple wet at approximately 8 feet.
...er refusal on possible boulder at approximately 13 feet. Boring was redrilled with roller bit and water.
... feet of 2-inch schedule 40, threaded flush-jointed, 10-slot PVC well-screen set at approx. 13 feet. Morie silica Sand placed around well from 13 to 2 feet. Bentonite seal placed around curb-box from 2 to 1 feet. Well completed with curb-box cemented in place. 5. Well developed on 5/13/88 with 1/4-inch trilock hand pump.

...S: 1) STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE AT TIMES AND UNDER CONDITIONS STATED, FLUCTUATIONS OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE

BORING No. GZ-5

GOLDBERG-ZOINO & ASSOCIATES, INC.
955 CONNECTICUT AVE., BRIDGEPORT, CT
GEOTECHNICAL/GEOHYDROLOGICAL CONSULTANTS

PROJECT
UA Cablevision
[illegible]

REPORT OF BORING No. GZ-6
SHEET 1 OF 1
FILE No. H-50196
CHKD. BY

BORING Co. East Coast Drilling
FOREMAN Tom Cotter
GZA ENGINEER [illegible]

BORING LOCATION Northeast edge of site
GROUND SURFACE ELEVATION DATUM
DATE START 5/12/88 DATE END 5/12/88

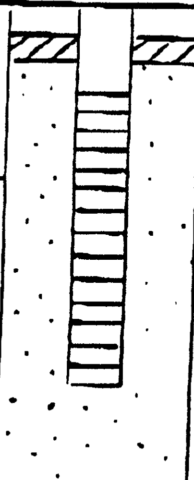
SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 in.

CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING A 300 lb. HAMMER FALLING 24 in.

CASING SIZE: OTHER:

GROUNDWATER READINGS

DATE	TIME	WATER	CASING	STABILIZATION TIME
5/2	----	±5'	OUT	0 hrs.
5/31	----	6.62		19 days

DEPTH	CASING BLOWS	SAMPLE No.	PEN./REC.	DEPTH (Ft.)	BLOWS/6"	SAMPLE DESCRIPTION Burmister CLASSIFICATION	STRATUM DESCRIPTION	EQUIPMENT INSTALLED	FIELD TESTING	REMARKS
		S-1	24/18	0-2	7/2/2/3	Brown fine to medium SAND, some organic matter, little silt.	SAND AND SILT		11.7 HNu	1
		S-2	24/4	2-4	4/3/2/3	Brown fine to medium Sand, some cobbles, little silt.			3.2 ppm; 3.0 ppm; 4.8 ppm	
5		S-3	24/18	4-6	1/1/1/4	Brown fine to medium SAND, trace silt.			14 ppm; 8 ppm	
10		S-4	24/20	9-11	4/4/5/3	Brown fine to medium SAND.	SAND		6 ppm; 5 ppm	
15		S-5	24/20	13-15	6/6/5/6	Brown fine to medium SAND.	±15' E.O.B.		4.8 ppm; 5 ppm	2, 3
20										
25										
30										
35										
40										

1. Soil samples field screened for volatile organic compounds using HNu Model PI 101 11.7 EV Photoionization Detector.
2. Equipment used: Screen: 10' 2" 10 slot Schedule 40 threaded flush joint PVC. Setting: 3-13' below grade; completed 3' 2" PVC riser. Clean sand backfilled from 13-2' below grade. Bentonite seal placed from 2-1' foot below grade; Clean sand placed from 1-1/2 foot below grade. 5' locking steel protective sleeve cemented secure ±2' above grade.
3. Well developed on 5/13/88 using a 1/2-inch trilock hand pump.

NOTES: 1) STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES. TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE AT TIMES AND UNDER CONDITIONS STATED. FLUCTUATIONS OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE

GZA

BORING No. GZ-6

GOLDBERG-ZOINO & ASSOCIATES, INC.
955 CONNECTICUT AVE., BRIDGEPORT, CT
GEOTECHNICAL/GEOHYDROLOGICAL CONSULTANTS

PROJECT
U.A. Cablevision
[illegible], NY

REPORT OF BORING NO. GZ-7
SHEET 1 OF 1
FILE No. H-50196
CHKD. BY

BORING Co. East Coast Drilling
FOREMAN [illegible]
GZA ENGINEER [illegible]

BORING LOCATION NE corner of site
GROUND SURFACE ELEVATION DATUM
DATE START 5/13/88 DATE END 5/13/88

PLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 in.

CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING A 300 lb. HAMMER FALLING 24 in.

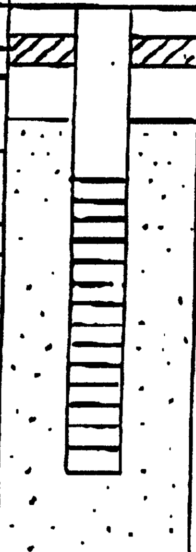
CASING SIZE: OTHER:

GROUNDWATER READINGS

DATE	TIME	WATER	CASING	STABILIZATION TIME
5/13	---	± 9'	NONE	0 hr.
5/13	---	± 8		1 hr.
5/31	----	5.09		19 days

DEPTH	CASING BLOWS	SAMPLE No.	PEN./REC.	DEPTH (Ft.)	BLOWS/6"	SAMPLE DESCRIPTION Burmister CLASSIFICATION	STRATUM DESCRIPTION	FIELD TESTING	RCMKS
		S-1	24/24	0-2	3/10/10/8	Top 18" Dark brown SILT, little fine-coarse Sand, little Gravel, trace Clay. Bottom 6" Orange-brown fine to medium SAND, trace coarse Sand, trace Silt.	SILT / SAND	10.2-HNu; 0.2 ppm; 0.4 ppm	1; 1
		S-2	24/24	2-4	3/6/8/11	Top 2" Orange brown fine-medium SAND, trace Silt. Middle 2" Dark brown organic layer. Bottom 20" (Peat) Grey SILT, little clay, trace fine Sand.	SILT	0.4 ppm; 0.6 ppm	1; 1
5		S-3	24/24	4-6	2/2/4/5	Grey-brown SILT and CLAY, trace fine Sand.	SILT AND CLAY	1.7 ppm; 5.8 ppm	1
		S-4	24/24	6-8	5/5/15/28	Top 18" Grey SILT and CLAY, trace fine Sand. Bottom 6" Grey medium to coarse SAND, little fine Sand, trace Silt. Grades into grey fine-medium SAND, trace Silt.	SAND	35 ppm; 150 ppm	
		S-5	24/18	8-10	3/5/12/17	Top 8" Brown orange SILT and clay, trace fine Sand. Bottom 8" Grey fine to coarse SAND, trace Silt.	SILT AND CLAY	15 ppm; 22 ppm	1; 1
10		S-6	24/18	10-12	4/7/8/13	Grey fine to coarse SAND, trace Silt, trace fine Gravel.	SAND	10 ppm	1
15		S-7	0/0	16-16		No sample due to running sand plugging auger.	±16' E.O.B.		3; 2

EQUIPMENT INSTALLED:



1. Soil samples field-screened with 10.2 EV HNu Photoionizer to detect volatile organic compounds.
2. Sample wet at approximately 8 feet.
3. [illegible] feet of 2-inch Schedule 40, threaded, flush-jointed, 10-slot PVC well-screen set at approximately 16 feet. [illegible] Silica sand placed around well from 16 to 4 feet. Bentonite seal placed around curb-box from 2-3 feet. Well completed with curb-box cemented in place.
4. Well developed on 5/13/88 with 1/4-inch trilock hand pump.

NOTES: 1) STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES. TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE AT TIMES AND UNDER CONDITIONS STATED. FLUCTUATIONS OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE

GZA

BORING No. GZ-7

GOLDBERG-ZOINO & ASSOCIATES, INC. 955 CONNECTICUT AVE., BRIDGEPORT, CT GEOTECHNICAL/GEOHYDROLOGICAL CONSULTANTS	PROJECT U.A. Cablevision Mamaroneck, NY	REPORT OF BORING NO. GZ-6 SHEET 1 OF 1 FILE No. W-50190 CHKD. BY

BORING Co. East Coast Drilling
FOREMAN Tom Cotter
GZA ENGINEER Tony Carmell

BORING LOCATION Adjacent to GZ-4
GROUND SURFACE ELEVATION DATUM
DATE START 5/12/88 DATE END 5/12/88

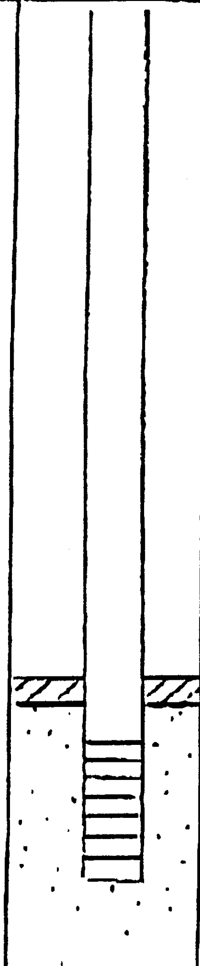
PLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 in.

CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING A 300 lb. HAMMER FALLING 24 in.

CASING SIZE: OTHER:

GROUNDWATER READINGS				
DATE	TIME	WATER	CASING	STABILIZATION TIME
5/12	----	±5	OUT	0 hrs.
5/31	----	6.85		19 days

DEPTH	CASING BLOWS	SAMPLE No.	PEN./REC.	DEPTH (Ft.)	BLOWS/6"	SAMPLE DESCRIPTION Burmister CLASSIFICATION	STRATUM DESCRIPTION	EQUIPMENT INSTALLED	FIELD TESTING	REMARKS
									11.7 HNu	1 2
5						Refer to Boring GZ-4 for soil descriptions (0-21').				
10										
15										
20										
25		S-1	24/12	25-27	5/5/7/6	Brown fine to medium SAND, some silt, trace cobbles.	SAND		5.2 ppm	
30		S-2	24/20	30-32	3/4/5/3	Brown-Grey fine-medium SAND.			2.0 ppm	
							±32' E.O.B.			3
35										



Soil samples field-screened for volatile organic compounds with HNu Model PI 101 11.7 EV Photoionization Detector.
Refer to GZ-4 boring log for sample descriptions to 25 feet.
Equipment used: Screen: 5' 2" 10 slot schedule 40 threaded flush joint PVC completed 25' 2" PVC riser; Setting: 25-30' below grade. Clean sand backfilled from 30-24 below grade. Bentonite seal from 24-23 feet below grade. Sand backfilled from 23-1 foot below grade. 5' locking steel protective sleeve cemented secure.

NOTES: 1) STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES. TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE AT TIMES AND UNDER CONDITIONS STATED. FLUCTUATIONS OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE

GZA

BORING No. GZ-6

GOLDBERG-ZOINO & ASSOCIATES, INC. 955 CONNECTICUT AVE., BRIDGEPORT, CT GEOTECHNICAL/GEOHYDROLOGICAL CONSULTANTS	PROJECT U.A. Cablevision [illegible]	REPORT OF BORING No. GZ-9 SHEET 1 OF 1 FILE No. [illegible] CHKD. BY

BORING Co. East Coast Drilling
FOREMAN [illegible]
GZA ENGINEER [illegible]

BORING LOCATION Western edge of site
GROUND SURFACE ELEVATION DATUM
DATE START 5/13/88 DATE END 5/13/88

[SA]MPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 in.

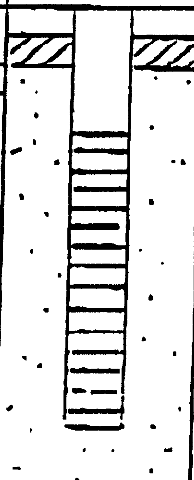
CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING A 300 lb. HAMMER FALLING 24 in.

CASING SIZE: OTHER:

GROUNDWATER READINGS

DATE	TIME	WATER	CASING	STABILIZATION TIME
5/13	---	± 10	NONE	0 hr.
5/31	---	8.70		19 days

DEPTH	CASING BLOWS	SAMPLE No.	PEN./REC.	DEPTH (Ft.)	BLOWS/6"	SAMPLE DESCRIPTION Burmister CLASSIFICATION	STRATUM DESCRIPTION	EQUIPMENT INSTALLED	FIELD TESTING	REMARKS
		S-1	24/16	0-2	3/6/9/9	Brown fine to coarse SAND, some Silt, trace fine Gravel.	SAND		10.2 HNu 0.2 ppm	1
		S-2	24/20	2-4	10/30/11/5	Top 6" Dark brown fine to coarse SAND, little fine Gravel, trace Silt. Bottom 14" Orange fine to medium SAND, some Silt, little coarse Sand, little Gravel.	SAND SILT		0.2 ppm	1
5		S-3	24/24	4-6	4/3/4/3	Top 2" Orange fine to medium SAND, some Silt, little coarse Sand. Bottom 22" Grey-tan SILT, trace Clay, trace fine Sand.			0.1 ppm 0.1 ppm	1 1
		S-4	24/6	6-8	3/5/7/8	Grey-tan SILT, trace Clay, trace fine Sand.			0.2 ppm	1
		S-5	24/24	8-10	6/12/16/18	Top 12" Grey-tan SILT, trace Clay, trace fine Sand. Bottom 12" Tan-grey fine to medium SAND, trace Silt.	SAND		0.1 ppm	1 2
10										
15		S-6	24/20	15-17	6/11/8/6	Grey fine to coarse SAND, trace fine Gravel.			0.1 ppm 0.0 ppm	1 1
							± 17' E.O.B.			
20										
25										
30										
35										
40										



[1]. Soil samples field-screened with 10.2 E.V. HNu Photoionizer to detect volatile organic compounds.
[2]. Sample wet at approximately 10 feet.
[3]. [Ten] feet of 2-inch, Schedule 40, threaded, flush-jointed, 10-slot PVC well-screen set at approximately 14.5 feet. Morie silica Sand placed around the well from 14.5 to 2 feet. Bentonite seal placed around steel protective pipe from 2-1 feet. Well completed with locked steel protective pipe cemented in place.
[4]. Well developed on 5/13/88 with 1/4-inch trilock hand pump.

NOTES: 1) STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE AT TIMES AND UNDER CONDITIONS STATED, FLUCTUATIONS OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE

GZA

BORING No. GZ-9

GOLDBERG-ZOINO & ASSOCIATES, INC.
955 CONNECTICUT AVE., BRIDGEPORT, CT
GEOTECHNICAL/GEOHYDROLOGICAL CONSULTANTS

PROJECT
U.A. Cablevision
[illegible], NY

REPORT OF BORING No. B-1
SHEET 1 OF 1
FILE No. W-50196
CHKD. BY

BORING CO. East Coast Drilling
FOREMAN [illegible]
GZA ENGINEER [illegible]

BORING LOCATION
GROUND SURFACE ELEVATION DATUM
DATE START 5/12/88 DATE END 5/12/88

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 in.

CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING A 300 lb. HAMMER FALLING 24 in.

CASING SIZE: OTHER:

GROUNDWATER READINGS

DATE	TIME	WATER	CASING	STABILIZATION TIME
5/12	---	±8	NONE	0 hr.

DEPTH	CASING	BLOWS	SAMPLE No.	PEN./REC.	DEPTH (Ft.)	BLOWS/6"	SAMPLE DESCRIPTION Burmister CLASSIFICATION	STRATUM DESCRIPTION	EQUIPMENT INSTALLED	FIELD TESTING	REMARKS
			S-1	24/12	0-2	10/12/16/14	Asphalt Surface. Brown Black medium-coarse SAND, some Gravel, little Silt (fill).	SAND	NONE	10.2 HNU 0.0 ppm 0.0 ppm	1 1
			S-2	24/14	2-4	10/6/6/4	Brown fine coarse SAND, some silt, little fine Gravel.			0.0 ppm 0.0 ppm	1 1
5			S-3	24/24	4-6	4/4/6/5	Top 8" Orange brown SILT, little fine Sand. Bottom 16" Grey fine-medium SAND, trace Silt.	SILT		0.0 ppm 0.0 ppm	1 1
			S-4	24/24	6-8	6/6/5/8	Grey fine-medium SAND, trace coarse Sand, trace Silt.	SAND		0.0 ppm 0.0 ppm	1 1
								±8' E.O.B.			2 3
10											
15											
20											
25											
30											
35											
40											

REMARKS:

1. Soil samples field-screened with 10.2 E.V. HNU Photoionizer to detect volatile organic compounds.
2. Sample wet at approximately 8 feet.
3. Boring ended at approximately 8 feet.

NOTES: 1) STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES. TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE AT TIMES AND UNDER CONDITIONS STATED. FLUCTUATIONS OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE

GZA

BORING No. B-1

GOLDBERG-ZOINO & ASSOCIATES, INC.
955 CONNECTICUT AVE., BRIDGEPORT, CT
GEOTECHNICAL/GEOHYDROLOGICAL CONSULTANTS

PROJECT
U.A. Cablevision
Mamaroneck, NY

REPORT OF BORING NO. B-2
SHEET 1 OF 1
FILE No. R-30196
CHKD. BY

BORING Co. East Coast Drilling
FOREMAN Ken Spear
GZA ENGINEER Lynda McKee

BORING LOCATION
GROUND SURFACE ELEVATION DATUM
DATE START 5/12/88 DATE END 5/12/88

MPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 in.

CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING A 300 lb. HAMMER FALLING 24 in.

CASING SIZE: OTHER:

GROUNDWATER READINGS

DATE	TIME	WATER	CASING	STABILIZATION TIME
5/12	---	±6	NONE	0 hr.

DEPTH	CASING BLOWS	SAMPLE No.	PEN./REC.	DEPTH (Ft.)	BLOWS/6"	SAMPLE DESCRIPTION Burmister CLASSIFICATION	STRATUM DESCRIPTION	EQUIPMENT INSTALLED	FIELD TESTING	REMARKS
		S-1	24/10	0-2	10/9/20/17	Asphalt surface Black grey fine-coarse SAND, some Gravel, little Silt.	SAND	NONE	10.2 HNU 0.0 ppm	1
		S-2	24/16	2-4	12/4/3/4	Black-grey-white GRAVEL, some medium-coarse Sand, little fine Sand, little Silt.	GRAVEL		0.0 ppm 0.0 ppm	1 1
5		S-3	24/24	4-6	5/5/6/18	Orange brown SILT, little fine Sand.	SILT		0.0 ppm 0.0 ppm	1 1 2
		S-4	24/24	6-8	6/9/6/9	Grey medium-coarse SAND, little fine Sand, trace Silt.	SAND		0.0 ppm 0.0 ppm	1 3
10							±8' E.O.B.			
5										
0										
5										
5										

REMARKS:

1. Soil samples field-screened with 10.2 E.V. HNu Photoionizer to detect volatile organic compounds.
2. Sample wet at approximately 6 feet.
3. Boring ended at approximately 8 feet.

ES: 1) STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE AT TIMES AND UNDER CONDITIONS STATED, FLUCTUATIONS OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE

GZA

BORING No. B-2

GOLDBERG-ZOINO & ASSOCIATES, INC.
955 CONNECTICUT AVE., BRIDGEPORT, CT

GEOTECHNICAL/GEOHYDROLOGICAL CONSULTANTS

PROJECT

U.A. Cablevision
[illegible]

REPORT OF BORING No. B-3
SHEET 1 OF 1
FILE No. H-50196
CHKD. BY

BORING Co. East Coast Drilling
FOREMAN [illegible]
GZA ENGINEER [illegible]

BORING LOCATION
GROUND SURFACE ELEVATION   DATUM
DATE START 5/12/88   DATE END 5/12/88

MPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 in.

CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING A 300 lb. HAMMER FALLING 24 in.

CASING SIZE: OTHER:

GROUNDWATER READINGS

DATE	TIME	WATER	CASING	STABILIZATION TIME
5/12	---	± 8'	NONE	0

DEPTH	CASING	BLOWS	SAMPLE No.	PEN./REC.	DEPTH (Ft.)	BLOWS/6"	SAMPLE DESCRIPTION Burmister CLASSIFICATION	STRATUM DESCRIPTION	EQUIPMENT INSTALLED	FIELD TESTING	REMARKS
			S-1	24/16	0-2	3/8/22/14	Asphalt Surface Black brown fine to coarse SAND, little Gravel, little Silt, trace coal (fill?)	SAND	NONE	10.2 HNu 0.6 ppm	1
			S-2	24/24	2-4	7/3/3/4	No sample from B-3 From B-3A (3 feet south of B-3) Orange brown SILT, little clay, trace fine sand.	SILT		0.6 ppm 0.5 ppm	1 1
5			S-3	24/20	4-6	4/4/8/8	Grey fine to medium SAND, trace Silt.	SAND		0.6 ppm 1.0 ppm	1 1
			S-4	24/20	6-8	6/10/10/8	Top 4" Orange brown SILT, little clay. Middle 2" Dark brown-black SILT, trace fine sand. (odor) Bottom 14" Grey SILT, trace fine Sand that grades into grey fine to medium sand, little Silt.	SILT SAND ±8' E.O.B.		0.5 ppm 0.2 ppm	2 3
10											
15											
20											
25											
30											
35											
40											

REMARKS:

1. Soil samples field-screened with 10.2 ev HNu Photoionizer to detect volatile organic compounds.
2. Sample wet at approximately 8 feet.
3. Boring ended at approximately 8 feet.

NOTES: 1) STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES. TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE AT TIMES AND UNDER CONDITIONS STATED. FLUCTUATIONS OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE

GZA

BORING No. B-3

GOLDBERG-ZOINO & ASSOCIATES, INC. 955 CONNECTICUT AVE., BRIDGEPORT, CT GEOTECHNICAL/GEOHYDROLOGICAL CONSULTANTS	PROJECT U.A. Cablevision [illegible], NY	REPORT OF BORING No. B-5 SHEET 1 OF 1 FILE No. R-5010A CHKD. BY

BORING Co. East Coast Drilling
FOREMAN Tom Lotter
GZA ENGINEER Tony Carmel

BORING LOCATION North Central side of site
GROUND SURFACE ELEVATION DATUM
DATE START 5/13/88 DATE END 5/13/88

MPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 in.

CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING A 300 lb. HAMMER FALLING 24 in.

CASING SIZE: OTHER:

GROUNDWATER READINGS

DATE	TIME	WATER	CASING	STABILIZATION TIME
5/13	---	± 7'	OUT	None

DEPTH	CASING BLOWS	SAMPLE No.	PEN./REC.	DEPTH (Ft.)	BLOWS/6"	SAMPLE DESCRIPTION Burmister CLASSIFICATION	STRATUM DESCRIPTION	EQUIPMENT INSTALLED	FIELD TESTING 11.7 HNu	REMARKS
		S-1	24/18	0-2	4/6/5/4	Brown fine to medium SAND and Silt some cobbles.	SAND	NONE	4.6 ppm 4.8 ppm	1
		S-2	24/20	2-4	5/6/4/3	Brown fine to medium SAND and SILT some cobbles, trace rotten wood.	SAND AND SILT		7.0 ppm 5.0 ppm	
5		S-3	24/18	4-6	4/3/4/4	Brown grey fine to medium SILT and Clay.	SILT AND CLAY		6.0 ppm 4.4 ppm	
		S-4	24/20	6-8	5/5/5/4	Brown fine to medium SAND. Some Silt.	SAND		6.0 ppm 5.0 ppm	2
							± 8' E.O.B.			
10										
5										
0										
25										
1										
5										

REMARKS:

1. Soil samples field screened for volatile organic compounds HNu Model PI 101 11.7 e.v. Photoionization Detector.
2. Soil boring completed to water table.

TES: 1) STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE AT TIMES AND UNDER CONDITIONS STATED. FLUCTUATIONS OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE

2A

BORING No. B-5

GOLDBERG-ZOINO & ASSOCIATES, INC.
955 CONNECTICUT AVE., BRIDGEPORT, CT
GEOTECHNICAL/GEOHYDROLOGICAL CONSULTANTS

PROJECT
U.A. Cablevision
Mamaroneck, NY

REPORT OF BORING No. B-6
SHEET 1 OF 1
FILE No. H-50196
CHKD. BY

BORING Co. East Coast Drilling
FOREMAN Tom Cotter
GZA ENGINEER Tony Carmelli

BORING LOCATION Northwest side of site
GROUND SURFACE ELEVATION DATUM
DATE START 5/13/88 DATE END 5/13/88

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 in.

CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING A 300 lb. HAMMER FALLING 24 in.

CASING SIZE: OTHER:

GROUNDWATER READINGS

DATE	TIME	WATER	CASING	STABILIZATION TIME
5/13	---	±5'	OUT	None

DEPTH	CASING BLOWS	SAMPLE No.	PEN./REC.	DEPTH (Ft.)	BLOWS/6"	SAMPLE DESCRIPTION Burmister CLASSIFICATION	STRATUM DESCRIPTION	EQUIPMENT INSTALLED	FIELD TESTING	REMARKS
		S-1	24/12	0-2	6/5/8/30	Brown fine to coarse SAND and GRAVEL, FILL.	SAND	NONE	11.7 HNu	
									5.4 ppm	1
		S-2	24/20	2-4	99/99/55/73	White fine to coarse QUARTZ and CONCRETE.	CONCRETE		3.2 ppm	
		S-3	24/20	4-6	5/4/6/5	Brown fine to medium SAND and SILT	SAND		42 ppm 76 ppm	
5							±6'			
							E.O.B.			2
10										
15										
20										
25										
30										
35										
40										

REMARKS:

1. Soil samples field screened for volatile organic compounds using HNu Model PI 101 11.7 EV Photoionization Detector.
2. Soil boring completed to water table.

NOTES: 1) STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE AT TIMES AND UNDER CONDITIONS STATED. FLUCTUATIONS OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE

GZA

BORING No. B-6

GOLDBERG-ZOINO & ASSOCIATES, INC.
955 CONNECTICUT AVE., BRIDGEPORT, CT
GEOTECHNICAL/GEOHYDROLOGICAL CONSULTANTS

PROJECT	REPORT OF BORING No. B-7
U.A. Cablevision	SHEET 1 OF 1
Mamaroneck, NY	FILE No. W-50196
	CHKD. BY

BORING Co. East Coast Drilling
FOREMAN Tom Cotter
GZA ENGINEER Tony Cammett

BORING LOCATION West of GZ-2
GROUND SURFACE ELEVATION DATUM
DATE START 5/13/88 DATE END 5/13/88

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 in.

CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING A 300 lb. HAMMER FALLING 24 in.

CASING SIZE: OTHER:

GROUNDWATER READINGS

DATE	TIME	WATER	CASING	STABILIZATION TIME
5/13	---	±5'	OUT	0 hrs.

DEPTH	CASING BLOWS	SAMPLE No.	PEN./REC.	DEPTH (Ft.)	BLOWS/6"	SAMPLE DESCRIPTION Burmister CLASSIFICATION	STRATUM DESCRIPTION	EQUIPMENT INSTALLED	FIELD TESTING	REMARKS
		S-1	24/12	0-2	5/4/6/5	Brown fine to coarse SAND and FILL	SAND	NONE	11.7 HNu	
									2.0 ppm 1.2 ppm	1
		S-2	24/18	2-4	9/15/9/4	Brown fine to coarse SAND and FILL			5.0 ppm 4.0 ppm	
5		S-3	24/18	4-6	2/2/4/4	Brown-gray fine to medium SAND and SILT.	SAND AND SILT ±6'		0.4 ppm 2.0 ppm	
							E.O.B.			2
10										
15										
20										
25										
30										
35										
40										

REMARKS:

1. Soil samples field screened for volatile organic compounds using HNu Model PI 101 11.7 EV Photoionization Detector.
2. Soil boring completed to water table.

NOTES: 1) STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES. TRANSITIONS MAY BE GRADUAL. 2) WATER LEVEL READINGS HAVE BEEN MADE AT TIMES AND UNDER CONDITIONS STATED. FLUCTUATIONS OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE

GZA

BORING No. B-7

GOLDBERG-ZOINO & ASSOCIATES, INC.
955 CONNECTICUT AVE., BRIDGEPORT, CT

GEOTECHNICAL/GEOHYDROLOGICAL CONSULTANTS

PROJECT
U.A. Cablevision
Mamaroneck, NY

REPORT OF BORING No. B-8
SHEET 1 OF 1
FILE NO. R-50146
CHKD. BY

BORING Co. East Coast Drilling
FOREMAN Tom Cotter
GZA ENGINEER [illegible]

BORING LOCATION Ground Level Parking Area
GROUND SURFACE ELEVATION DATUM
DATE START 5/13/88 DATE END 5/13/88

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 in.

CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING A 300 lb. HAMMER FALLING 24 in.

CASING SIZE: OTHER:

GROUNDWATER READINGS				
DATE	TIME	WATER	CASING	STABILIZATION TIME
5/13	---	±6'	OUT	None

DEPTH	CASING BLOWS	SAMPLE No.	PEN./REC.	DEPTH (Ft.)	BLOWS/6"	SAMPLE DESCRIPTION Burmister CLASSIFICATION	STRATUM DESCRIPTION	EQUIPMENT INSTALLED	FIELD TESTING	REMARKS
						ASPHALT	ASPHALT		11.7 HNU	
		S-1	24/12	1-3	6/5/7/3	Brown fine to medium SAND and SILT some cobbles.	SAND AND SILT	NONE	4.2 ppm 5.0 ppm	1
		S-2	24/18	3-5	5/7/4/8	Brown fine to medium SAND.	SAND		3.2 ppm 3.6 ppm	
5		S-3	24/18	5-7	5/4/4/6	Brown SILT and Clay.	SILT AND CLAY ±7'		4.2 ppm 3.2 ppm	2
							E.O.B.			
10										
15										
20										
25										
30										
35										
40										

REMARKS:

1. Soil samples field screened for volatile organic compounds using HNU model PI 101 11.7 EV Photoionization Detector.
2. Soil boring completed to water table.

NOTES:
1) STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES. TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE AT TIMES AND UNDER CONDITIONS STATED. FLUCTUATIONS OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE

GZA

BORING No. B-8

GOLDBERG-ZOINO & ASSOCIATES, INC. 955 CONNECTICUT AVE., BRIDGEPORT, CT GEOTECHNICAL/GEOHYDROLOGICAL CONSULTANTS	PROJECT U.A. Cablevision Mamaroneck, NY	REPORT OF BORING No. B-9 SHEET 1 OF 1 FILE No. H-50196 CHKD. BY

BORING Co. East Coast Drilling
FOREMAN Tom Cotter
GZA ENGINEER Tony Carnell

BORING LOCATION North Central edge of Building
GROUND SURFACE ELEVATION DATUM
DATE START 5/13/88 DATE END 5/13/88

IPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 in.

CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING A 300 lb. HAMMER FALLING 24 in.

CASING SIZE: OTHER:

GROUNDWATER READINGS

DATE	TIME	WATER	CASING	STABILIZATION TIME
5/13	---	±5'	OUT	None

DEPTH	CASING BLOWS	SAMPLE No.	PEN./REC.	DEPTH (Ft.)	BLOWS/6"	SAMPLE DESCRIPTION Burmister CLASSIFICATION	STRATUM DESCRIPTION	EQUIPMENT INSTALLED	FIELD TESTING	REMKS
		S-1	24/18	0-2	15/8/8/5	Top 6" Asphalt Bottom 12" Brown fine to medium SAND and SILT.	Asphalt	NONE	11.7 HNu N.D.	1
		S-2	24/20	2-4	4/4/4/5	Brown fine to medium SAND and SILT trace clay.	SAND AND SILT		4.0 ppm 4.0 ppm 3.0 ppm	
5		S-3	24/20	4-6	3/2/2/2	Brown grey fine to medium SAND and SILT. 5-1/2-6 Brown fine SAND.	±6' E.O.B.		3.2 ppm 3.0 ppm	2
10										
15										
20										
25										
30										
35										

REMARKS:

1. Soil samples field screened for volatile organic compounds using HNu Model PI 101 11.7 EV Photoionization Detector.
2. Soil boring completed to water table.

NOTES: 1) STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES. TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE AT TIMES AND UNDER CONDITIONS STATED. FLUCTUATIONS OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE

GZA

BORING No. B-9

GOLDBERG-ZOINO & ASSOCIATES, INC.
955 CONNECTICUT AVE., BRIDGEPORT, CT
GEOTECHNICAL/GEOHYDROLOGICAL CONSULTANTS

PROJECT
U.A. Cablevision
[illegible], NY

REPORT OF BORING No. B-10
SHEET
FILE No. R-50196
CHKD. BY

BORING Co. East Coast Drilling
FOREMAN Tom Cotter [illegible]
G2A ENGINEER [illegible]

BORING LOCATION East of Boring B-9
GROUND SURFACE ELEVATION DATUM
DATE START 5/13/88 DATE END 5/13/88

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 in.

CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING A 300 lb. HAMMER FALLING 24 in.

CASING SIZE: OTHER:

GROUNDWATER READINGS

DATE	TIME	WATER	CASING	STABILIZATION TIME
5/13	•••	± 5'	OUT	None

DEPTH	CASING BLOWS	SAMPLE No.	PEN./REC.	DEPTH (Ft.)	BLOWS/6"	SAMPLE DESCRIPTION Burmister CLASSIFICATION	STRATUM DESCRIPTION	EQUIPMENT INSTALLED	FIELD TESTING	REMARKS
		S-1	24/28	0-2	28/6/6/4	Top 6" Asphalt Bottom 12" Brown fine to medium SAND, trace Silt.	ASPHALT	NONE	11.7 HNU 4.8 ppm 4.0 ppm	1
		S-2	24/20	2-4	5/4/4/5	Brown fine to medium SAND and SILT	SAND AND SILT		3.2 ppm 4.0 ppm	
5		S-3	24/20	4-6	6/6/5/6	Brown fine to medium SAND and SILT	±6' E.O.B.		2.0 ppm 3.0 ppm	2
10										
15										
20										
25										
30										
35										

REMARKS:

1. Soil samples field screened for volatile organic compounds with HNU Model PI 101 11.7 EV Photoionization Detector
2. Soil boring completed to water table.

NOTES: 1) STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES. TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE AT TIMES AND UNDER CONDITIONS STATED. FLUCTUATIONS OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE

GZA

BORING No. B-10

FIELD BOREHOLE LOG

BOREHOLE NUMBER: MW-01

PROJECT NUMBER: **050035673.00**
PROJECT NAME: **FORMER EMCA SITE 360025**
LOACATION: **MAMARONECK, NY**
DRILLING CO: **ADT**
DRILLING METHOD: **GEOPROBE: 2" MACRO-CORE**
FIELD PARTY: **LLOYD/VICTOR**
GEOLOGIST: **J. VOUGHT**
DATE BEGUN: **10/5/99** DATE COMPLETED: **10/5/99**

FIELD BOOK NO: ---
TOTAL DEPTH: **16.0'**
GROUND SURFACE ELEVATION: ---

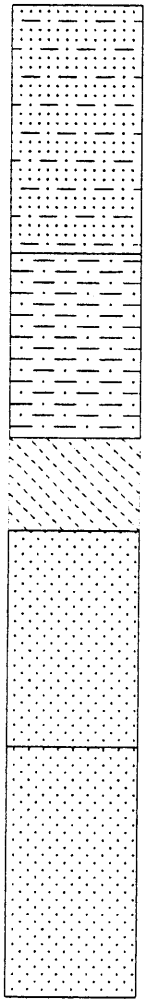
STATIC WATER LEVEL (BLS)

Depth (ft)	6'	

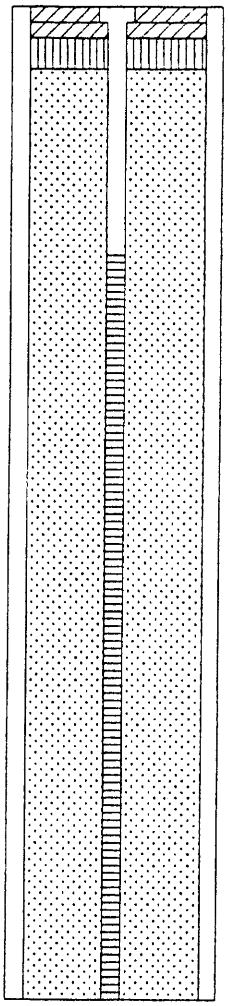
NOTE: Well secured with flushmount casing and locking cap.

DEPTH	SAMPLING METHOD	SAMPLE NUMBER	MOISTURE	FID	USCS	% RECOVERY	DESCRIPTION	Well Construct. Details
0.0	4' MAC COR	G-1 0-4'	DRY	7.0 ppm	SM	85	SAND AND SILT: Fine sand, some silt, trace gravel.	Cement/Bentonite; Bentonite; No. 2 Silica sandpack (1' to 16' bgs).
-4.0	4' MAC COR	G-2 4'-8'	MST	8.0 ppm		100	SILT: Silt, some fine sand.	PVC Screen 1" d. 0.010" slot
-5.0					ML			
-6.0			WET					
-7.0					CL		CLAY: Clay, some silt.	
-8.0	4' MAC COR	G-3 8'-12'		10.0 ppm		100		
-8.5							SAND: Fine to coarse sand, trace silt.	
-9.0					SM			
-10.0					SW			
-11.0					SM			
-12.0	4' MAC COR	G-4 12'-16.0'		16.0 ppm	SW	75	SAND: Fine to coarse sand.	
-16.0								

LITHOLOGY



WELL INSTALLATION



FIELD BOREHOLE LOG

BOREHOLE NUMBER: MW-02

PROJECT NUMBER: **050035673.00**
PROJECT NAME: **FORMER EMCA SITE 360025**
LOACATION: **MAMARONECK, NY**
DRILLING CO: **ADT**
DRILLING METHOD: **GEOPROBE: 2" MACRO-CORE**
FIELD PARTY: **LLOYD/VICTOR**
GEOLOGIST: **J. VOUGHT**
DATE BEGUN: **10/5/99** DATE COMPLETED: **10/5/99**

FIELD BOOK NO: —
TOTAL DEPTH: **16.0'**
GROUND SURFACE ELEVATION: —

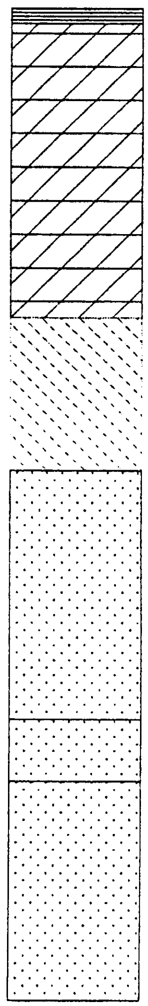
STATIC WATER LEVEL (BLS)

Depth (ft)	6'	

NOTE: Well secured with flushmount casing and locking cap.

DEPTH	SAMPLING METHOD	SAMPLE NUMBER	MOISTURE	FID	USCS	% RECOVERY	DESCRIPTION
0.0	4' MAC COR	G-1 0-4'	DRY	10.0 ppm	FILL	58	ASPHALT: First 3" asphalt.
-1.0							FILL: Brown fill material consisting of fine to medium sand, some silt, trace gravel.
-3.0			MST				
-4.0	4' MAC COR	G-2 4'-8'		20.0 ppm		100	
-5.0					CL		CLAY: Gray clay, some silt.
-6.0			WET				
-7.5					SP		SAND: Gray fine to coarse sand, trace silt.
-8.0	4' MAC COR	G-3 8'-12'		50.0 ppm		100	
-11.5							SAND: Brown fine to coarse sand, trace silt.
-12.0	4' MAC COR	G-4 12'-16'		100.0 ppm		100	
-12.5					SM		SAND: Gray fine to medium sand, trace to some silt, laminations.
-16.0							

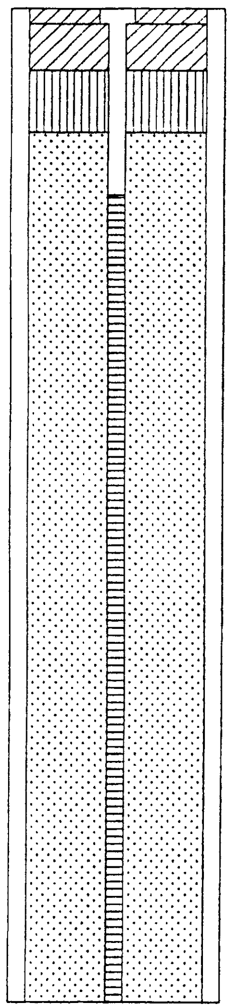
LITHOLOGY



Well Construct. Details

Depth	Well Construct. Details
0.0 to -1.0	Cement/Bentonite
-1.0 to -2.0	Bentonite Seal
-2.0 to -16.0	No. 2 Silica Sandpack (1' to 16' bgs).
-3.0 to -16.0	PVC Screen (3'-16') 1" diameter 0.010" slot.

WELL INSTALLATION



FIELD BOREHOLE LOG

BOREHOLE NUMBER: MW-03

PROJECT NUMBER: 050035673.00
PROJECT NAME: FORMER EMCA SITE 360025
LOACATION: MAMARONECK, NY
DRILLING CO: ADT
DRILLING METHOD: GEOPROBE: 2" MACRO-CORE
FIELD PARTY: LLOYD/VICTOR
GEOLOGIST: J. VOUGHT
DATE BEGUN: 10/5/99 DATE COMPLETED: 10/5/99

FIELD BOOK NO: ---
TOTAL DEPTH: 16.0'
GROUND SURFACE ELEVATION: ---

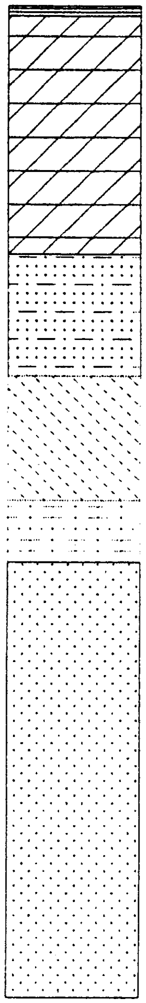
STATIC WATER LEVEL (BLS)

Depth (ft)	6'	

NOTE: Well secured with flushmount casing and locking cap.

DEPTH	SAMPLING METHOD	SAMPLE NUMBER	MOISTURE	FID	USCS	% RECOVERY	DESCRIPTION
0.0	4' MAC COR	G-1 0-4'	DRY	7.0 ppm	FILL	83	ASPHALT: First 2" asphalt.
							FILL: Brown fine to coarse sand, some fine gravel, asphalt and glass, trace cobbles.
-4.0	4' MAC COR	G-2 4'-8'	MST	4.0 ppm	ML	100	SAND AND SILT: Brown silt, trace fine sand.
-6.0			WET		CL		CLAY: Brown clay, some silt.
-8.0	4' MAC COR	G-3 8'-12'		7.0 ppm	ML	88	CLAY AND SILT: Brown silt, some clay.
-9.0					SW		SAND: Brown fine to coarse sand, trace silt.
-12.0	4' MAC COR	G-4 12'-16'		5.0 ppm		100	
-16.0							

LITHOLOGY



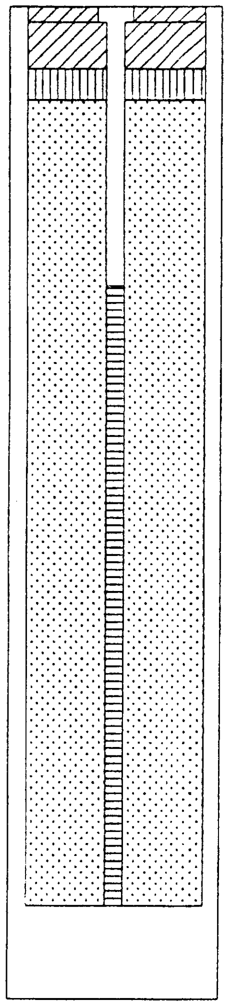
Well Construct. Details

Cement/Bentonite

Bentonite Seal

No. 2 Silica Sandpack (1.5' to 14.5' bgs) 1" PVC Screen 0.010" slot (4.5' to 14.5').

WELL INSTALLATION



FIELD BOREHOLE LOG

BOREHOLE NUMBER: MW-04

PROJECT NUMBER: **050035673.00**
PROJECT NAME: **FORMER EMCA SITE 360025**
LOACATION: **MAMARONECK, NY**
DRILLING CO: **ADT**
DRILLING METHOD: **GEOPROBE: 2" MACRO-CORE**
FIELD PARTY: **LLOYD/VICTOR**
GEOLOGIST: **J. VOUGHT**
DATE BEGUN: **10/5/99** DATE COMPLETED: **10/5/99**

FIELD BOOK NO: —
TOTAL DEPTH: **31.0**
GROUND SURFACE ELEVATION: —

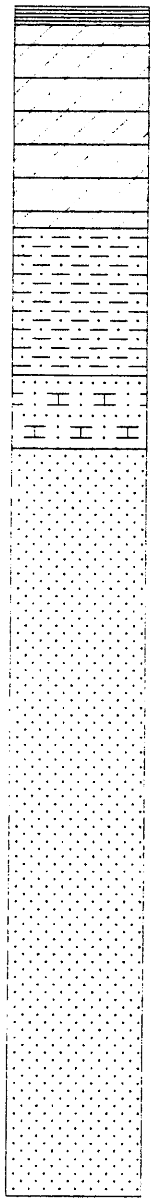
STATIC WATER LEVEL (BLS)

Depth (ft)		

NOTE: Well secured with flushmount casing and locking cap.

DEPTH	SAMPLING METHOD	SAMPLE NUMBER	MOISTURE	FID	USCS	% RECOVERY	DESCRIPTION
0.0	4' MAC COR	G-1 0-4'	DRY	12.0 ppm	FILL	71	ASPHALT: First 3" asphalt.
-1.0							FILL: Brown fill material consisting of fine to medium sand, some silt, trace gravel.
-2.0							
-3.0			MST		ML		SILT: Brown silt, some fine sand.
-4.0	4' MAC COR	G-2 4'-8'		8.0 ppm		100	
-5.0					CL		CLAY AND SILT: Gray silt and clay.
-6.0			WET		SM		SAND: Fine to coarse sand, trace fine to medium gravel.
-7.0							
-8.0	4' MAC COR	G-3 8'-12'		3.0 ppm		100	
-9.0							
-10.0					SW		
-11.0							
-12.0	4' MAC COR	G-4 12'-16'		3.0 ppm		100	
-13.0							
-14.0							
-15.0							
-16.0							

LITHOLOGY



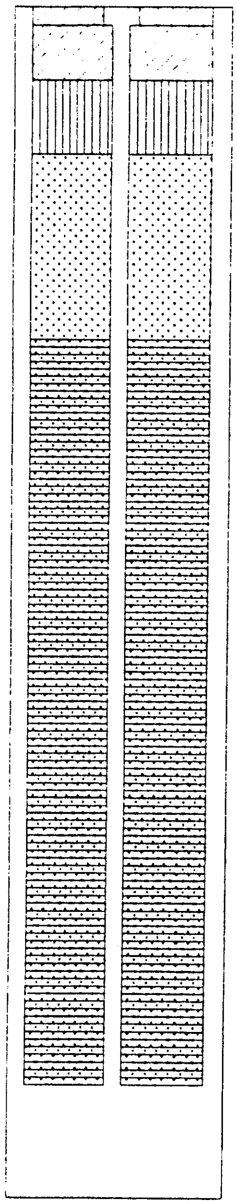
Well Construct. Details

Cement/Bentonite

Bentonite Seal

No. 2 Silica Sandpack (2' to 14.5' bgs). PVC Screen (4.5'-14.5') 1" diameter 0.010" slot.

WELL INSTALLATION



FIELD BOREHOLE LOG

BOREHOLE NUMBER: MW-05

PROJECT NUMBER: 050035673.00
PROJECT NAME: FORMER EMCA SITE 360025
LOACATION: MAMARONECK, NY
DRILLING CO: ADT
DRILLING METHOD: GEOPROBE: 2" MACRO-CORE
FIELD PARTY: T. HEBERT
GEOLOGIST: J. VOUGHT
DATE BEGUN: 7/11/00 DATE COMPLETED: 7/11/00

FIELD BOOK NO: —
TOTAL DEPTH: 16
GROUND SURFACE ELEVATION: —

STATIC WATER LEVEL (BLS)

Depth (ft)		

NOTE: Well secured with flushmount casing and locking cap.

DEPTH	SAMPLING METHOD	SAMPLE NUMBER	MOISTURE	FID	USCS	% RECOVERY	DESCRIPTION	Well Construct. Details
0.0	Post Hole Digger	NA	DRY	0.0 ppm		NA	SAND: Fine to medium sand, some silt, some fine to course gravel, trace cobbles	GROUTED ANNULUS: Cement/Bentonite
-1.0								BENTONITE: Bentonite Seal
-2.0					FILL			
-3.0								SAND: No. 2 Silica Sandpack (3' to 16' bgs). PVC Screen (4'-16') 1" diameter 0.010" slot
-4.0	4' MAC COR	C-1	MST			90	SAND AND SILT: Fine sand and silt, trace clay	
-5.0					SM			
-6.0								
-7.0			WET		ML		SILT: Silt, some clay	
-8.0	4' MAC COR	C-2				100		
-9.0					SM		SAND AND SILT: Fine to medium sand and silt	
-10.0							SAND: Fine to course sand, trace silt	
-11.0								
-12.0	4' MAC COR	C-3				100		
-13.0								
-14.0								
-15.0								
-16.0								

LITHOLOGY

WELL INSTALLATION

FIELD BOREHOLE LOG

BOREHOLE NUMBER: SG-06

PROJECT NUMBER: **050035673.00**
PROJECT NAME: **FORMER EMCA SITE 360025**
LOACATION: **MAMARONECK, NY**
DRILLING CO: **ADT**
DRILLING METHOD: **GEOPROBE: 2" MACRO-CORE**
FIELD PARTY: **T. HEBERT**
GEOLOGIST: **J. VOUGHT**
DATE BEGUN: **7/11/00** DATE COMPLETED: **7/11/00**

FIELD BOOK NO: **—**
TOTAL DEPTH: **4.5**
GROUND SURFACE ELEVATION: **—**

STATIC WATER LEVEL (BLS)

Depth (ft)		

DEPTH	SAMPLING METHOD	SAMPLE NUMBER	MOISTURE	FID	USCS	% RECOVERY	DESCRIPTION	LITHOLOGY	Well Construct. Details	WELL INSTALLATION
0.0 to -2.0	Macro Core	C-1	DRY	0.0 ppm	FILL	75	SAND: Fine to medium sand, some silt, trace fine gravel			
-2.0 to -4.5							SAND AND SILT: Fine sand and silt, some fine to course gravel			
-4.5 to -6.0							*SG-06 taken from 4.0-4.5 feet below grade and submitted for VOC and Freon 113 analysis (TO-14a)			

URS Corporation

BORING LOG

BORING NO:	MW-06
SHEET:	1 OF 1
JOB NO.:	11172730
BORING LOCATION:	
GROUND ELEVATION:	
DATE STARTED:	06/09/03
DATE FINISHED:	06/09/03
EQUIPMENT OPERATOR:	L. Caballero
GEOLOGIST:	Steve Moeller
REVIEWED BY:	

PROJECT:	Former EMCA Site
CLIENT:	Rohm & Haas Company
BORING CONTRACTOR:	Zebra Environmental

GROUNDWATER:

DATE	TIME	LEVEL	TYPE
6/10/03	11:00	4.78 ft.	

	CASING	SAMPLER
TYPE		macrocore
DIA.		
WT.		
FALL		

DEPTH (Ft.)	SAMPLE NO.	TYPE	REC. (%)	COLOR	MOISTURE	PID (ppm)	FID (ppm)	MATERIAL DESCRIPTION	REMARKS
0–4	1	GP	84	black/ brown tan/ gray	moist	bkg	bkg	Asphalt (poor condition) over sand & gravel subbase [6"] over well graded sand with rounded gravel [6"] over silty Clay [6"] Sand with rounded gravel, well graded, over silty Clay, orange brown grading to olive brown, firm, plastic.	background meas. PID = -0.55 ppm FID = -18 ppm
4–8 (5)	2	GP	0					No sample	
8–12 (10)	3	GP	63	gray, greenish brown	wet	19	40	Sand, well graded, trace to some gravel, gray, slight odor [6"-8"] over greenish brown sand, as above.	no odor
12–16 (15)	4	GP	100	brown gray	wet	bkg	bkg	As above, brown (f) Sand, gray, micaceous	
16–20	5	GP	100	brown, gray	wet	bkg	bkg	(f) Sand, trace silt	
20								Boring Completed at 20 ft. Monitoring Well Installed	
25									
30									
35									

COMMENTS: Boring advanced with Geoprobe (direct-push) rig.

PROJECT NO.	11172730
BORING NO.	MW-06

DRILLING SUMMARY

Geologist:
Steve Moeller

Drilling Company:
Zebra Environmental

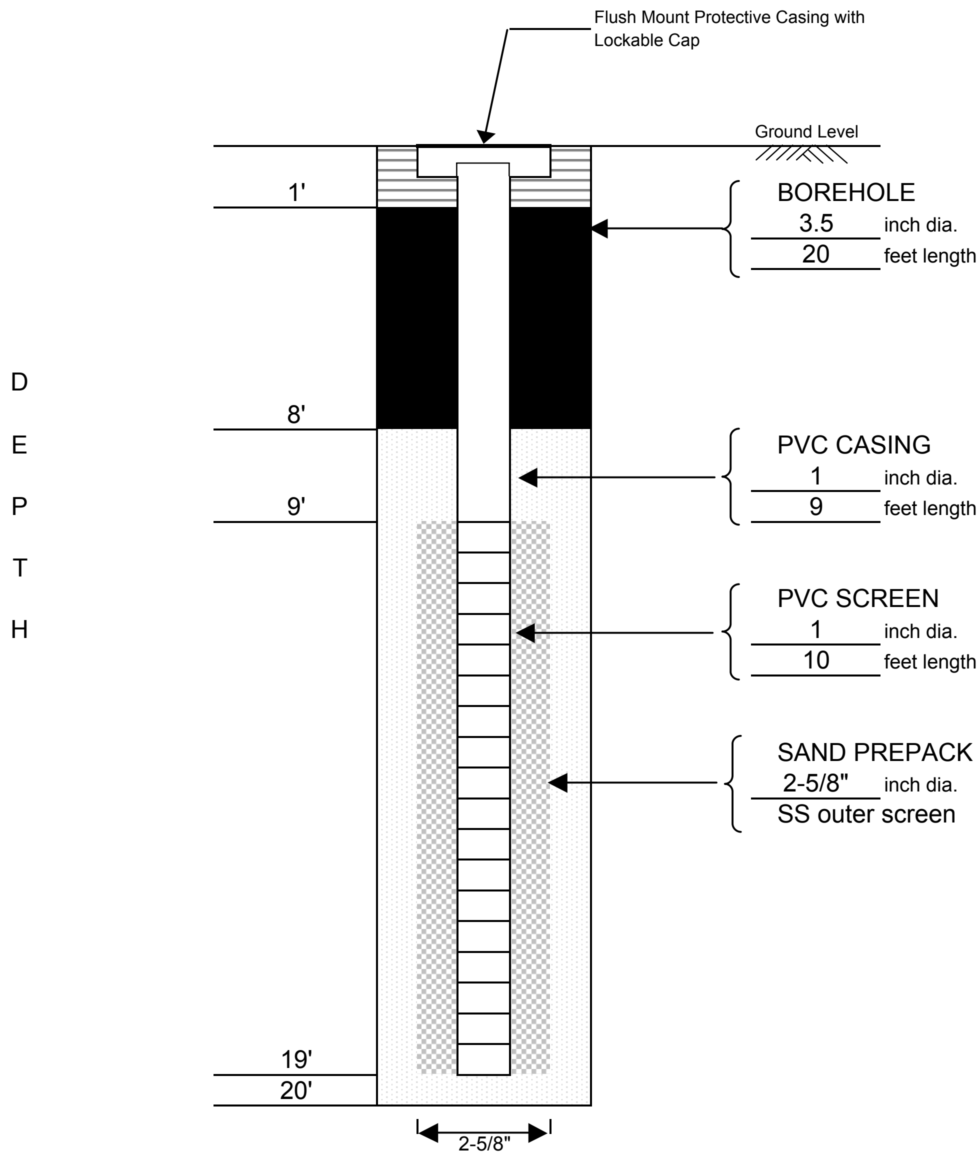
Driller:
L. Caballero

Rig Make/Model:
Geoprobe

Date:
6/9/2003

GEOLOGIC LOG

Depth(ft.)	Description
0-0.5	Asphalt
0.5-1	Sand & Gravel subbase
1-4	Sand with gravel over silty-Clay
4-20	Sand, well graded, trace to some gravel



WELL DESIGN

CASING MATERIAL		*SCREEN*		*FILTER MATERIAL*	
Surface:	6" dia. Steel flush mount road box	Type:	1" PVC	Type: see note 2	Setting: 8' - 20'
				SEAL MATERIAL	
Monitor:	1" sch. 40 PVC	Slot Size:		Type: Bentonite	Setting: 1' - 8'

NOTES:

(1) CETCO C/S Granular bentonite
(2) 20.30 Silica Sand (Florida) by Standard Sand & Silica Co.

LEGEND

Concrete
Bentonite Seal(1)
Silica Sandpack(2)

Client	**Rohm & Haas Company**	**Location: Former EMCA Site**	**Project No.:**	**11172730**
URS Corporation		**MONITORING WELL CONSTRUCTION DETAILS**	**Well Number:**	**MW-06**

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URS Corporation

BORING LOG

BORING NO:	MW-07
SHEET:	1 OF 1
JOB NO.:	11172730
BORING LOCATION:	
GROUND ELEVATION:	
DATE STARTED:	06/10/03
DATE FINISHED:	06/10/03
EQUIPMENT OPERATOR:	R. Vining
GEOLOGIST:	Steve Moeller
REVIEWED BY:	

PROJECT:	Former EMCA Site
CLIENT:	Rohm & Haas Company
BORING CONTRACTOR:	Zebra Environmental

GROUNDWATER:

DATE	TIME	LEVEL	TYPE

	CASING	SAMPLER
TYPE		macrocore
DIA.		
WT.		
FALL		

DEPTH (Ft.)	SAMPLE NO.	TYPE	REC. (%)	COLOR	MOISTURE	PID (ppm)	FID (ppm)	MATERIAL DESCRIPTION	REMARKS
0–4	1	GP	80	brown/ dk. brown/ black	sl. moist/ moist	45	42	Asphalt (8") over well graded gravel, sand, silt, & clay subbase. Sand, Silt, Clay, trace gravel, angular reddish sandstone. (f-c) Sand, well graded, trace rounded gravel, loam at approx. 3.5 ft.	petroleum odor ↓
4–8	2	GP	88	gray	moist/ wet	25	120	silty Clay, gray, trace (f) sand, petroleum stained at seams grades to layered gray (vf) Sand [6"], (f) Sand [10"], (m) Sand [6"], and (f-c) well graded Sand [6"].	
8–12	3	GP	91	gray gray/tan gray/ dk. gray	wet	37	110	Layered sand: (f) Sand, gray, trace (m) sand & gravel [8"] over (f-m) Sand, trace (c) sand [10"] over (vf) Sand, micaceous, [8"] over (m) Sand, trace (c) sand.	
12–16	4	GP	90	gray / tan	wet	16	35	(f) Sand, trace (m-c) sand.	
16–20	5	GP	UNK	gray/ olive gray	wet	2	3	(vf-f) Sand, trace (m) sand.	
20								Boring Completed at 20 ft. Monitoring Well Installed	background meas. PID = -0.06 ppm FID = -0.02 ppm

COMMENTS: Boring advanced with Geoprobe (direct-push) rig.

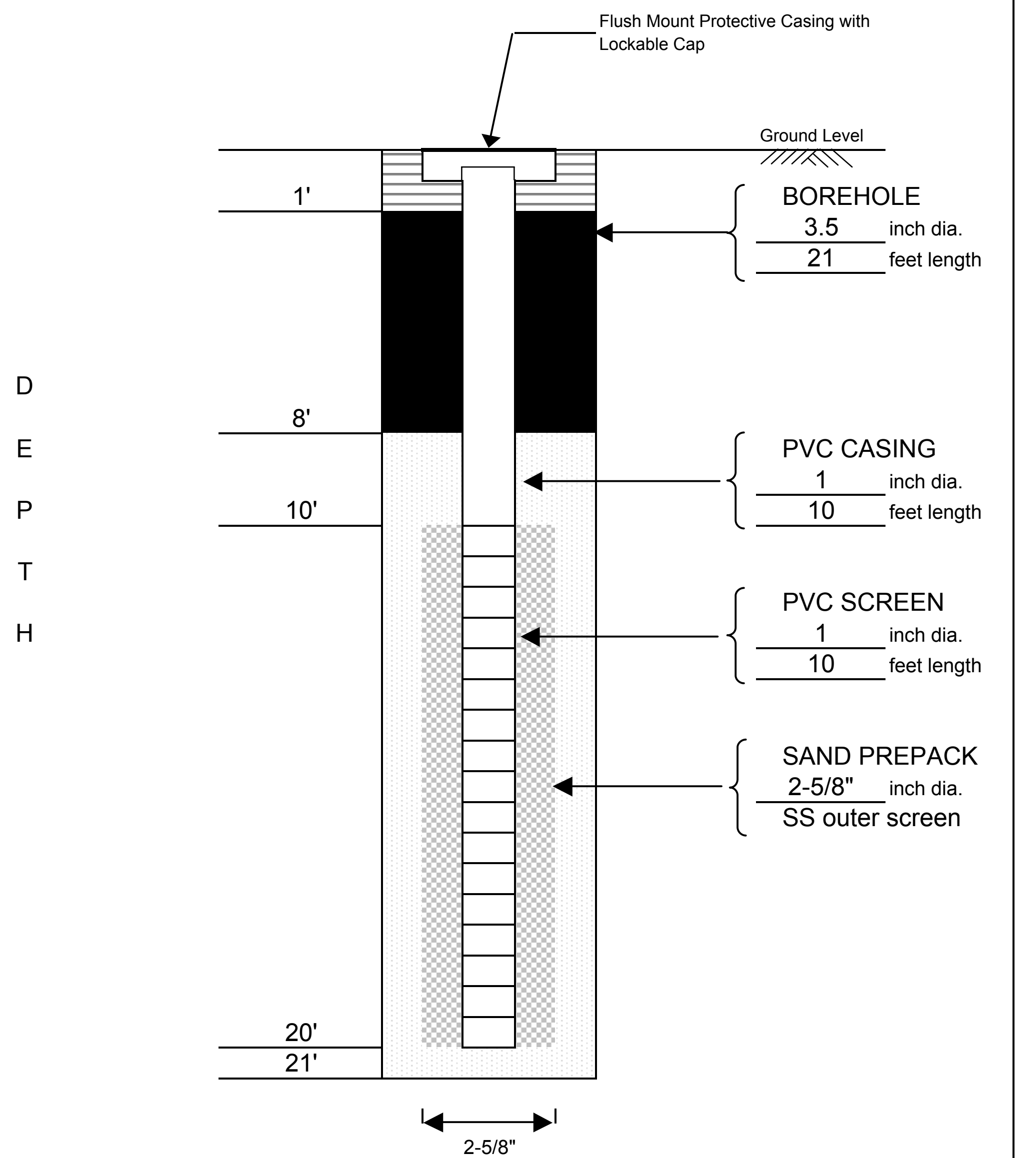
PROJECT NO.	11172730
BORING NO.	MW-07

DRILLING SUMMARY

Geologist:	Steve Moeller
Drilling Company:	Zebra Environmental
Driller:	R. Vining
Rig Make/Model:	Geoprobe
Date:	6/10/2003

GEOLOGIC LOG

Depth(ft.)	Description
0-.7	Asphalt & sand, silt, clay subbase.
0.7-1.7	Sand, silt, clay, trace gravel
1.7-4	(f-c) Sand, trace gravel. Loam at approx. 4'
4-12	slity Clay, trace (f) Sand grades to layered (f-m-c) Sand.
12-16	(f) Sand, trace (m-c) sand
16-20	(vf-f) Sand, trace (m) sand



WELL DESIGN

CASING MATERIAL		*SCREEN*		*FILTER MATERIAL*	
Surface:	6" dia. Steel flush mount road box	Type:	1" PVC	Type: see note 2	Setting: 10' - 21'
				SEAL MATERIAL	
Monitor:	1" sch. 40 PVC	Slot Size:		Type: Bentonite	Setting: 1' - 8'

NOTES:

(1) CETCO C/S Granular bentonite
(2) 20.30 Silica Sand (Florida) by Standard Sand & Silica Co.

LEGEND

- Concrete
- Bentonite Seal[(1)]
- Silica Sandpack[(2)]

Client	**Rohm & Haas Company**	**Location: Former EMCA Site**	**Project No.: 11172730**
URS Corporation		**MONITORING WELL CONSTRUCTION DETAILS**	**Well Number: MW-07**

FORMER EMCA SITE
SUMMARY OF URS SURVEY RESULTS

LOCATION ID	NORTHING	EASTING	GROUND ELEV. (ft.)	MEASUREMENT POINT ELEV. (ft.)	REMARKS
MW-01	1872	2795	99.5	99.22	Measurement point is top of well riser
MW-02	2038	2846	99.18	99.18	Measurement point is top of well riser
MW-03	2059	2809	99.61	99.35	Measurement point is top of well riser
MW-04	2101	2746	98.84	98.61	Measurement point is top of well riser
MW-05	2160	2784	98.25	98.14	Measurement point is top of well riser
GZ-03	1981	2713	100.28	102.71	Measurement point is top of well riser
GZ-06	1987	2890	99.9	101.55	Measurement point is top of well riser
GZ-09	2057	2810	99.61	99.57	Measurement point is top of well riser
WS-01	2252	2592		92.00	Measurement point marked on lath
WS-02	2080	2496		92.00	Measurement point marked on lath
WS-03	1939	2425		92.00	Measurement point marked on lath
WS-04				97.00	Located approximately 460' upstream of WS-03 on north face of Rockland Avenue bridge over the Sheldrake River. Measurement point is chisel marked on center abutment.
PZ-01	1925	2849	99.51	103.96	Temporary piezometer. Measurement point was top of riser.
PZ-02	1964	2666	100.22	101.06	Temporary piezometer. Measurement point was top of riser.
GRAB-01	2101	2746	98.85		Geoprobe boring groundwater grab sample location.
SG-01	1833	2827	99.37		
SG-02	2038	2846	99.18		
SG-03	2057	2804	99.61		
SG-04	2099	2748	98.98		
SG-05	2041	2761	99.88		
SG-06	2136	2809	98.18		
SG-07	2114	2833	98.83		
SS-01	2040	2762	99.86		
SS-02	2118	2734	97.87		
URS Benchmark	2029	2805		100.00	Measurement point is finish floor in first floor doorway near northernmost corner of building.

Survey is based upon an arbitrary datum and coordinate system established by URS.

APPENDIX C

SUBSURFACE INJECTION LOGS

PILOT STUDY INJECTION LOGS

URS Corporation	Subsurface Injection Log	
Client: Rohm & Haas Company	Location: Former EMCA Site	Injection Point: 1A

Contractor:	Zebra Environmental	**Project No.:**	11172730.00000
Rig:	Geoprobe	**Date:**	6/13/03
Pump:	R.E. Rupe Model ORC 9/1500	**Weather:**	Overcast, light rain
Operator:	Dominic Pino	**Geologist:**	Steve Moeller

Depth (ft.)	Injection Pt.	Notes:	Injection Quantities and Measurements
0 - 5		CETCO granular bentonite flakes added to 0' - 5' interval to seal hole while injecting solutions. Asphalt patch installed at ground surface at completion.	Injection fluid totals (5 ft. - 25 ft.) and injection sequence: 1) 55 gal. chase water. 2) 11 gal. WILCLEAR sodium lactate. 3) 90 gal. dilute EOS with 1.35 L sodium bicarbonate.
5 - 9			Injection Interval: 5 ft. - 9 ft. 11 gal. chase water. 2 gal. WILCLEAR sodium lactate. 18 gal. dilute EOS mixed at ratio of 14.4 gal. water: 3.6 gal. EOS concentrate. 270 ml sodium bicarbonate added to dilute EOS.
9 - 13		Solution take occurred primarily at 12'.	Injection Interval: 9 ft. - 13 ft. 11 gal. chase water. 2.25 gal. WILCLEAR sodium lactate. 18 gal. dilute EOS mixed at ratio of 14.4 gal. water: 3.6 gal. EOS concentrate. 270 ml sodium bicarbonate added to dilute EOS.
13 - 17		Solution take occurred primarily at 15.5'.	Injection Interval: 13 ft. - 17 ft. 11 gal. chase water. 2.25 gal. WILCLEAR sodium lactate. 18 gal. dilute EOS mixed at ratio of 14.4 gal. water: 3.6 gal. EOS concentrate. 270 ml sodium bicarbonate added to dilute EOS.
17 - 21		Solution take occurred primarily at 21'.	Injection Interval: 17 ft. - 21 ft 11 gal. chase water. 18 gal. dilute EOS mixed at ratio of 14.4 gal. water: 3.6 gal. EOS concentrate. 270 ml sodium bicarbonate added to dilute EOS. 2.25 gal. WILCLEAR sodium lactate.
21 - 25		Solution take occurred primarily at 24'.	Injection Interval: 21 ft. - 25 ft. 11 gal. chase water. 2.25 gal. WILCLEAR sodium lactate. 18 gal. dilute EOS mixed at ratio of 14.4 gal. water: 3.6 gal. EOS concentrate. 270 ml sodium bicarbonate added to dilute EOS.

URS Corporation	Subsurface Injection Log	
Client: Rohm & Haas Company	Location: Former EMCA Site	Injection Point: 1B

Contractor:	Zebra Environmental	Project No.:	11172730.00000
Rig:	Geoprobe	Date:	6/11/03
Pump:	R.E. Rupe Model ORC 9/1500	Weather:	Overcast, 70 deg F, afternoon rain
Operator:	Dominic Pino	Geologist:	Steve Moeller

Depth (ft.)	Injection Pt.	Notes:	Injection Quantities and Measurements
0 - 5		CETCO granular bentonite flakes added to 0' - 5' interval to seal hole while injecting solutions. Asphalt patch installed at ground surface at completion.	Injection fluid totals (5 ft. - 25 ft.) and injection sequence: 1) 90 gal. dilute EOS with 1.35 L sodium bicarbonate. 2) 55 gal. chase water. 3) 22.5 gal. WILCLEAR sodium lactate.
5 - 9			Injection Interval: 5 ft. - 9 ft. 18 gal. dilute EOS mixed at ratio of 14.4 gal. water: 3.6 gal. EOS concentrate. 270 ml sodium bicarbonate added to dilute EOS. 11 gal. chase water. 4.5 gal. WILCLEAR sodium lactate.
9 - 13		bottom of interval accepted more of the injection solutions.	Injection Interval: 9 ft. - 13 ft. 18 gal. dilute EOS mixed at ratio of 14.4 gal. water: 3.6 gal. EOS concentrate. 270 ml sodium bicarbonate added to dilute EOS. 11 gal. chase water. 4.5 gal. WILCLEAR sodium lactate.
13 - 17		tight soil, interval would not accept dilute EOS at initial injection attempt. Retry at slower injection rate was successful.	Injection Interval: 13 ft. - 17 ft. 18 gal. dilute EOS mixed at ratio of 14.4 gal. water: 3.6 gal. EOS concentrate. 270 ml sodium bicarbonate added to dilute EOS. 11 gal. chase water. 4.5 gal. WILCLEAR sodium lactate.
17 - 21			Injection Interval: 17 ft. - 21 ft 18 gal. dilute EOS mixed at ratio of 14.4 gal. water: 3.6 gal. EOS concentrate. 270 ml sodium bicarbonate added to dilute EOS 11 gal. chase water. 4.5 gal. WILCLEAR sodium lactate.
21 - 25		22' -23' interval did not accept dilute EOS.	Injection Interval: 21 ft. - 25 ft. 18 gal. dilute EOS mixed at ratio of 14.4 gal. water: 3.6 gal. EOS concentrate. 270 ml sodium bicarbonate added to dilute EOS. 11 gal. chase water. 4.5 gal. WILCLEAR sodium lactate.

URS Corporation	Subsurface Injection Log	
Client: Rohm & Haas Company	Location: Former EMCA Site	Injection Point: 2A

Contractor:	Zebra Environmental	**Project No.:**	11172730.00000
Rig:	Geoprobe	**Date:**	6/18/03
Pump:	R.E. Rupe Model ORC 9/1500	**Weather:**	Moderate to heavy rain
Operator:	Ethan Plank	**Geologist:**	Steve Moeller

Depth (ft.)	Injection Pt.	Notes:	Injection Quantities and Measurements
5		CETCO granular bentonite flakes added to 0' - 5' interval to seal hole while injecting solutions. Asphalt patch installed at ground surface at completion	Injection fluid totals (5 ft. - 25 ft.) and injection sequence: 1) 90 gal. dilute EOS with 1.35 L sodium bicarbonate. 2) 55 gal. chase water. 3) 10 gal. WILCLEAR sodium lactate.
9		Injected solutions at approx. 8' due to surface seal problems.	Injection Interval: 5 ft. - 9 ft. 18 gal. dilute EOS mixed at ratio of 14.4 gal. water: 3.6 gal. EOS concentrate (0-50 psig) 270 ml sodium bicarbonate added to dilute EOS. 11 gal. chase water (25-50 psig). 2 gal. WILCLEAR sodium lactate (50-500 psig).
13		Injected solutions at approx. 11 and 12'.	Injection Interval: 9 ft. - 13 ft. 18 gal. dilute EOS mixed at ratio of 14.4 gal. water: 3.6 gal. EOS concentrate (0-10 psig). 270 ml sodium bicarbonate added to dilute EOS. 11 gal. chase water (0 psig). 2 gal. WILCLEAR sodium lactate (0 psig).
17		Injected solutions at approx. 13.5', 14.5', and 16'.	Injection Interval: 13 ft. - 17 ft. 18 gal. dilute EOS mixed at ratio of 14.4 gal. water: 3.6 gal. EOS concentrate (0 psig). 270 ml sodium bicarbonate added to dilute EOS. 11 gal. chase water (0 psig). 2 gal. WILCLEAR sodium lactate (0 psig)
21		Injected solutions at approx 18', 19', and 20'.	Injection Interval: 17 ft. - 21 ft 18 gal. dilute EOS mixed at ratio of 14.4 gal. water: 3.6 gal. EOS concentrate (40-50 psig 270 ml sodium bicarbonate added to dilute EOS 11 gal. chase water (0 psig) 2 gal. WILCLEAR sodium lactate (0-50 psig).
23.5		Injected solutions in 0.5' increments from 21.5' to 23.5'.	Injection Interval: 21 ft. - 25 ft. 18 gal. dilute EOS mixed at ratio of 14.4 gal. water:3.6 gal. EOS concentrate (50-100 psig). 270 ml sodium bicarbonate added to dilute EOS. 11 gal. chase water (40 psig). 2 gal. WILCLEAR sodium lactate (50-100 psig).

URS Corporation	Subsurface Injection Log	
Client: Rohm & Haas Company	Location: Former EMCA Site	Injection Point: 2B

Contractor:	Zebra Environmental	**Project No.:**	11172730.00000
Rig:	Geoprobe	**Date:**	6/12/03
Pump:	R.E. Rupe Model ORC 9/1500	**Weather:**	Overcast, humid, 65 deg F
Operator:	Dominic Pino	**Geologist:**	Steve Moeller

Depth (ft.)	Injection Pt.	Notes:	Injection Quantities and Measurements
0 - 5		CETCO granular bentonite flakes added to 0' - 5' interval to seal hole while injecting solutions. Asphalt patch installed at ground surface at completion.	Injection fluid totals (5 ft. - 25 ft.) and injection sequence: 1) 72 gal. dilute EOS with 0.96 L sodium bicarbonate. 2) 44 gal. chase water. 3) 18 gal. WILCLEAR sodium lactate.
5 - 9		Unable to inject solutions into 5' - 9' interval.	Injection Interval: 5 ft. - 9 ft.
9 - 13		Injected solutions primarily at 11.5'	Injection Interval: 9 ft. - 13 ft. 18 gal. dilute EOS mixed at ratio of 14.4 gal. water: 3.6 gal. EOS concentrate. 270 ml sodium bicarbonate added to dilute EOS. 11 gal. chase water. 4.5 gal. WILCLEAR sodium lactate.
13 - 17		Injected solutions at approx 15.5'	Injection Interval: 13 ft. - 17 ft. 36 gal. dilute EOS mixed at ratio of 14.4 gal. water: 3.6 gal. EOS concentrate. 540 ml sodium bicarbonate added to dilute EOS. 22 gal. chase water. 9 gal. WILCLEAR sodium lactate.
17 - 21		Unable to inject solutions into 17' - 21' interval. 3 attempts made.	Injection Interval: 17 ft. - 21 ft
21 - 25		22' - 23' interval did not accept dilute EOS. 23' - 25' interval accepted dilute EOS well.	Injection Interval: 21 ft. - 25 ft. 18 gal. dilute EOS mixed at ratio of 14.4 gal. water: 3.6 gal. EOS concentrate. 150 ml sodium bicarbonate added to dilute EOS. 11 gal. chase water. 4.5 gal. WILCLEAR sodium lactate.

URS Corporation

Subsurface Injection Log

Client: Rohm & Haas Company	Location: Former EMCA Site	Injection Point: 3A

Contractor:	Zebra Environmental	**Project No.:**	11172730.00000
Rig:	Geoprobe	**Date:**	6/12/03
Pump:	R.E. Rupe Model ORC 9/1500	**Weather:**	Overcast, humid, 65 deg F
Operator:	Dominic Pino	**Geologist:**	Steve Moeller

Depth (ft.)	Injection Pt.	Notes:	Injection Quantities and Measurements
0 - 5		CETCO granular bentonite flakes added to 0' - 5' interval to seal hole while injecting solutions. Asphalt patch installed at ground surface at completion.	Injection fluid totals (5 ft. - 25 ft.) and injection sequence: 1) 90 gal. dilute EOS with 1.35 L sodium bicarbonate. 2) 55 gal. chase water. 3) 13.5 gal. WILCLEAR sodium lactate.
5 - 9		Injected solutions primarily at 7.5'.	Injection Interval: 5 ft. - 9 ft. 18 gal. dilute EOS mixed at ratio of 14.4 gal. water: 3.6 gal. EOS concentrate. 270 ml sodium bicarbonate added to dilute EOS. 11 gal. chase water. 2.25 gal. WILCLEAR sodium lactate.
9 - 13		Injected solutions primarily at 12'.	Injection Interval: 9 ft. - 13 ft. 18 gal. dilute EOS mixed at ratio of 14.4 gal. water: 3.6 gal. EOS concentrate. 270 ml sodium bicarbonate added to dilute EOS. 11 gal. chase water. 2.25 gal. WILCLEAR sodium lactate.
13 - 17		Injected solutions primarily at 15.5'.	Injection Interval: 13 ft. - 17 ft. 18 gal. dilute EOS mixed at ratio of 14.4 gal. water: 3.6 gal. EOS concentrate. 270 ml sodium bicarbonate added to dilute EOS. 11 gal. chase water. 2.5 gal. WILCLEAR sodium lactate.
17 - 21		Injected solutions primarily between 20' - 21'.	Injection Interval: 17 ft. - 21 ft 18 gal. dilute EOS mixed at ratio of 14.4 gal. water: 3.6 gal. EOS concentrate. 270 ml sodium bicarbonate added to dilute EOS. 11 gal. chase water. 2 gal. WILCLEAR sodium lactate.
21 - 25		Injected solutions primarily between 23' - 25'.	Injection Interval: 21 ft. - 25 ft. 18 gal. dilute EOS mixed at ratio of 14.4 gal. water: 3.6 gal. EOS concentrate. 270 ml sodium bicarbonate added to dilute EOS. 11 gal. chase water. 4.5 gal. WILCLEAR sodium lactate.

URS Corporation

Subsurface Injection Log

Client: Rohm & Haas Company	Location: Former EMCA Site	Injection Point: 3B

Contractor:	Zebra Environmental	**Project No.:**	11172730.00000
Rig:	Geoprobe	**Date:**	6/13/03 -6/17/03
Pump:	R.E. Rupe Model ORC 9/1500	**Weather:**	Overcast, light rain
Operator:	Dominic Pino/Ethan Plank	**Geologist:**	Steve Moeller

Depth (ft.)	Injection Pt.	Notes:	Injection Quantities and Measurements
0 - 5		CETCO granular bentonite flakes added to 0' - 5' interval to seal hole while injecting solutions. Asphalt patch installed at ground surface at completion.	Injection fluid totals (5 ft. - 25 ft.) and injection sequence: 1) 90 gal. dilute EOS with 1.35 L sodium bicarbonate. 2) 55 gal. chase water. 3) 22.5 gal. WILCLEAR sodium lactate.
5 - 9		Injected solutions primarily at 6'.	Injection Interval: 5 ft. - 9 ft. 18 gal. dilute EOS mixed at ratio of 14.4 gal. water: 3.6 gal. EOS concentrate. 270 ml sodium bicarbonate added to dilute EOS. 11 gal. chase water. 4.5 gal. WILCLEAR sodium lactate.
9 - 13		Injected solutions primarily at 10.5'.	Injection Interval: 9 ft. - 13 ft. 18 gal. dilute EOS mixed at ratio of 14.4 gal. water: 3.6 gal. EOS concentrate. 270 ml sodium bicarbonate added to dilute EOS. 11 gal. chase water. 4.5 gal. WILCLEAR sodium lactate.
13 - 17		Injected solutions at approx. 13.5' and 14.5'.	Injection Interval: 13 ft. - 17 ft. 18 gal. dilute EOS mixed at ratio of 14.4 gal. water: 3.6 gal. EOS concentrate. 270 ml sodium bicarbonate added to dilute EOS. 11 gal. chase water. 4.5 gal. WILCLEAR sodium lactate.
17 - 21		Injected solutions at approx 18' and 20'.	Injection Interval: 17 ft. - 21 ft 18 gal. dilute EOS mixed at ratio of 14.4 gal. water: 3.6 gal. EOS concentrate. 270 ml sodium bicarbonate added to dilute EOS. 11 gal. chase water. 4.5 gal. WILCLEAR sodium lactate.
21 - 25		Injected solutions primarily at 24'.	Injection Interval: 21 ft. - 25 ft. 18 gal. dilute EOS mixed at ratio of 14.4 gal. water: 3.6 gal. EOS concentrate. 270 ml sodium bicarbonate added to dilute EOS. 11 gal. chase water. 4 gal. WILCLEAR sodium lactate.

URS Corporation	Subsurface Injection Log	
Client: Rohm & Haas Company	Location: Former EMCA Site	Injection Point: 4A

Contractor:	Zebra Environmental	**Project No.:**	11172730.00000
Rig:	Geoprobe	**Date:**	6/19/03
Pump:	R.E. Rupe Model ORC 9/1500	**Weather:**	Overcast, rain, calm, 65 deg F
Operator:	Ethan Plank	**Geologist:**	Steve Moeller

Depth (ft.)	Injection Pt.	Notes:	Injection Quantities and Measurements
0 - 5		CETCO granular bentonite flakes added to 0' - 5' interval to seal hole while injecting solutions. Asphalt patch installed at ground surface at completion	Injection fluid totals (5 ft. - 25 ft.) and injection sequence: 1) 90 gal. dilute EOS with 1.35 L sodium bicarbonate. 2) 55 gal. chase water. 3) 10 gal. WILCLEAR sodium lactate.
5 - 9		Injected solutions at approx. 7.5' and 8.5'.	Injection Interval: 5 ft. - 9 ft. 18 gal. dilute EOS mixed at ratio of 14.4 gal. water: 3.6 gal. EOS concentrate (25-60 psig). 270 ml sodium bicarbonate added to dilute EOS. 11 gal. chase water (40-60 psig). 2 gal. WILCLEAR sodium lactate (50-60 psig).
9 - 13		Injected solutions at approx. 10.5' and 11.5'.	Injection Interval: 9 ft. - 13 ft. 18 gal. dilute EOS mixed at ratio of 14.4 gal. water: 3.6 gal. EOS concentrate (25-40 psig). 270 ml sodium bicarbonate added to dilute EOS. 11 gal. chase water (25-40 psig). 2 gal. WILCLEAR sodium lactate (50-60 psig).
13 - 17		Injected solutions at approx. 14.5' and 15.5'.	Injection Interval: 13 ft. - 17 ft. 18 gal. dilute EOS mixed at ratio of 14.4 gal. water: 3.6 gal. EOS concentrate (0-25 psig). 270 ml sodium bicarbonate added to dilute EOS. 11 gal. chase water (20-40 psig). 2 gal. WILCLEAR sodium lactate (25-60 psig)
17 - 21		Injected solutions at approx 18' and 20'.	Injection Interval: 17 ft. - 21 ft 18 gal. dilute EOS mixed at ratio of 14.4 gal. water: 3.6 gal. EOS concentrate (0-25 psig 270 ml sodium bicarbonate added to dilute EOS 11 gal. chase water (0-20 psig) 2 gal. WILCLEAR sodium lactate (30-70 psig).
21 - 25		Injected solutions at approx. 22' and 23.5'.	Injection Interval: 21 ft. - 25 ft. 18 gal. dilute EOS mixed at ratio of 14.4 gal. water: 3.6 gal. EOS concentrate (40-200 psig). 270 ml sodium bicarbonate added to dilute EOS. 11 gal. chase water (0-10 psig). 2 gal. WILCLEAR sodium lactate (0-20 psig).

URS Corporation

Subsurface Injection Log

Client: Rohm & Haas Company	**Location: Former EMCA Site**	**Injection Point:**	**4B**

Contractor:	Zebra Environmental	**Project No.:**	11172730.00000
Rig:	Geoprobe	**Date:**	6/13/03
Pump:	R.E. Rupe Model ORC 9/1500	**Weather:**	Overcast, light rain
Operator:	Dominic Pino	**Geologist:**	Steve Moeller

Depth (ft.)	Injection Pt.	Notes:	Injection Quantities and Measurements
0 - 5		CETCO granular bentonite flakes added to 0' - 5' interval to seal hole while injecting solutions. Asphalt patch installed at ground surface at completion.	Injection fluid totals (5 ft. - 25 ft.) and injection sequence: 1) 90 gal. dilute EOS with 1.35 L sodium bicarbonate. 2) 55 gal. chase water. 3) 20.5 gal. WILCLEAR sodium lactate.
5 - 9		Unable to inject solutions into 5' - 9' interval.	Injection Interval: 5 ft. - 9 ft.
9 - 13		Injected solutions primarily at 11.5'.	Injection Interval: 9 ft. - 13 ft. 36 gal. dilute EOS mixed at ratio of 14.4 gal. water: 3.6 gal. EOS concentrate. 540 ml sodium bicarbonate added to dilute EOS. 22 gal. chase water. 8 gal. WILCLEAR sodium lactate.
13 - 17		Injected solutions primarily at 16'.	Injection Interval: 13 ft. - 17 ft. 18 gal. dilute EOS mixed at ratio of 14.4 gal. water: 3.6 gal. EOS concentrate. 270 ml sodium bicarbonate added to dilute EOS. 11 gal. chase water. 4 gal. WILCLEAR sodium lactate.
17 - 21		Injected solutions primarily at 19'.	Injection Interval: 17 ft. - 21 ft 18 gal. dilute EOS mixed at ratio of 14.4 gal. water: 3.6 gal. EOS concentrate. 270 ml sodium bicarbonate added to dilute EOS. 11 gal. chase water. 4 gal. WILCLEAR sodium lactate.
21 - 25			Injection Interval: 21 ft. - 25 ft. 18 gal. dilute EOS mixed at ratio of 14.4 gal. water: 3.6 gal. EOS concentrate. 270 ml sodium bicarbonate added to dilute EOS. 11 gal. chase water. 4.5 gal. WILCLEAR sodium lactate.

URS Corporation	Subsurface Injection Log	
Client: Rohm & Haas Company	**Location: Former EMCA Site**	**Injection Point: 5A**

Contractor:	Zebra Environmental	**Project No.:**	11172730.00000
Rig:	Geoprobe	**Date:**	6/19/03 - 6/20/03
Pump:	R.E. Rupe Model ORC 9/1500	**Weather:**	Overcast, rain, calm, 65 deg F
Operator:	Ethan Plank	**Geologist:**	Steve Moeller

Depth (ft.)	Notes:	Injection Quantities and Measurements
0 - 5	CETCO granular bentonite flakes added to 0' - 5' interval to seal hole while injecting solutions. Asphalt patch installed at ground surface at completion	Injection fluid totals (5 ft. - 25 ft.) and injection sequence: 1) 118.5 gal. dilute EOS with 1.74 L sodium bicarbonate. 2) 55 gal. chase water. 3) 17.5 gal. WILCLEAR sodium lactate.
5 - 9	Injected solutions at approx. 8'.	Injection Interval: 5 ft. - 9 ft. 27.5 gal. dilute EOS mixed at ratio of 22 gal. water: 5.5 gal. EOS concentrate (0-10 psig). 400 ml sodium bicarbonate added to dilute EOS. 11 gal. chase water (0-10 psig). 4.5 gal. WILCLEAR sodium lactate (0-10 psig).
9 - 13	Injected solutions at approx. 12'.	Injection Interval: 9 ft. - 13 ft. 27.5 gal. dilute EOS mixed at ratio of 22 gal. water: 5.5 gal. EOS concentrate (0-10 psig). 400 ml sodium bicarbonate added to dilute EOS. 11 gal. chase water (0-10 psig). 4 gal. WILCLEAR sodium lactate (0-10 psig).
13 - 17	Injected solutions at approx 16'.	Injection Interval: 13 ft. - 17 ft. 27.5 gal. dilute EOS mixed at ratio of 22 gal. water: 5.5 gal. EOS concentrate (0-20 psig). 400 ml sodium bicarbonate added to dilute EOS. 11 gal. chase water (0-10 psig). 3 gal. WILCLEAR sodium lactate (0-10 psig)
17 - 21	Injected solutions at approx. 19.5'.	Injection Interval: 17 ft. - 21 ft 18 gal. dilute EOS mixed at ratio of 14.4 gal. water: 3.6 gal. EOS concentrate (0-150 psig 270 ml sodium bicarbonate added to dilute EOS (0-20 psig 11 gal. chase water 3 gal. WILCLEAR sodium lactate (0-25 psig).
21 - 25	Injected solutions at approx. 21.5 and 23.5'.	Injection Interval: 21 ft. - 25 ft. 18 gal. dilute EOS mixed at ratio of 14.4 gal. water: 3.6 gal. EOS concentrate (25-175 psig). 270 ml sodium bicarbonate added to dilute EOS. 11 gal. chase water (25-50 psig). 3 gal. WILCLEAR sodium lactate (0-25 psig).

URS Corporation

Subsurface Injection Log

Client: Rohm & Haas Company	Location: Former EMCA Site	Injection Point: 5B

Contractor:	Zebra Environmental	**Project No.:**	11172730.00000
Rig:	Geoprobe	**Date:**	6/18/03
Pump:	R.E. Rupe Model ORC 9/1500	**Weather:**	Moderate to heavy rain
Operator:	Ethan Plank	**Geologist:**	Steve Moeller

Depth (ft.)	Injection Pt.	Notes:	Injection Quantities and Measurements
0–5		CETCO granular bentonite flakes added to 0' - 5' interval to seal hole while injecting solutions. Asphalt patch installed at ground surface at completion.	Injection fluid totals (5 ft. - 25 ft.) and injection sequence: 1) 90 gal. dilute EOS with 1.35 L sodium bicarbonate. 2) 55 gal. chase water. 3) 22.5 gal. WILCLEAR sodium lactate.
5–9		Injected solutions at approx. 7' and 8'.	Injection Interval: 5 ft. - 9 ft. 18 gal. dilute EOS mixed at ratio of 14.4 gal. water: 3.6 gal. EOS concentrate (0-40 psig). 270 ml sodium bicarbonate added to dilute EOS. 11 gal. chase water (25-50 psig). 4.5 gal. WILCLEAR sodium lactate (50-80 psig).
9–13		Injected solutions at approx. 10', 11', and 12'.	Injection Interval: 9 ft. - 13 ft. 18 gal. dilute EOS mixed at ratio of 14.4 gal. water: 3.6 gal. EOS concentrate (0-50 psig). 270 ml sodium bicarbonate added to dilute EOS. 11 gal. chase water (50 psig). 4.5 gal. WILCLEAR sodium lactate (50 psig).
13–17		Injected solutions at approx. 14', 15', and 16'.	Injection Interval: 13 ft. - 17 ft. 18 gal. dilute EOS mixed at ratio of 14.4 gal. water: 3.6 gal. EOS concentrate (0-25 psig). 270 ml sodium bicarbonate added to dilute EOS. 11 gal. chase water (0-25 psig). 4.5 gal. WILCLEAR sodium lactate (20-70 psig).
17–21		Injected solutions at approx 19', and 20'.	Injection Interval: 17 ft. - 21 ft 18 gal. dilute EOS mixed at ratio of 14.4 gal. water: 3.6 gal. EOS concentrate (0-40 psig). 270 ml sodium bicarbonate added to dilute EOS. 11 gal. chase water (0 psig). 4.5 gal. WILCLEAR sodium lactate (0-50 psig).
21–25		Injected solutions at approx. 21', 22', and 23'.	Injection Interval: 21 ft. - 25 ft. 18 gal. dilute EOS mixed at ratio of 14.4 gal. water: 3.6 gal. EOS concentrate (0-100 psig) 270 ml sodium bicarbonate added to dilute EOS. 11 gal. chase water (0-50 psig). 4.5 gal. WILCLEAR sodium lactate (25-100 psig).

URS Corporation	Subsurface Injection Log	
Client: Rohm & Haas Company	**Location: Former EMCA Site**	**Injection Point: 6A**

Contractor:	Zebra Environmental	**Project No.:**	11172730.00000
Rig:	Geoprobe	**Date:**	6/19/03
Pump:	R.E. Rupe Model ORC 9/1500	**Weather:**	Overcast, rain, calm, 65 deg F
Operator:	Ethan Plank	**Geologist:**	Steve Moeller

Depth (ft.)	Injection Pt.	Notes:	Injection Quantities and Measurements
0 - 5		CETCO granular bentonite flakes added to 0' - 5' interval to seal hole while injecting solutions. Asphalt patch installed at ground surface at completion	Injection fluid totals (5 ft. - 25 ft.) and injection sequence: 1) 90 gal. dilute EOS with 1.35 L sodium bicarbonate. 2) 55 gal. chase water. 3) 15 gal. WILCLEAR sodium lactate.
5 - 9		Injected solutions at approx. 5.5' and 7.5'.	Injection Interval: 5 ft. - 9 ft. 18 gal. dilute EOS mixed at ratio of 14.4 gal. water: 3.6 gal. EOS concentrate (0-40 psig). 270 ml sodium bicarbonate added to dilute EOS. 11 gal. chase water (25-50 psig). 3 gal. WILCLEAR sodium lactate (25-50 psig).
9 - 13		Injected solutions at approx. 10' and 11'.	Injection Interval: 9 ft. - 13 ft. 18 gal. dilute EOS mixed at ratio of 14.4 gal. water: 3.6 gal. EOS concentrate (50-120 psig). 270 ml sodium bicarbonate added to dilute EOS. 11 gal. chase water (50-90 psig). 3 gal. WILCLEAR sodium lactate (70-170 psig).
13 - 17		Injected solutions at approx. 14' and 15.5'.	Injection Interval: 13 ft. - 17 ft. 18 gal. dilute EOS mixed at ratio of 14.4 gal. water: 3.6 gal. EOS concentrate (0-25 psig). 270 ml sodium bicarbonate added to dilute EOS. 11 gal. chase water (25 psig). 3 gal. WILCLEAR sodium lactate (50-90 psig)
17 - 21		Injected solutions at approx 18' and 20'.	Injection Interval: 17 ft. - 21 ft 18 gal. dilute EOS mixed at ratio of 14.4 gal. water: 3.6 gal. EOS concentrate (10-40 psig 270 ml sodium bicarbonate added to dilute EOS 11 gal. chase water (0-20 psig) 3 gal. WILCLEAR sodium lactate (30-60 psig).
21 - 25		Injected solutions at approx. 22' and 24'.	Injection Interval: 21 ft. - 25 ft. 18 gal. dilute EOS mixed at ratio of 14.4 gal. water: 3.6 gal. EOS concentrate (25-150 psig). 270 ml sodium bicarbonate added to dilute EOS. 11 gal. chase water (0-100 psig). 3 gal. WILCLEAR sodium lactate (30-50 psig).

URS Corporation	Subsurface Injection Log	
Client: Rohm & Haas Company	**Location: Former EMCA Site**	**Injection Point: 6B**

Contractor:	Zebra Environmental	**Project No.:**	11172730.00000
Rig:	Geoprobe	**Date:**	6/19/03
Pump:	R.E. Rupe Model ORC 9/1500	**Weather:**	Overcast, rain, calm, 65 deg F
Operator:	Ethan Plank	**Geologist:**	Steve Moeller

Depth (ft.)	Injection Pt.	Notes:	Injection Quantities and Measurements
0–5		CETCO granular bentonite flakes added to 0' - 5' interval to seal hole while injecting solutions. Asphalt patch installed at ground surface at completion.	Injection fluid totals (5 ft. - 25 ft.) and injection sequence: 1) 90 gal. dilute EOS with 1.35 L sodium bicarbonate. 2) 55 gal. chase water. 3) 22.5 gal. WILCLEAR sodium lactate.
5–9		Injected solutions at approx. 7.5'.	Injection Interval: 5 ft. - 9 ft. 18 gal. dilute EOS mixed at ratio of 14.4 gal. water: 3.6 gal. EOS concentrate (0-40 psig). 270 ml sodium bicarbonate added to dilute EOS. 11 gal. chase water (40 psig). 4.5 gal. WILCLEAR sodium lactate (50-80 psig).
9–13		Injected solutions at approx. 10.5' and 12'.	Injection Interval: 9 ft. - 13 ft. 18 gal. dilute EOS mixed at ratio of 14.4 gal. water: 3.6 gal. EOS concentrate (0-40 psig). 270 ml sodium bicarbonate added to dilute EOS. 11 gal. chase water (0-25 psig). 4.5 gal. WILCLEAR sodium lactate (25-75 psig).
13–17		Injected solutions at approx. 14.5' and 16'.	Injection Interval: 13 ft. - 17 ft. 18 gal. dilute EOS mixed at ratio of 14.4 gal. water: 3.6 gal. EOS concentrate (0-10 psig). 270 ml sodium bicarbonate added to dilute EOS. 11 gal. chase water (0-10 psig). 4.5 gal. WILCLEAR sodium lactate (0-40 psig).
17–21		Injected solutions at approx 18' and 20'.	Injection Interval: 17 ft. - 21 ft 18 gal. dilute EOS mixed at ratio of 14.4 gal. water: 3.6 gal. EOS concentrate (0-20 psig). 270 ml sodium bicarbonate added to dilute EOS. 11 gal. chase water (0-20 psig). 4.5 gal. WILCLEAR sodium lactate (0-40 psig).
21–25		Injected solutions at approx. 22.5' and 24'.	Injection Interval: 21 ft. - 25 ft. 18 gal. dilute EOS mixed at ratio of 14.4 gal. water: 3.6 gal. EOS concentrate (0-50 psig). 270 ml sodium bicarbonate added to dilute EOS. 11 gal. chase water (25-75 psig). 4.5 gal. WILCLEAR sodium lactate (0-150 psig).

INTERIM REMEDIAL MEASURE INJECTION LOGS

URS Corporation	Subsurface Injection Log	
Client: Rohm & Haas Company	Location: Former EMCA Site	Injection Point: 7 A

Contractor:	URS-Pittsburgh	Project No.:	11173570.00000
Rig:	Power Probe 9600	Date:	11/10/04
Pump:	12 hp Moynopump	Weather:	Clear, sunny, 29 °F
Operator:		Geologist:	Scott McCabe

Depth (ft.)	Injection Pt.	Notes:	Injection Quantities and Measurements
0–5		BAROID 3/8-inch bentonite chips added to 0' - 2' interval to seal hole while injecting solutions. Asphalt patch installed at ground surface at completion.	MW-03 Area Injection fluid totals (5 ft. to 21 ft.) and injection sequence: 1) 35 gal. of dilute WILCLEAR™ (10 gal. water : 1 gal. WILCLEAR™)
5		5.0-9.0' formation taking injection ~400 psi	
9		9.0-13.0' formation very slow to take injection ~600psi	
13		13.0-17.0' formation slow to take injection ~500psi	
17		17.0-21.0' formation very slow to take injection ~600psi	Note: Short a 4-foot rod, boring taken to 21.0', consult with client and double injection volume at point 8A in 21.0-25.0' interval
21			
25			

URS Corporation	Subsurface Injection Log	
Client: Rohm & Haas Company	Location: Former EMCA Site	Injection Point: 8 A

Contractor:	URS-Pittsburgh	**Project No.:**	11173570.00000
Rig:	Power Probe 9600	**Date:**	11/10/04
Pump:	12 hp Moynopump	**Weather:**	Clear, sunny, 29 °F
Operator:	Ray Junkins	**Geologist:**	Scott McCabe

Depth (ft.)	Injection Pt.	Notes:	Injection Quantities and Measurements
0–2	(bentonite seal)	BAROID 3/8-inch bentonite chips added to 0' - 2' interval to seal hole while injecting solutions. Asphalt patch installed at ground surface at completion.	MW-03 Area Injection fluid totals (5 ft. to 25 ft.) and injection sequence: 1) 44 gal. of dilute WILCLEAR™ (10 gal. water : 1 gal. WILCLEAR™)
5		5.0-25.0' formation very slow to take injection ~600psi slight leaking around injection rods over entire interval, very tight formation	
9			
13			
17			
21			Note: Doubled injection volume in 21.0-25.0' interval due to missed interval at point 7A.
		23.0-25.0' formation very slow to take injection ~600psi	
25			

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URS Corporation	**Subsurface Injection Log**	
Client: Rohm & Haas Company	**Location: Former EMCA Site**	**Injection Point: 9 A**

Contractor:	URS-Pittsburgh	**Project No.:**	11173570.00000
Rig:	Power Probe 9600	**Date:**	11/10/04
Pump:	12 hp Moynopump	**Weather:**	Clear, sunny, 29°F
Operator:	Ray Junkins	**Geologist:**	Scott McCabe

Depth (ft.)	**Injection Pt.**	**Notes:**	**Injection Quantities and Measurements**
0–5	(bentonite seal 0'–2')	BAROID 3/8-inch bentonite chips added to 0' - 2' interval to seal hole while injecting solutions. Asphalt patch installed at ground surface at completion.	MW-03 Area Injection fluid totals (5 ft. to 25 ft.) and injection sequence: 1) 44 gal. of dilute WILCLEAR^{TM} (10 gal. water : 1 gal. WILCLEAR^{TM})
5, 9, 13, 17, 21		5.0-23.0' formation taking injection ~300 psi	
25		23.0-25.0' formation very slow to take injection ~600psi	

URS Corporation	Subsurface Injection Log	
Client: Rohm & Haas Company	Location: Former EMCA Site	Injection Point: 10 A

Contractor:	URS-Pittsburgh	**Project No.:**	11173570.00000
Rig:	Power Probe 9600	**Date:**	11/10/04
Pump:	12 hp Moynopump	**Weather:**	Clear, sunny, 29 °F
Operator:	Ray Junkins	**Geologist:**	Scott McCabe

Depth (ft.)	Injection Pt.	Notes:	Injection Quantities and Measurements
0–2	(bentonite seal)	BAROID 3/8-inch bentonite chips added to 0' - 2' interval to seal hole while injecting solutions. Asphalt patch installed at ground surface at completion.	MW-03 Area Injection fluid totals (5 ft. to 25 ft.) and injection sequence: 1) 44 gal. of dilute WILCLEAR™ (10 gal. water : 1 gal. WILCLEAR™)
5		5.0-13.0' formation taking injection ~300-400psi some communication with point 12 A in this zone	
9			
13		13.0-17.0' formation very slow to take injection ~600psi	
17		17.0-22.0' formation slow to take injection ~500psi	
21		22.0-25.0' formation very slow to take injection ~600psi	
25			

URS Corporation

Subsurface Injection Log

Client: Rohm & Haas Company	Location: Former EMCA Site	Injection Point: 11 A

Contractor:	URS-Pittsburgh	**Project No.:**	11173570.00000
Rig:	Power Probe 9600	**Date:**	11/10/04
Pump:	12 hp Moynopump	**Weather:**	Clear, sunny, 29 °F
Operator:	Ray Junkins	**Geologist:**	Scott McCabe

Depth (ft.)	Injection Pt.	Notes:	Injection Quantities and Measurements
0–2	(seal)	BAROID 3/8-inch bentonite chips added to 0' - 2' interval to seal hole while injecting solutions. Asphalt patch installed at ground surface at completion.	MW-03 Area Injection fluid totals (5 ft. to 25 ft.) and injection sequence: 1) 44 gal. of dilute WILCLEAR™ (10 gal. water : 1 gal. WILCLEAR™)
5		5.0-22.0' formation taking injection ~300 psi	
9			
13			
17			
21			
22		22.0-25.0' formation very slow to take injection ~600psi	
25			

URS Corporation	Subsurface Injection Log	
Client: Rohm & Haas Company	Location: Former EMCA Site	Injection Point: 12 A

Contractor:	URS-Pittsburgh	**Project No.:**	11173570.00000
Rig:	Power Probe 9600	**Date:**	11/10/04
Pump:	12 hp Moynopump	**Weather:**	Clear, sunny, 29 °F
Operator:	Ray Junkins	**Geologist:**	Scott McCabe

Depth (ft.)	Injection Pt.	Notes:	Injection Quantities and Measurements
0–2		BAROID 3/8-inch bentonite chips added to 0' - 2' interval to seal hole while injecting solutions. Asphalt patch installed at ground surface at completion.	MW-03 Area Injection fluid totals (5 ft. to 25 ft.) and injection sequence: 1) 44 gal. of dilute WILCLEAR™ (10 gal. water : 1 gal. WILCLEAR™)
5		5.0-13.0 formation taking injection ~300 psi	
9			
13		13.0-21.0' formation slow to take injection 500 - 600psi	
17			
21		21.0-23.0' formation slow to take injection ~500psi	
		23.0-25.0' formation very slow to take injection ~600psi	
25			

URS Corporation	Subsurface Injection Log	
Client: Rohm & Haas Company	Location: Former EMCA Site	Injection Point: 7 B

Contractor:	URS-Pittsburgh	**Project No.:**	11173570.00000
Rig:	Power Probe 9600	**Date:**	11/10/04
Pump:	12 hp Moynopump	**Weather:**	Clear, sunny, 29 °F
Operator:	Ray Junkins	**Geologist:**	Scott McCabe

Depth (ft.)	Injection Pt.	Notes:	Injection Quantities and Measurements
0–5		BAROID 3/8-inch bentonite chips added to 0' - 2' interval to seal hole while injecting solutions. Asphalt patch installed at ground surface at completion.	MW-03 Area Injection fluid totals (5 ft. to 25 ft.) and injection sequence: 1) 270 gal. of dilute WILCLEAR™ (10 gal. water : 1 gal. WILCLEAR™)
5		5.0-19.0' formation taking injection ~400 psi	
9			
13			
17			
19		19.0-25.0' formation very slow to take injection ~600psi	
21			
25			

URS Corporation	Subsurface Injection Log	
Client: Rohm & Haas Company	Location: Former EMCA Site	Injection Point: 8 B

Contractor:	URS-Pittsburgh	**Project No.:**	11173570.00000
Rig:	Power Probe 9600	**Date:**	11/11/04
Pump:	12 hp Moynopump	**Weather:**	Clear, sunny, 47 °F
Operator:	Ray Junkins	**Geologist:**	Scott McCabe

Depth (ft.)	Injection Pt.	Notes:	Injection Quantities and Measurements
0–2		BAROID 3/8-inch bentonite chips added to 0' - 2' interval to seal hole while injecting solutions. Asphalt patch installed at ground surface at completion.	MW-03 Area Injection fluid totals (5 ft. to 25 ft.) and injection sequence: 1) 270 gal. of dilute WILCLEAR™ (10 gal. water : 1 gal. WILCLEAR™)
5		5.0-19.0' formation taking injection ~400 psi	
9			
13			
17			
		19.0-20.0' formation very slow to take injection ~600psi	
		20.0-24.0' formation taking injection ~400 psi	
21			
25		24.0-25.0' formation very slow to take injection ~600psi	

URS Corporation	Subsurface Injection Log	
Client: Rohm & Haas Company	Location: Former EMCA Site	Injection Point: 9 B

Contractor:	URS-Pittsburgh	**Project No.:**	11173570.00000
Rig:	Power Probe 9600	**Date:**	11/11/04
Pump:	12 hp Moynopump	**Weather:**	Clear, sunny, 47 °F
Operator:	Ray Junkins	**Geologist:**	Scott McCabe

Depth (ft.)	Injection Pt.	Notes:	Injection Quantities and Measurements
0–2		BAROID 3/8-inch bentonite chips added to 0' - 2' interval to seal hole while injecting solutions. Asphalt patch installed at ground surface at completion.	MW-03 Area Injection fluid totals (5 ft. to 25 ft.) and injection sequence: 1) 270 gal. of dilute WILCLEAR™ (10 gal. water : 1 gal. WILCLEAR™)
5		5.0-24.0' formation taking injection ~300 psi	
9			
13			
17			
21			
25		24.0-25.0' formation very slow to take injection ~600psi	

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URS Corporation	Subsurface Injection Log	
Client: Rohm & Haas Company	Location: Former EMCA Site	Injection Point: 10 B

Contractor:	URS-Pittsburgh	**Project No.:**	11173570.00000
Rig:	Power Probe 9600	**Date:**	11/11/04
Pump:	12 hp Moynopump	**Weather:**	Clear, sunny, 47 °F
Operator:	Ray Junkins	**Geologist:**	Scott McCabe

Depth (ft.)	Injection Pt.	Notes:	Injection Quantities and Measurements
0–2		BAROID 3/8-inch bentonite chips added to 0' - 2' interval to seal hole while injecting solutions. Asphalt patch installed at ground surface at completion.	MW-03 Area Injection fluid totals (5 ft. to 25 ft.) and injection sequence: 1) 270 gal. of dilute WILCLEAR™ (10 gal. water : 1 gal. WILCLEAR™)
5		5.0-24.5' formation taking injection ~400 psi	
9			
13			
17			
21			
25		24.5-25.0' formation very slow to take injection ~600psi	

URS Corporation	Subsurface Injection Log	
Client: Rohm & Haas Company	Location: Former EMCA Site	Injection Point: 11 B

Contractor:	URS-Pittsburgh	**Project No.:**	11173570.00000
Rig:	Power Probe 9600	**Date:**	11/11/04
Pump:	12 hp Moynopump	**Weather:**	Clear, sunny, 47 °F
Operator:	Ray Junkins	**Geologist:**	Scott McCabe

Depth (ft.)	Injection Pt.	Notes:	Injection Quantities and Measurements
0–2		BAROID 3/8-inch bentonite chips added to 0' - 2' interval to seal hole while injecting solutions. Asphalt patch installed at ground surface at completion.	MW-03 Area Injection fluid totals (5 ft. to 25 ft.) and injection sequence: 1) 270 gal. of dilute WILCLEAR™ (10 gal. water : 1 gal. WILCLEAR™)
5		5.0-25.0' formation taking injection ~400 psi	
9			
13			
17			
21			
25			

URS Corporation	Subsurface Injection Log	
Client: Rohm & Haas Company	Location: Former EMCA Site	Injection Point: 12 B

Contractor:	URS-Pittsburgh	**Project No.:**	11173570.00000
Rig:	Power Probe 9600	**Date:**	11/10/04
Pump:	12 hp Moynopump	**Weather:**	Clear, sunny, 29 °F
Operator:	Ray Junkins	**Geologist:**	Scott McCabe

Depth (ft.)	Injection Pt.	Notes:	Injection Quantities and Measurements
0–2	(sealed)	BAROID 3/8-inch bentonite chips added to 0' - 2' interval to seal hole while injecting solutions. Asphalt patch installed at ground surface at completion.	MW-03 Area Injection fluid totals (5 ft. to 25 ft.) and injection sequence: 1) 270 gal. of dilute WILCLEAR™ (10 gal. water : 1 gal. WILCLEAR™)
5		5.0-25.0' formation taking injection ~400 psi	
9			
13			
17			
21			
25			

URS Corporation	Subsurface Injection Log	
Client: Rohm & Haas Company	Location: Former EMCA Site	Injection Point: 1 C

Contractor:	URS-Pittsburgh	**Project No.:**	11173570.00000
Rig:	Power Probe 9600	**Date:**	11/12/04
Pump:	12 hp Moynopump	**Weather:**	Cloudy, light to moderate rain, 41° F
Operator:	Ray Junkins	**Geologist:**	Scott McCabe

Depth (ft.)	Injection Pt.	Notes:	Injection Quantities and Measurements
0–5		BAROID 3/8-inch bentonite chips added to 0' - 2' interval to seal hole while injecting solutions. Asphalt patch installed at ground surface at completion.	MW-02/MW-06 Area Injection fluid totals (5 ft. to 25 ft.) and injection sequence: 1) 110 gallons of dilute EOS™ (4 gal. water : 1 gal EOS™) 2) 53 gal. of dilute WILCLEAR™ (16.7 gal. water : 1 gal. WILCLEAR™)
5		5.0-25.0' formation taking injection ~400 psi	
9			
13			
17			
21			
25			

URS Corporation	Subsurface Injection Log	
Client: Rohm & Haas Company	Location: Former EMCA Site	Injection Point: 2 C

Contractor:	URS-Pittsburgh	**Project No.:**	11173570.00000
Rig:	Power Probe 9600	**Date:**	11/12/04
Pump:	12 hp Moynopump	**Weather:**	Cloudy, light to moderate rain, 41° F
Operator:	Ray Junkins	**Geologist:**	Scott McCabe

Depth (ft.)	Injection Pt.	Notes:	Injection Quantities and Measurements
0–2	(bentonite seal)	BAROID 3/8-inch bentonite chips added to 0' - 2' interval to seal hole while injecting solutions. Asphalt patch installed at ground surface at completion.	MW-02/MW-06 Area Injection fluid totals (5 ft. to 25 ft.) and injection sequence: 1) 110 gallons of dilute EOS™ (4 gal. water : 1 gal EOS™) 2) 53 gal. of dilute WILCLEAR™ (16.7 gal. water : 1 gal. WILCLEAR™)
5		5.0-25.0' formation taking injection ~400 psi	
9			
13			
17			
21			
25			

URS Corporation	Subsurface Injection Log	
Client: Rohm & Haas Company	**Location: Former EMCA Site**	**Injection Point: 3 C**

Contractor:	URS-Pittsburgh	**Project No.:**	11173570.00000
Rig:	Power Probe 9600	**Date:**	11/12/04
Pump:	12 hp Moynopump	**Weather:**	Cloudy, light to moderate rain, 41° F
Operator:	Ray Junkins	**Geologist:**	Scott McCabe

Depth (ft.)	Injection Pt.	Notes:	Injection Quantities and Measurements
0–2	bentonite seal	BAROID 3/8-inch bentonite chips added to 0' - 2' interval to seal hole while injecting solutions. Asphalt patch installed at ground surface at completion.	MW-02/MW-06 Area Injection fluid totals (5 ft. to 25 ft.) and injection sequence: 1) 110 gallons of dilute EOS™ (4 gal. water : 1 gal EOS™) 2) 53 gal. of dilute WILCLEAR™ (16.7 gal. water : 1 gal. WILCLEAR™)
5		5.0-25.0' formation taking injection ~400 psi	
9			
13			
17			
21			
25			

URS Corporation	Subsurface Injection Log	
Client: Rohm & Haas Company	Location: Former EMCA Site	Injection Point: 4 C

Contractor:	URS-Pittsburgh	**Project No.:**	11173570.00000
Rig:	Power Probe 9600	**Date:**	11/12/04
Pump:	12 hp Moynopump	**Weather:**	Cloudy, light to moderate rain, 41° F
Operator:	Ray Junkins	**Geologist:**	Scott McCabe

Depth (ft.)	Injection Pt.	Notes:	Injection Quantities and Measurements
0–2	(bentonite seal)	BAROID 3/8-inch bentonite chips added to 0' - 2' interval to seal hole while injecting solutions. Asphalt patch installed at ground surface at completion.	MW-02/MW-06 Area Injection fluid totals (5 ft. to 25 ft.) and injection sequence: 1) 110 gallons of dilute EOS™ (4 gal. water : 1 gal EOS™) 2) 53 gal. of dilute WILCLEAR™ (16.7 gal. water : 1 gal. WILCLEAR™)
5		5.0-25.0' formation taking injection ~400 psi	
9			
13			
17			
21			
25			

URS Corporation

Subsurface Injection Log

Client: Rohm & Haas Company	Location: Former EMCA Site	Injection Point: 5 C

Contractor:	URS-Pittsburgh	**Project No.:**	11173570.00000
Rig:	Power Probe 9600	**Date:**	11/12/04
Pump:	12 hp Moynopump	**Weather:**	Cloudy, light to moderate rain, 41° F
Operator:	Ray Junkins	**Geologist:**	Scott McCabe

Depth (ft.)	Injection Pt.	Notes:	Injection Quantities and Measurements
0–2	(sealed)	BAROID 3/8-inch bentonite chips added to 0' - 2' interval to seal hole while injecting solutions. Asphalt patch installed at ground surface at completion.	MW-02/MW-06 Area Injection fluid totals (5 ft. to 25 ft.) and injection sequence: 1) 110 gallons of dilute EOS™ (4 gal. water : 1 gal EOS™) 2) 53 gal. of dilute WILCLEAR™ (16.7 gal. water : 1 gal. WILCLEAR™)
5		5.0-22.0' formation taking injection ~400 psi	
9			
13			
17			
21			
22		22.0-25.0' formation very slow to take injection ~600psi	
25			

URS Corporation	Subsurface Injection Log	
Client: Rohm & Haas Company	**Location: Former EMCA Site**	**Injection Point: 6 C**

Contractor:	URS-Pittsburgh	**Project No.:**	11173570.00000
Rig:	Power Probe 9600	**Date:**	11/12/04
Pump:	12 hp Moynopump	**Weather:**	Clear, sunny, 36 °F
Operator:	Ray Junkins	**Geologist:**	Scott McCabe

Depth (ft.)	Injection Pt.	Notes:	Injection Quantities and Measurements
0–2		BAROID 3/8-inch bentonite chips added to 0' - 2' interval to seal hole while injecting solutions. Asphalt patch installed at ground surface at completion.	MW-02/MW-06 Area Injection fluid totals (5 ft. to 25 ft.) and injection sequence: 1) 110 gallons of dilute EOS™ (4 gal. water : 1 gal EOS™) 2) 53 gal. of dilute WILCLEAR™ (16.7 gal. water : 1 gal. WILCLEAR™)
5		5.0-21.0' formation taking injection ~400 psi	
9			
13			
17			
21		21.0-25.0' formation very slow to take injection ~600psi	
25			

URS Corporation	Subsurface Injection Log	
Client: Rohm & Haas Company	Location: Former EMCA Site	Injection Point: 7 C

Contractor:	URS-Pittsburgh	**Project No.:**	11173570.00000
Rig:	Power Probe 9600	**Date:**	11/12/04
Pump:	12 hp Moynopump	**Weather:**	Clear, sunny, 36 °F
Operator:	Ray Junkins	**Geologist:**	Scott McCabe

Depth (ft.)	Injection Pt.	Notes:	Injection Quantities and Measurements
0–2		BAROID 3/8-inch bentonite chips added to 0' - 2' interval to seal hole while injecting solutions. Asphalt patch installed at ground surface at completion.	MW-02/MW-06 Area Injection fluid totals (5 ft. to 25 ft.) and injection sequence: 1) 110 gallons of dilute EOS™ (4 gal. water : 1 gal EOS™) 2) 53 gal. of dilute WILCLEAR™ (16.7 gal. water : 1 gal. WILCLEAR™)
5		5.0-23.0' formation taking injection ~400 psi	
9			
13			
17			
21			
23		23.0-25.0' formation very slow to take injection ~600psi	
25			

URS Corporation	Subsurface Injection Log	
Client: Rohm & Haas Company	Location: Former EMCA Site	Injection Point: 8 C

Contractor:	URS-Pittsburgh	**Project No.:**	11173570.00000
Rig:	Power Probe 9600	**Date:**	11/12/04
Pump:	12 hp Moynopump	**Weather:**	Clear, sunny, 36 °F
Operator:	Ray Junkins	**Geologist:**	Scott McCabe

Depth (ft.)	Injection Pt.	Notes:	Injection Quantities and Measurements
0–2	(bentonite seal)	BAROID 3/8-inch bentonite chips added to 0' - 2' interval to seal hole while injecting solutions. Asphalt patch installed at ground surface at completion.	MW-02/MW-06 Area Injection fluid totals (5 ft. to 25 ft.) and injection sequence: 1) 110 gallons of dilute EOS™ (4 gal. water : 1 gal EOS™) 2) 53 gal. of dilute WILCLEAR™ (16.7 gal. water : 1 gal. WILCLEAR™)
5		5.0-25.0' formation taking injection ~400 psi	
9			
13			
17			
21			
25			

URS Corporation	Subsurface Injection Log	
Client: Rohm & Haas Company	Location: Former EMCA Site	Injection Point: 9 C

Contractor:	URS-Pittsburgh	**Project No.:**	11173570.00000
Rig:	Power Probe 9600	**Date:**	11/12/04
Pump:	12 hp Moynopump	**Weather:**	Clear, sunny, 36 °F
Operator:	Ray Junkins	**Geologist:**	Scott McCabe

Depth (ft.)	Injection Pt.	Notes:	Injection Quantities and Measurements
0–2	(bentonite seal)	BAROID 3/8-inch bentonite chips added to 0' - 2' interval to seal hole while injecting solutions. Asphalt patch installed at ground surface at completion.	MW-02/MW-06 Area Injection fluid totals (5 ft. to 25 ft.) and injection sequence: 1) 110 gallons of dilute EOS™ (4 gal. water : 1 gal EOS™) 2) 53 gal. of dilute WILCLEAR™ (16.7 gal. water : 1 gal. WILCLEAR™)
5		5.0-23.0' formation taking injection ~400 psi	
9			
13			
17			
21			
23		23.0-25.0' formation very slow to take injection ~600psi	
25			

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URS Corporation	Subsurface Injection Log	
Client: Rohm & Haas Company	Location: Former EMCA Site	Injection Point: 10 C

Contractor:	URS-Pittsburgh	**Project No.:**	11173570.00000
Rig:	Power Probe 9600	**Date:**	11/12/04
Pump:	12 hp Moynopump	**Weather:**	Clear, sunny, 36 °F
Operator:	Ray Junkins	**Geologist:**	Scott McCabe

Depth (ft.)	Injection Pt.	Notes:	Injection Quantities and Measurements
0–2	(bentonite seal)	BAROID 3/8-inch bentonite chips added to 0' - 2' interval to seal hole while injecting solutions. Asphalt patch installed at ground surface at completion.	MW-02/MW-06 Area Injection fluid totals (5 ft. to 25 ft.) and injection sequence: 1) 110 gallons of dilute EOS™ (4 gal. water : 1 gal EOS™) 2) 53 gal. of dilute WILCLEAR™ (16.7 gal. water : 1 gal. WILCLEAR™)
5		5.0-25.0' formation taking injection ~400 psi	
9			
13			
17			
21			
25			

URS Corporation	Subsurface Injection Log	
Client: Rohm & Haas Company	Location: Former EMCA Site	Injection Point: 1 D

Contractor:	URS-Pittsburgh	**Project No.:**	11173570.00000
Rig:	Power Probe 9600	**Date:**	11/11/04
Pump:	12 hp Moynopump	**Weather:**	Clear, sunny, 47 °F
Operator:	Ray Junkins	**Geologist:**	Scott McCabe

Depth (ft.)	Injection Pt.	Notes:	Injection Quantities and Measurements
0–2	(bentonite seal)	BAROID 3/8-inch bentonite chips added to 0' - 2' interval to seal hole while injecting solutions. Asphalt patch installed at ground surface at completion.	GZ-06 Area Injection fluid totals (5 ft. to 21 ft.) and injection sequence: 1) 96 gal. of dilute WILCLEAR™ (10 gal. water : 1 gal. WILCLEAR™)
5		5.0-21.0' formation taking injection ~400 psi	
9			
13			
17			
21			Refusal at 21 ft.
25			

URS Corporation	Subsurface Injection Log	
Client: Rohm & Haas Company	Location: Former EMCA Site	Injection Point: 2 D

Contractor:	URS-Pittsburgh	**Project No.:**	11173570.00000
Rig:	Power Probe 9600	**Date:**	11/11/04
Pump:	12 hp Moynopump	**Weather:**	Clear, sunny, 47 °F
Operator:	Ray Junkins	**Geologist:**	Scott McCabe

Depth (ft.)	Injection Pt.	Notes:	Injection Quantities and Measurements
0–2	(bentonite seal)	BAROID 3/8-inch bentonite chips added to 0' - 2' interval to seal hole while injecting solutions. Asphalt patch installed at ground surface at completion.	GZ-06 Area Injection fluid totals (5 ft. to 24 ft.) and injection sequence: 1) 114 gal. of dilute WILCLEAR™ (10 gal. water : 1 gal. WILCLEAR™)
5		5.0-24.0' formation taking injection ~400 psi	
9			
13			
17			
21			
25			Refusal at 24 ft.

URS Corporation	Subsurface Injection Log	
Client: Rohm & Haas Company	**Location: Former EMCA Site**	**Injection Point: 3 D**

Contractor:	URS-Pittsburgh	**Project No.:**	11173570.00000
Rig:	Power Probe 9600	**Date:**	11/11/04
Pump:	12 hp Moynopump	**Weather:**	Clear, sunny, 47 °F
Operator:	Ray Junkins	**Geologist:**	Scott McCabe

Depth (ft.)	Injection Pt.	Notes:	Injection Quantities and Measurements
0–5		BAROID 3/8-inch bentonite chips added to 0' - 2' interval to seal hole while injecting solutions. Asphalt patch installed at ground surface at completion.	GZ-06 Area Injection fluid totals (5 ft. to 15 ft.) and injection sequence: 1) 96 gal. of dilute WILCLEAR™ (10 gal. water : 1 gal. WILCLEAR™)
5–15		5.0-15.0' formation slow to take injection ~500psi	Refusal at 15 ft.
17			
21			
25			

N\11172730.00000\EXCEL\IRM injection logs 2004.xls

URS Corporation	Subsurface Injection Log	
Client: Rohm & Haas Company	Location: Former EMCA Site	Injection Point: 1E

Contractor:	URS-Pittsburgh	**Project No.:**	11173570.00000
Rig:	Power Probe 9600	**Date:**	11/9/04
Pump:	12 hp Moynopump	**Weather:**	Clear, sunny, 41 °F
Operator:	Ray Junkins	**Geologist:**	Scott McCabe

Depth (ft.)	Injection Pt.	Notes:	Injection Quantities and Measurements
0-2	Bentonite seal	BAROID 3/8-inch bentonite chips added to 0' - 2' interval to seal hole while injecting solutions. Asphalt patch installed at ground surface at completion.	MW-07 Area Injection fluid totals (5 ft. to 25 ft.) and injection sequence: 1) 165 gal. of dilute WILCLEAR™ (10 gal. water : 1 gal. WILCLEAR™)
5		5.0-8.0' formation slow to take injection ~500psi	
9		8.0-14.0' formation taking injection ~300-400psi	
13			
		14.0-17.0' formation slow to take injection ~500psi	
17		17.0-18.0' formation taking injection ~300-400psi	
		18.0-19.0' formation very slow to take injection ~600psi	
		19.0-23.0' formation taking injection ~300-400psi	
21			
		23.0-25.0' formation very slow to take injection ~600psi	
25			

URS Corporation	Subsurface Injection Log	
Client: Rohm & Haas Company	Location: Former EMCA Site	Injection Point: 2E

Contractor:	URS-Pittsburgh	**Project No.:**	11173570.00000
Rig:	Power Probe 9600	**Date:**	11/9/04
Pump:	12 hp Moynopump	**Weather:**	Clear, sunny, 41 °F
Operator:	Ray Junkins	**Geologist:**	Scott McCabe

Depth (ft.)	Injection Pt.	Notes:	Injection Quantities and Measurements
0–2		BAROID 3/8-inch bentonite chips added to 0' - 2' interval to seal hole while injecting solutions. Asphalt patch installed at ground surface at completion.	MW-07 Area Injection fluid totals (5 ft. to 25 ft.) and injection sequence: 1) 165 gal. of dilute WILCLEAR™ (10 gal. water : 1 gal. WILCLEAR™)
5		5.0-25.0' formation slow to take injection 500 - 600psi	
9			
13			
17			
21			
25			

URS Corporation	Subsurface Injection Log	
Client: Rohm & Haas Company	Location: Former EMCA Site	Injection Point: 3E

Contractor:	URS-Pittsburgh	**Project No.:**	11173570.00000
Rig:	Power Probe 9600	**Date:**	11/9/04
Pump:	12 hp Monopump	**Weather:**	Clear, sunny, 41 °F
Operator:	Ray Junkins	**Geologist:**	Scott McCabe

Depth (ft.)	Injection Pt.	Notes:	Injection Quantities and Measurements
0–2	(sealed)	BAROID 3/8-inch bentonite chips added to 0' - 2' interval to seal hole while injecting solutions. Asphalt patch installed at ground surface at completion.	MW-07 Area Injection fluid totals (5 ft. to 25 ft.) and injection sequence: 1) 165 gal. of dilute WILCLEAR™ (10 gal. water : 1 gal. WILCLEAR™)
5		5.0-9.0' formation slow to take injection ~500psi	
9		9.0-11.0' formation taking injection ~300-400psi	
		11.0-18.0' formation very slow to take injection ~600psi	
13			
17			
		18.0-21.0' formation taking injection ~300-400psi	
21		21.0-25.0' formation very slow to take injection ~600psi	
25			

APPENDIX D

CHEMICAL SUMMARY FOR FREON 113

EPA 749-F-94-012a

CHEMICAL SUMMARY FOR FREON 113

prepared by
OFFICE OF POLLUTION PREVENTION AND TOXICS
U.S. ENVIRONMENTAL PROTECTION AGENCY
August 1994

This summary is based on information retrieved from a systematic search limited to secondary sources (see Appendix A). These sources include online databases, unpublished EPA information, government publications, review documents, and standard reference materials. No attempt has been made to verify information in these databases and secondary sources.

I. CHEMICAL IDENTITY AND PHYSICAL/CHEMICAL PROPERTIES

The chemical identity and physical/chemical properties of freon 113 are summarized in Table 1.

TABLE 1. CHEMICAL IDENTITY AND
CHEMICAL/PHYSICAL PROPERTIES OF FREON 113

<table>
<tr><th>Characteristic/Property</th><th>Data</th><th>Reference</th></tr>
<tr><td>CAS No.</td><td>76-13-1</td><td></td></tr>
<tr><td>Common Synonyms</td><td>CFC-113; UCON-113;
1,1,2-trichloro-
1,2,2-trifluoroethane</td><td>HSDB 1994</td></tr>
<tr><td>Molecular Formula</td><td>C2Cl3F3</td><td></td></tr>
<tr><td>Chemical Structure</td><td>   Cl F
    | |
F - C - C - Cl
    | |
    Cl F</td><td></td></tr>
<tr><td>Physical State</td><td>colorless liquid</td><td>Verschueren 1983</td></tr>
<tr><td>Molecular Weight</td><td>187.38</td><td>Verschueren 1983</td></tr>
<tr><td>Melting Point</td><td>-35øC</td><td>Verschueren 1983</td></tr>
<tr><td>Boiling Point</td><td>48øC</td><td>Verschueren 1983</td></tr>
<tr><td>Water Solubility</td><td>170 mg/L</td><td>CHEMFATE 1994</td></tr>
<tr><td>Density</td><td>1.5635 at 25øC</td><td>HSDB 1994</td></tr>
<tr><td>Vapor Density (air = 1)</td><td>6.5</td><td>Verschueren 1983</td></tr>
<tr><td>KOC</td><td>372</td><td>CHEMFATE 1994</td></tr>
<tr><td>Log KOW</td><td>1.66</td><td>HSDB 1994</td></tr>
<tr><td>Vapor Pressure</td><td>284 mm Hg at 20øC</td><td>HSDB 1994</td></tr>
<tr><td>Reactivity</td><td></td><td></td></tr>
<tr><td>Flash Point</td><td>nonflammable</td><td>HSDB 1994</td></tr>
<tr><td>Henry's Law Constant</td><td>5.3 x 10-1 atm m3/mol</td><td>HSDB 1994</td></tr>
<tr><td>Fish Bioconcentration Factor</td><td>10 to 30 (estimated)</td><td>HSDB 1994</td></tr>
<tr><td>Odor Threshold</td><td>135 ppm (in air)</td><td>Verschueren 1983</td></tr>
<tr><td>Conversion Factors</td><td>1 ppm = 7.79 mg/m3
1 mg/m3 = 0.13 ppm</td><td>Verschueren 1983</td></tr>
</table>

II. PRODUCTION, USE, AND TRENDS

A. Production

Freon 113, also called trichlorotrifluoroethane or CFC-113, is produced in the U.S. by 2 companies. Table 2 lists producers, plant locations, and plant capacities. Annual capacity is estimated to be 300 million pounds, though production was limited to 177 million pounds in 1993 (Mannsville 1993).

B. Use

Freon 113 is used primarily as a chlorofluorocarbon (CFC) cleaning solvent. It also has applications as a refrigerant in commercial/industrial air conditioning and industrial process cooling; as a chemical intermediate in the manufacture of high-temperature lubricants; as a foaming or blowing agent; as an intermediate in the manufacture of fluorocarbon resins; and as a solvent or active ingredient in aerosol formulations.

C. Trends

A ban of the production of CFCs is scheduled to take effect at the end of 1995. One freon 113 producer DuPont has announced plans to cease production of CFCs by the end of 1994.

TABLE 2. U.S. PRODUCERS OF FREON 113

Company	Plant Location	Plant Capacity (Allowance) (in millions of pounds)
Allied-Signal	Baton Rouge, LA	100(48)
DuPont	Corpus Christi, TX	200(129)

Source: Mannsville 1993.

III. ENVIRONMENTAL FATE

A. Environmental Release

Greater than 99% of the 24.6 million pounds of freon 113 released in 1992, was into the atmosphere (TRI92 1994). Only 1916 pounds and 9028 pounds were released to surface and ground waters combined and to land, respectively (TRI92 1994). Due to the high volatility of the chemical, the small amount released to land or ground or surface waters would be expected to enter the atmosphere quickly. Once in the atmosphere, freon 113 diffuses from the troposphere into the stratosphere (U.S. EPA 1983; HSDB 1994). Between 1973 and 1980, freon 113 concentrations in rural and urban areas of the U.S. ranged from 28 ppt to 220 ppt, respectively (HSDB 1994).

B. Transport

Freon 113's water solubility and vapor pressure indicate rapid volatilization to the atmosphere from surface waters. An estimated half-life for freon 113 in a model river is 4 hours

(HSDB 1994). If released to soils, the chemical would rapidly volatalize or leach to ground waters. Once in the atmosphere, freon 113 is relatively inert in the troposphere and is transported slowly to the stratosphere (HSDB 1994; U.S. EPA 1983). The half-life for diffusion out of the troposphere is 20 years (HSDB 1994).

C. Transformation/Persistence

1. Air - Freon 113 is relatively inert in the troposphere; however, once in the stratosphere, the chemical is degraded by direct photolysis or reaction with excited atomic oxygen (U.S. EPA 1983). Photolytic degradation accounts for 84-89% of breakdown with a stratospheric half-life ranging from 63 to 122 years (U.S. EPA 1983). Photodissociation releases atomic chlorine which reacts with ozone to yield chlorine oxide and oxygen. This can, in theory, lead to a chain reaction resulting in continual destruction of ozone (U.S. EPA 1983).

2. Soil - If released to soil, freon 113 will rapidly volatalize to the atmosphere or leach into ground water (HSDB 1994).

3. Water - Because freon 113's water solubility and vapor pressure, the chemical will quickly enter the atmosphere (HSDB 1994).

4. Biota - Based on bioconcentration factors of 11 - 34, freon 113 is not expected to accumulate in aquatic organisms (HSDB 1994).

IV. HUMAN HEALTH EFFECTS

A. Pharmacokinetics

1. Absorption - Freon 113 is rapidly absorbed after inhalation or dermal exposure. Absorption after ingestion is estimated to be 35 - 48 times lower than after inhalation (HSDB 1994). Absorption is biphasic with an initial rapid increase in blood levels followed by a slower increase to maximum (U.S. EPA 1983). A concentration of 12 ppm was detected within 20 minutes in the expired air of individuals exposed to freon 113 on their hands, forearms, and scalp (U.S. EPA 1983); but no account was given for possible inhalation of vapors.

2. Distribution - The main factor affecting distribution of freon 113 in an individual is body fat. Freon 113 can be concentrated in body fat before being released to the blood. The chemical is also partitioned to brain, liver, and lung (HSDB 1994).

3. Metabolism - After human volunteers were exposed to 247 ppm or 494 ppm freon 113, only 2.6 - 4.3% of the dose was recovered in expired air after termination of exposure. The report suggests some metabolism may have occurred (U.S. EPA 1983), but no data were presented. Rats exposed to 2000 ppm 6 hours/day, 5 days/week, for 2 weeks had decreased cerebral glutathione and glutathione peroxidase levels as well as decreased hepatic cytochrome P-450. Freon 113 appeared to bind to microsomal cytochrome P-450 (U.S. EPA 1983) but no metabolites were reported.

4. Excretion - Experiments in dogs given similar chemicals by various routes of exposure indicate that chlorofluorocarbons

are eliminated entirely by the respiratory tract (U.S. EPA 1983). In humans exposed dermally, the concentration of freon 113 in expired air declined from a peak of 12.7 ppm to 0.5 ppm within 90 minutes (U.S. EPA 1983).

B. Acute Toxicity

Adverse acute human health effects of freon 113 include irregular heartbeat and adverse effects on psychomotor performance. A no-observed-effect level (NOEL) for acute effects for freon 113 is in the range of 1500 to 2000 ppm. 4-Hour inhalation LC50 values for rats are greater than 52,000 ppm.

1. Humans - Inhalation of freon 113 for 2.75 hours resulted in no effect on psychomotor performance at 1500 ppm, slight deterioration at 2500 ppm, and increasing decrement at 4500 ppm (U.S. EPA 1983). Cardiac arrhythmias have been associated with inhalation exposure to freon 113 (HSDB 1994). Based on these data, a no-observed-adverse-effect level (NOAEL) for short-term exposure to freon 113 is in the range of 1500 to 2000 ppm (U.S. EPA 1983). Accidental ingestion of approximately 1 liter of the chemical produced immediate but transient cyanosis and severe rectal irritation and diarrhea for 3 days (U.S. EPA 1983; HSDB 1994). No adverse toxicity or dermal irritation resulted from application of freon 113 to the scalp and forehead for up to 30 days (U.S. EPA 1983).

2. Animals - The 4 hour inhalation LC50's for rats range from 52,000 to 68,000 ppm. For rats, guinea pigs, mice, and rabbits, 2 hour lethal concentrations range from 50,000 to 120,000 ppm (HSDB 1994). Anesthetized monkeys exposed to 25,000 ppm or 50,000 ppm for 5 minutes had cardiac arrhythmias including tachycardia and decreased contractility (U.S. EPA 1983). Rats exposed to 1000 or 2000 ppm freon 113 for 1 and 2 weeks had proliferation and vacuolization of the smooth endoplasmic reticulum of the liver (U.S. EPA 1983). Liver alterations were also seen in rats exposed to 5000 ppm for 30 days (HSDB 1994). No signs of toxicity were observed in rabbits or dogs exposed to 12,500 ppm for 3.5 hours/day for 20 days (U.S. EPA 1983). Dermal application to rabbits greater than 11 g/kg caused only drying of the skin at the site of application (U.S. EPA 1983).

C. Subchronic/Chronic Toxicity

No adverse human health effects have been reported for workers exposed to freon 113. Based on a NOEL of 697 ppm for workers, EPA has derived an oral RfD of 30 mg/kg/day for freon 113.

1. Humans - No effects have been reported for workers occupationally exposed to 65 ppm for 11 years or 697 ppm for 2.77 years. Therefore, a NOAEL for chronic freon 113 exposure is listed as 697 ppm with the oral RfD (reference dose), calculated from the inhalation study, of 30 mg/kg/day (see end note 1) (U.S. EPA 1994). Epidemiological studies of men and women with greater than 1 year of occupational exposure to freon 113 showed no alterations in blood chemistry or urinalysis; one case of dermatitis was observed in males (U.S. EPA 1983).

2. Animals - Gross and microscopic pathology evaluations of rats exposed to freon 113 for 90 days or 1 year show no evidence of toxicity up to 20,000 ppm (U.S. EPA 1983).

D. Carcinogenicity

No information was found on the carcinogenicity of freon 113. One study has reported no carcinogenicty in rats exposed by inhalation to concentrations up to 20,000 ppm for two years.

1. Humans - No information was found in the secondary sources searched concerning the carcinogenicity of direct exposure to freon 113. However, in the stratosphere, freon 113 photo-catalytically destroys ozone allowing more ultraviolet radiation to reach the earth's surface. Theoretically this effect could result in an increase in the incidence of non-malignant skin cancers, although to date, there is no empirical data to support this hypothesis (U.S. EPA 1983).

2. Animals - No cancers were seen in rats exposed to 2000, 10,000, or 20,000 ppm freon 113 for 2 years (U.S. EPA 1983).

E. Genotoxicity

Freon 113 was negative for gene reversion in 4 strains of Salmonella typhimurium (U.S. EPA 1983).

F. Developmental/Reproductive Toxicity

No information was found concerning the developmental or reproductive toxicity of freon 113 to humans. No developmental/ reproductive effects have been reported in laboratory animal studies of freon 113.

1. Humans - No information was found in the secondary sources searched concerning the developmental or reproductive toxicity of freon 113 to humans.

2. Animals - Rats were exposed to 5000, 12,500, or 25,000 ppm freon 113 for 6 hours/day on days 6-15 of gestation. Maternal toxicity as indicated by decreased weight gain and feed consumption occurred at the highest dose, but no evidence of developmental toxicity was seen in pups from any exposure group (U.S. EPA 1983). No teratogenicity was seen in offspring of rabbits exposed either orally (up to 5 g/kg) or by inhalation (up to 20,000 ppm); EPA has concluded that niether of these studies was adequate for use in assessing the developmental toxicity of freon 113 (U.S. EPA 1983).

G. Neurotoxicity

Available evidence from human and laboratory animal studies indicates that freon 113 adversely affects the psychomotor performance at high inhalation doses. The threshold concentration of freon 113 for impairment of psychomotor performance (loss of concentration ability, mild lethargy) is about 2500 ppm.

1. Humans - The threshold concentration of freon 113 for impairment of psychomotor performance (loss of concentration ability, mild

lethargy) is about 2500 ppm. Humans limited to exposures for 2.75 hours showed no impairment of psychomotor performance at 1500 ppm, slight impairment at 2500 ppm, and increased decrement at 4500 ppm (HSDB 1994). One case of sensorimotor neuropathy was reported in a woman who worked in a laundry for several years; recovery occurred after removal from exposure (HSDB 1994).

2. Animals - Guinea pigs exposed to 50,000 ppm freon 113 have loss of coordination after 30 minutes and die within 1 hour (HSDB 1994).

V. ENVIRONMENTAL EFFECTS

A. Toxicity to Aquatic Organisms

No information was found concerning the toxicity of freon 113 to aquatic organisms. Due to its water solubility (170 mg/L), its high vapor pressure (284 mm Hg), and its estimated low bioconcentration factors (10-30), freon 113 is not likely to accumulate in aquatic organisms to toxic levels (HSDB 1994). Aquatic organisms, such as phytoplankton, zooplankton, and the larval stages of many insects and fishes, that inhabit the surface of the water column may be susceptible to increased ultraviolet radiation (TRI92 1994) due to ozone depletion as a result of freon 113 degradation and release of chlorine atoms in the upper atmosphere (see Section V.C).

B. Toxicity to Terrestrial Organisms

No information was found in the secondary sources searched for toxicity of freon 113 to terrestrial organisms. Due to its volatility, freon 113 is not expected to accumulate to toxic concentrations in soils or surface waters. The range of inhalation LC50 values (52,000 - 68,000 ppm) in laboratory animals is orders of magnitude higher than any measured atmospheric concentration in the US (220 ppt in urban areas) (HSDB 1994).

C. Abiotic Effects

Freon 113 moves slowly through the lower atmosphere into the stratosphere. Photodegradation of freon 113 in the upper atmosphere releases chlorine atoms which react with ozone. Stratospheric depletion of ozone increases the amount of ultraviolet-B radiation that reaches the earth's surface (U.S. EPA 1983). Increased, surface UV radiation can adversely affect human health and the environment.

VI. EPA/OTHER FEDERAL/OTHER GROUP ACTIVITY

The EPA is interested in Freon 113 because of its ozone depleting properties. A ban on the production of chlorofluorocarbons (CFCs) is scheduled to take effect at the end of 1995 (Mannsville 1993). Occupational exposure to Freon 113 is regulated by the Occupational Safety and Health Administration. The permissible exposure limit (PEL) is 1,000 parts per million parts of air (ppm) (29 CFR 1910.1000).

Federal agency and other group activities for freon 113 are summarized in Tables 3 and 4.

TABLE 3. EPA OFFICES AND CONTACT NUMBERS FOR INFORMATION ON FREON 113

EPA OFFICE	LAW	PHONE NUMBER
Pollution Prevention & Toxics	Toxic Substances Control Act (Sec. 8A/8D/8E)	(202) 554-1404
	Emergency Planning and Community Right-to-Know Act (EPCRA)	
	Regulations (Sec. 313)	(800) 424-9346
	Toxics Release Inventory data	(202) 260-1531
Air	Clean Air Act	(919) 541-0888
Solid Waste & Emergency Response	Resource Conservation and Recovery Act / EPCRA (Sec. 311/312)	(800) 424-9346

TABLE 4. OTHER FEDERAL OFFICE/OTHER GROUP CONTACT NUMBERS FOR INFORMATION ON FREON 113

Other Agency/Department/Group	Contact Number
Agency for Toxic Substances & Disease Registry	(404) 639-6000
American Conference of Governmental Industrial Hygienists	(513) 742-2020
(Recommended Exposure Limit (see end note 2): 1000 ppm)	
(Recommended Short Term Limit (see end note 3): 1250 ppm)	
Consumer Product Safety Commission	(301) 817-0994
National Institute for Occupational Safety & Health	
(Recommended Exposure Limit (see end note 2): 1000 ppm)	(800) 356-4674
Occupational Safety & Health Administration	
(Permissible Exposure Limit (see end note 4): 1000 ppm)	
(Check local phone book for phone number under Department of Labor)	

VII. END NOTES

1. The RfD is an estimate (with uncertainty spanning perhaps an order of magnitude) of the daily exposure level for the human population, including sensitive subpopulations, that is likely to be without an appreciable risk of deleterious effects during the time period of concern.

2. The ACGIH/NIOSH exposure limits are time-weighted average (TWA) concentrations for an 8-hour workday (ACGIH) and up to a 10-hour workday (NIOSH) for a 40-hour workweek.

3. This is a recommended 15-minute exposure limit that should not be exceeded any time during an 8-hour workday.

4. The OSHA exposure limit is a time-weighted average (TWA)concentration that must not be exceeded during any 8-hour workshift of a 40-hour workweek.

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APPENDIX E

GROUNDWATER ANALYTICAL RESULTS

JULY 2001 – JULY 2004

TABLE 1
FORMER EMCA SITE
ANALYTES DETECTED IN GROUNDWATER (JUNE 2001- JULY 2004)

Location ID		GZ-06	GZ-06	GZ-06	GZ-06	GZ-06
Sample ID		GZ-06	GZ06_52103	GZ06	GZ06-091703	GZ-06-121803
Matrix		Groundwater	Groundwater	Groundwater	Groundwater	Groundwater
Depth Interval (ft)		-	-	-	-	-
Date Sampled		07/25/01	05/21/03	07/23/03	09/17/03	12/18/03
Parameter	**Units**					
Volatiles						
Acetone	UG/L	38	2.12 U	1.89 U	5.0 U	5.0 U
Benzene	UG/L	10 U	0.09 U	0.2 U	1.0 U	1.0 U
Bromodichloromethane	UG/L	10 U	0.13 U	0.08 U	1.0 U	1.0 U
Bromoform	UG/L	10 U	0.19 U	0.24 U	4.0 U	4.0 U
Bromomethane	UG/L	10 U	0.28 U	0.32 U	5.0 U	5.0 U
Methyl ethyl ketone (2-Butanone)	UG/L	10 U	R	R	R	R
Carbon Disulfide	UG/L	10 U	0.31 U	0.26 U	5.0 U	5.0 U
Carbon Tetrachloride	UG/L	10 U	0.32 U	0.39 U	2.0 U	2.0 U
Chlorobenzene	UG/L	10 U	0.1 U	0.08 U	5.0 U	5.0 U
Chloroethane	UG/L	10 U	0.23 U	0.46 U	5.0 U	5.0 U
Chloroform	UG/L	10 U	0.15 U	0.17 U	5.0 U	5.0 U
Chloromethane	UG/L	10 U	0.16 U	0.54 U	5.0 U	5.0 U
Chlorotrifluoroethene (Freon-1113)	UG/L	NA	NA	NA	NA	NA
Cyclohexane	UG/L	10 U	NA	NA	NA	NA
Dibromochloromethane	UG/L	10 U	0.2 U	0.17 U	5.0 U	5.0 U
Dichlorodifluoromethane	UG/L	10 U	NA	NA	NA	NA
1,2-Dibromo-3-chloropropane	UG/L	10 U	NA	NA	NA	NA
1,2-Dibromoethane	UG/L	10 U	NA	NA	NA	NA
1,2-Dichlorobenzene	UG/L	10 U	NA	NA	NA	NA
1,3-Dichlorobenzene	UG/L	10 U	NA	NA	NA	NA
1,4-Dichlorobenzene	UG/L	10 U	NA	NA	NA	NA
1,1-Dichloroethane	UG/L	10 U	0.1 U	0.24 U	5.0 U	5.0 U
1,2-Dichloroethane	UG/L	10 U	0.19 U	0.11 U	2.0 U	2.0 U

Flags assigned during chemistry validation are shown.

R - Rejected result   NA - Not Analyzed
U - Non-Detect   J - Estimated Result
UJ - Not detected above the estimated quantitation limit
D - Diluted sample

Detection Limits shown are MDL

TABLE 1
FORMER EMCA SITE
ANALYTES DETECTED IN GROUNDWATER (JUNE 2001- JULY 2004)

Location ID		GZ-06	GZ-06	GZ-06	GZ-06	GZ-06
Sample ID		GZ-06	GZ06_52103	GZ06	GZ06-091703	GZ-06-121803
Matrix		Groundwater	Groundwater	Groundwater	Groundwater	Groundwater
Depth Interval (ft)		-	-	-	-	-
Date Sampled		07/25/01	05/21/03	07/23/03	09/17/03	12/18/03
Parameter	Units					
Volatiles						
1,1-Dichloroethene	UG/L	10 U	0.8 J	1.5 J	2.0 U	2.0 U
cis-1,2-Dichloroethene	UG/L	10 U	0.11 U	0.22 U	5.0 U	5.0 U
trans-1,2-Dichloroethene	UG/L	10 U	0.17 U	0.21 U	5.0 U	5.0 U
1,2-Dichloropropane	UG/L	10 U	0.15 U	0.17 U	1.0 U	1.0 U
cis-1,3-Dichloropropene	UG/L	10 U	0.22 U	0.23 U	5.0 U	5.0 U
trans-1,3-Dichloropropene	UG/L	10 U	0.12 U	0.09 U	5.0 U	5.0 U
Ethylbenzene	UG/L	10 U	0.21 U	0.18 U	4.0 U	4.0 U
2-Hexanone	UG/L	10 U	1.21 U	1.09 U	5.0 U	5.0 U
Isopropylbenzene	UG/L	10 U	NA	NA	NA	NA
4-Methyl-2-Pentanone	UG/L	10 UJ	0.94 U	1.13 U	5.0 U	5.0 U
Methylene Chloride	UG/L	10 U	0.18 U	0.13 U	3.0 U	3.0 U
Methyl acetate	UG/L	10 U	NA	NA	NA	NA
Methyl tert-butyl ether	UG/L	3 J	NA	NA	NA	NA
Methylcyclohexane	UG/L	10 U	NA	NA	NA	NA
Styrene	UG/L	10 U	0.13 U	0.16 U	5.0 U	5.0 U
1,1,2,2-Tetrachloroethane	UG/L	10 U	0.3 U	0.22 U	1.0 U	1.0 U
Tetrachloroethene	UG/L	2 J	0.6 J	0.34 U	0.5 J	1.0 U
1,1,1-Trichloroethane	UG/L	10 U	0.23 U	0.37 U	5.0 U	5.0 U
1,1,2-Trichloroethane	UG/L	10 U	0.17 U	0.17 U	3.0 U	3.0 U
Trichloroethene	UG/L	10 U	0.14 U	0.25 U	1.0 U	1.0 U
Trichlorofluoromethane	UG/L	10 U	NA	NA	NA	NA
1,2,4-Trichlorobenzene	UG/L	10 UJ	NA	NA	NA	NA
1,1,2-Trichloro-1,2,2-trifluoroethane (Freon-113)	UG/L	250 D	100	230	74	5.0 U

Flags assigned during chemistry validation are shown.

R - Rejected result NA - Not Analyzed
U - Non-Detect J - Estimated Result
UJ - Not detected above the estimated quantitation limit
D - Diluted sample

Detection Limits shown are MDL

TABLE 1
FORMER EMCA SITE
ANALYTES DETECTED IN GROUNDWATER (JUNE 2001- JULY 2004)

Location ID		GZ-06	GZ-06	GZ-06	GZ-06	GZ-06
Sample ID		GZ-06	GZ06_52103	GZ06	GZ06-091703	GZ-06-121803
Matrix		Groundwater	Groundwater	Groundwater	Groundwater	Groundwater
Depth Interval (ft)		-	-	-	-	-
Date Sampled		07/25/01	05/21/03	07/23/03	09/17/03	12/18/03
Parameter	**Units**					
Volatiles						
Toluene	UG/L	10 U	0.49 U	0.17 U	5.0 U	5.0 U
Vinyl Chloride	UG/L	10 U	0.25 U	0.38 U	5.0 U	5.0 U
Xylene (total)	UG/L	10 U	0.89 U	0.23 U	5.0 U	5.0 U
1,2-Dichloro-1,1,2-trifluoroethane (Freon-123A)	UG/L	NA	20	41	26	0.7 J
Dissolved Gases						
Ethane	UG/L	1 U	10 U	0 U	10 U	5.0 U
Ethene	UG/L	1 U	10 U	0 U	10 U	5.0 U
Methane	UG/L	30 D	140	98	89	5.9
Total Metals						
Iron	UG/L	888	2,390	866	517 J	173
Manganese	UG/L	77.6	NA	NA	NA	NA
Dissolved Metals						
Iron	UG/L	720	2,290	778	583 J	85.3 B
Manganese	UG/L	73.4 J	NA	NA	NA	NA
Miscellaneous Parameters						
Alkalinity, Total (As CaCO3)	MG/L	98.9	NA	NA	NA	NA
Chloride	MG/L	531	559	474	477 J	218
Conductivity	UMHOS	1,081	2.27	1.99	1.98	1.11
Dissolved Oxygen	MG/L	1.53	0.76	0.50	0.48	6.86
Nitrogen, Ammonia (As N)	MG/L	0.10 U	0.1 U	0 U	0.1 U	0.1 U
Nitrogen, Kjeldahl, Total	MG/L	0.22	0.5 U	0.7	1.3	0.57
Nitrogen, Nitrate	MG/L	NA	0.1 U	NA	0.58	0.1 U
Nitrogen, Nitrite	MG/L	NA	0.1 U	NA	0.1 U	0.1 U

Flags assigned during chemistry validation are shown.

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U - Non-Detect J - Estimated Result
UJ - Not detected above the estimated quantitation limit
D - Diluted sample

Detection Limits shown are MDL

TABLE 1
FORMER EMCA SITE
ANALYTES DETECTED IN GROUNDWATER (JUNE 2001- JULY 2004)

Location ID		GZ-06	GZ-06	GZ-06	GZ-06	GZ-06
Sample ID		GZ-06	GZ06_52103	GZ06	GZ06-091703	GZ-06-121803
Matrix		Groundwater	Groundwater	Groundwater	Groundwater	Groundwater
Depth Interval (ft)		-	-	-	-	-
Date Sampled		07/25/01	05/21/03	07/23/03	09/17/03	12/18/03
Parameter	**Units**					
Miscellaneous Parameters						
Nitrogen, Nitrate-Nitrite	MG/L	0.51	NA	0.12 J	NA	NA
Oxidation Reduction Potential	mV	89.0	-110	-75	-129	73
Phosphorus, Total (As P)	MG/L	0.12	NA	NA	NA	NA
Heterotrophic Plate Count	CFU/ML	580 J	NA	NA	NA	NA
Sulfate	MG/L	43.6	25.2	27.5	32.4	5.0 U
Sulfide	MG/L	NA	NA	NA	NA	NA
Sulfide (lab)	MG/L	0.5 U	NA	NA	NA	NA
Sulfide (field)	MG/L	0.02	NA	NA	NA	NA
Total Organic Carbon	MG/L	6.0	NA	NA	NA	NA
Ferrous Iron (lab)	MG/L	100 UJ	NA	NA	NA	NA
Ferrous Iron (field)	MG/L	0.760	2.8	9.6	0.25	0.03
Ferric Iron (lab)	MG/L	0.888	1.0 U	0 U	0.52	0.143
Ferric Iron (field)	MG/L	0.128	NA	NA	NA	NA
Fluoride	MG/L	NA	0 U	0 U	0.1 U	0.32
TPH	MG/L	NA	5 U	5 U	NA	5 U
Oil & Grease	MG/L	NA	NA	NA	R	NA
Tentatively Identified Compound						
1,1-Dichloro-1,1,2-trifluoroethane (HCFC-123B)	UG/L	NA	0 U	0 U	0 U	0 U
1-Chloro-1,2,2-trifluoroethane (HCFC-133)	UG/L	NA	0 U	0 U	0 U	0 U
1,1,2-Trifluoroethane (HCFC-143)	UG/L	NA	0 U	0 U	0 U	0 U
Chlorotrifluoroethene (FREON-1113)	UG/L	NA	0 U	0 U	5.4	0 U

Flags assigned during chemistry validation are shown.

R - Rejected result NA - Not Analyzed
U - Non-Detect J - Estimated Result
UJ - Not detected above the estimated quantitation limit
D - Diluted sample

Detection Limits shown are MDL

TABLE 1
FORMER EMCA SITE
ANALYTES DETECTED IN GROUNDWATER (JUNE 2001- JULY 2004)

Location ID		GZ-06	MW-01	MW-02	MW-02	MW-02
Sample ID		GZ06	MW-01	MW-02	MW-02	MW02-5-20-03
Matrix		Groundwater	Groundwater	Groundwater	Groundwater	Groundwater
Depth Interval (ft)		-	-	-	-	-
Date Sampled		07/22/04	07/25/01	07/25/01	02/18/03	05/20/03
Parameter	Units					
Volatiles						
Acetone	UG/L	NA	10 U	360 DJ	NA	140 J
Benzene	UG/L	NA	14	10 U	NA	0.09 U
Bromodichloromethane	UG/L	NA	10 U	10 U	NA	0.13 U
Bromoform	UG/L	NA	10 U	10 U	NA	0.19 U
Bromomethane	UG/L	NA	10 U	10 U	NA	0.28 U
Methyl ethyl ketone (2-Butanone)	UG/L	NA	10 U	10 U	NA	R
Carbon Disulfide	UG/L	NA	10 U	10 U	NA	0.31 U
Carbon Tetrachloride	UG/L	NA	10 U	10 U	NA	0.32 U
Chlorobenzene	UG/L	NA	10 U	10 U	NA	0.1 U
Chloroethane	UG/L	NA	10 U	10 U	NA	0.23 U
Chloroform	UG/L	NA	10 U	4 J	NA	0.15 U
Chloromethane	UG/L	NA	10 U	10 U	NA	0.16 U
Chlorotrifluoroethene (Freon-1113)	UG/L	24	NA	NA	NA	NA
Cyclohexane	UG/L	NA	10 U	10 U	NA	NA
Dibromochloromethane	UG/L	NA	10 U	10 U	NA	0.2 U
Dichlorodifluoromethane	UG/L	NA	10 U	10 U	NA	NA
1,2-Dibromo-3-chloropropane	UG/L	NA	10 U	10 U	NA	NA
1,2-Dibromoethane	UG/L	NA	10 U	10 U	NA	NA
1,2-Dichlorobenzene	UG/L	NA	10 U	10 U	NA	NA
1,3-Dichlorobenzene	UG/L	NA	10 U	10 U	NA	NA
1,4-Dichlorobenzene	UG/L	NA	10 U	10 U	NA	NA
1,1-Dichloroethane	UG/L	NA	2 J	10 U	NA	0.1 U
1,2-Dichloroethane	UG/L	NA	10 U	10 U	NA	0.19 U

Flags assigned during chemistry validation are shown.

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D - Diluted sample

Detection Limits shown are MDL

TABLE 1
FORMER EMCA SITE
ANALYTES DETECTED IN GROUNDWATER (JUNE 2001- JULY 2004)

Location ID		GZ-06	MW-01	MW-02	MW-02	MW-02
Sample ID		GZ06	MW-01	MW-02	MW-02	MW02-5-20-03
Matrix		Groundwater	Groundwater	Groundwater	Groundwater	Groundwater
Depth Interval (ft)		-	-	-	-	-
Date Sampled		07/22/04	07/25/01	07/25/01	02/18/03	05/20/03
Parameter	Units					
Volatiles						
1,1-Dichloroethene	UG/L	NA	10 U	10 U	NA	4.4 J
cis-1,2-Dichloroethene	UG/L	NA	590 D	10 U	NA	0.11 U
trans-1,2-Dichloroethene	UG/L	NA	8 J	10 U	NA	0.17 U
1,2-Dichloropropane	UG/L	NA	10 U	10 U	NA	0.15 U
cis-1,3-Dichloropropene	UG/L	NA	10 U	10 U	NA	0.22 U
trans-1,3-Dichloropropene	UG/L	NA	10 U	10 U	NA	0.12 U
Ethylbenzene	UG/L	NA	10 U	10 U	NA	0.21 U
2-Hexanone	UG/L	NA	10 U	10 U	NA	1.21 U
Isopropylbenzene	UG/L	NA	4 J	10 U	NA	NA
4-Methyl-2-Pentanone	UG/L	NA	10 UJ	10 UJ	NA	0.94 U
Methylene Chloride	UG/L	NA	10 U	10 U	NA	0.18 U
Methyl acetate	UG/L	NA	10 U	10 U	NA	NA
Methyl tert-butyl ether	UG/L	NA	2 J	1 J	NA	NA
Methylcyclohexane	UG/L	NA	10 U	10 U	NA	NA
Styrene	UG/L	NA	10 U	10 U	NA	0.13 U
1,1,2,2-Tetrachloroethane	UG/L	NA	10 U	10 U	NA	0.3 U
Tetrachloroethene	UG/L	NA	150 D	3 J	NA	0.25 U
1,1,1-Trichloroethane	UG/L	NA	10 U	10 U	NA	0.23 U
1,1,2-Trichloroethane	UG/L	NA	10 U	10 U	NA	0.17 U
Trichloroethene	UG/L	NA	99	10 U	NA	0.14 U
Trichlorofluoromethane	UG/L	NA	10 U	10 U	NA	NA
1,2,4-Trichlorobenzene	UG/L	NA	10 UJ	10 UJ	NA	NA
1,1,2-Trichloro-1,2,2-trifluoroethane (Freon-113)	UG/L	100 J	10 U	2,400 D	NA	710

Flags assigned during chemistry validation are shown.

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D - Diluted sample

Detection Limits shown are MDL

TABLE 1
FORMER EMCA SITE
ANALYTES DETECTED IN GROUNDWATER (JUNE 2001- JULY 2004)

Location ID		GZ-06	MW-01	MW-02	MW-02	MW-02
Sample ID		GZ06	MW-01	MW-02	MW-02	MW02-5-20-03
Matrix		Groundwater	Groundwater	Groundwater	Groundwater	Groundwater
Depth Interval (ft)		-	-	-	-	-
Date Sampled		07/22/04	07/25/01	07/25/01	02/18/03	05/20/03
Parameter	**Units**					
Volatiles						
Toluene	UG/L	NA	10 U	10 U	NA	0.49 U
Vinyl Chloride	UG/L	NA	14	10 U	NA	0.25 U
Xylene (total)	UG/L	NA	10 U	10 U	NA	0.89 U
1,2-Dichloro-1,1,2-trifluoroethane (Freon-123A)	UG/L	36	NA	NA	NA	34 J
Dissolved Gases						
Ethane	UG/L	NA	2	1 U	NA	5.0 U
Ethene	UG/L	NA	2	1 U	NA	5.0 U
Methane	UG/L	48	2,100 D	23 D	NA	26
Total Metals						
Iron	UG/L	NA	437	19,900	NA	27,800
Manganese	UG/L	NA	83.7	1,630	NA	NA
Dissolved Metals						
Iron	UG/L	NA	31.8 B	19,500	NA	27,900
Manganese	UG/L	NA	77.2 J	1,520 J	NA	NA
Miscellaneous Parameters						
Alkalinity, Total (As CaCO3)	MG/L	NA	160	111	NA	NA
Chloride	MG/L	1,610	822	168	NA	338
Conductivity	UMHOS	5.25	953	597	3.28	1.68
Dissolved Oxygen	MG/L	1.15	0.60	0.34	0 U	0.36
Nitrogen, Ammonia (As N)	MG/L	NA	0.14	1.63	NA	3.3
Nitrogen, Kjeldahl, Total	MG/L	NA	0.20	2.87	NA	6.6
Nitrogen, Nitrate	MG/L	NA	NA	NA	NA	0.15
Nitrogen, Nitrite	MG/L	NA	NA	NA	NA	0.1 U

Flags assigned during chemistry validation are shown.

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D - Diluted sample

Detection Limits shown are MDL

TABLE 1
FORMER EMCA SITE
ANALYTES DETECTED IN GROUNDWATER (JUNE 2001- JULY 2004)

Location ID		GZ-06	MW-01	MW-02	MW-02	MW-02
Sample ID		GZ06	MW-01	MW-02	MW-02	MW02-5-20-03
Matrix		Groundwater	Groundwater	Groundwater	Groundwater	Groundwater
Depth Interval (ft)		-	-	-	-	-
Date Sampled		07/22/04	07/25/01	07/25/01	02/18/03	05/20/03
Parameter	Units					
Miscellaneous Parameters						
Nitrogen, Nitrate-Nitrite	MG/L	NA	0.27	0.38	NA	NA
Oxidation Reduction Potential	mV	-210	92.6	-52.1	0 U	-108
Phosphorus, Total (As P)	MG/L	NA	0.07	0.38	NA	NA
Heterotrophic Plate Count	CFU/ML	NA	60 J	7.0 J	NA	NA
Sulfate	MG/L	20.8	46.4	50.1	NA	44
Sulfide	MG/L	1.0 U	NA	NA	NA	NA
Sulfide (lab)	MG/L	NA	0.5 U	0.5 U	NA	NA
Sulfide (field)	MG/L	NA	0.01 U	0.01 U	NA	NA
Total Organic Carbon	MG/L	NA	7.3	4.2	NA	NA
Ferrous Iron (lab)	MG/L	NA	100 UJ	4.100 J	NA	NA
Ferrous Iron (field)	MG/L	NA	30 U	16.290	NA	25.3
Ferric Iron (lab)	MG/L	NA	0.437	15.800	NA	2.5
Ferric Iron (field)	MG/L	NA	0.437	2.710	NA	NA
Fluoride	MG/L	1.00 U	NA	NA	NA	0.28
TPH	MG/L	NA	NA	NA	NA	5 U
Oil & Grease	MG/L	NA	NA	NA	NA	NA
Tentatively Identified Compound						
1,1-Dichloro-1,1,2-trifluoroethane (HCFC-123B)	UG/L	NA	NA	NA	NA	0 U
1-Chloro-1,2,2-trifluoroethane (HCFC-133)	UG/L	NA	NA	NA	NA	0 U
1,1,2-Trifluoroethane (HCFC-143)	UG/L	NA	NA	NA	NA	0 U
Chlorotrifluoroethene (FREON-1113)	UG/L	NA	NA	NA	NA	0 U

Flags assigned during chemistry validation are shown.

R - Rejected result NA - Not Analyzed
U - Non-Detect J - Estimated Result
UJ - Not detected above the estimated quantitation limit
D - Diluted sample

Detection Limits shown are MDL

TABLE 1
FORMER EMCA SITE
ANALYTES DETECTED IN GROUNDWATER (JUNE 2001- JULY 2004)

Location ID		MW-02	MW-02	MW-02	MW-02	MW-02
Sample ID		MW02-5-20-03DUP	DUP-7_22_03	MW02-7_22_03	MW02-091803	MW-02-121803
Matrix		Groundwater	Groundwater	Groundwater	Groundwater	Groundwater
Depth Interval (ft)		-	-	-	-	-
Date Sampled		05/20/03	07/22/03	07/22/03	09/18/03	12/18/03
Parameter	**Units**	Field Duplicate (1-1)	Field Duplicate (1-1)			
Volatiles						
Acetone	UG/L	130 J	R	R	5.0 U	5.0 U
Benzene	UG/L	0.09 U	0.2 U	0.2 U	1.0 U	1.0 U
Bromodichloromethane	UG/L	0.13 U	0.08 U	0.08 U	1.0 U	1.0 U
Bromoform	UG/L	0.19 U	0.24 U	0.24 U	4.0 U	4.0 U
Bromomethane	UG/L	0.28 U	0.32 U	0.32 U	5.0 U	5.0 U
Methyl ethyl ketone (2-Butanone)	UG/L	R	R	R	R	R
Carbon Disulfide	UG/L	0.31 U	0.26 U	0.26 U	5.0 U	5.0 U
Carbon Tetrachloride	UG/L	0.32 U	0.39 U	0.39 U	2.0 U	2.0 U
Chlorobenzene	UG/L	0.1 U	0.08 U	0.08 U	5.0 U	5.0 U
Chloroethane	UG/L	0.23 U	0.46 U	0.46 U	5.0 U	5.0 U
Chloroform	UG/L	0.15 U	0.17 U	0.17 U	5.0 U	5.0 U
Chloromethane	UG/L	0.16 U	0.54 U	0.54 U	5.0 U	5.0 U
Chlorotrifluoroethene (Freon-1113)	UG/L	NA	NA	NA	NA	NA
Cyclohexane	UG/L	NA	NA	NA	NA	NA
Dibromochloromethane	UG/L	0.2 U	0.17 U	0.17 U	5.0 U	5.0 U
Dichlorodifluoromethane	UG/L	NA	NA	NA	NA	NA
1,2-Dibromo-3-chloropropane	UG/L	NA	NA	NA	NA	NA
1,2-Dibromoethane	UG/L	NA	NA	NA	NA	NA
1,2-Dichlorobenzene	UG/L	NA	NA	NA	NA	NA
1,3-Dichlorobenzene	UG/L	NA	NA	NA	NA	NA
1,4-Dichlorobenzene	UG/L	NA	NA	NA	NA	NA
1,1-Dichloroethane	UG/L	0.1 U	0.24 U	0.24 U	5.0 U	5.0 U
1,2-Dichloroethane	UG/L	0.19 U	0.11 U	0.11 U	2.0 U	2.0 U

Flags assigned during chemistry validation are shown.

R - Rejected result | NA - Not Analyzed
U - Non-Detect | J - Estimated Result
UJ - Not detected above the estimated quantitation limit
D - Diluted sample

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[LOGDATE] >= #7/25/01# AND [MATRIX] = 'WG'

Detection Limits shown are MDL

TABLE 1
FORMER EMCA SITE
ANALYTES DETECTED IN GROUNDWATER (JUNE 2001- JULY 2004)

Location ID		MW-02	MW-02	MW-02	MW-02	MW-02
Sample ID		MW02-5-20-03DUP	DUP-7_22_03	MW02-7_22_03	MW02-091803	MW-02-121803
Matrix		Groundwater	Groundwater	Groundwater	Groundwater	Groundwater
Depth Interval (ft)		-	-	-	-	-
Date Sampled		05/20/03	07/22/03	07/22/03	09/18/03	12/18/03
Parameter	Units	Field Duplicate (1-1)	Field Duplicate (1-1)			
Volatiles						
1,1-Dichloroethene	UG/L	5.1 J	8.2 J	7.5 J	2.0 U	2.0 U
cis-1,2-Dichloroethene	UG/L	0.11 U	0.22 U	0.22 U	5.0 U	5.0 U
trans-1,2-Dichloroethene	UG/L	0.17 U	0.21 U	0.21 U	5.0 U	5.0 U
1,2-Dichloropropane	UG/L	0.15 U	0.17 U	0.17 U	1.0 U	1.0 U
cis-1,3-Dichloropropene	UG/L	0.22 U	0.23 U	0.23 U	5.0 U	5.0 U
trans-1,3-Dichloropropene	UG/L	0.12 U	0.09 U	0.09 U	5.0 U	5.0 U
Ethylbenzene	UG/L	0.21 U	0.18 U	3.4 J	4.0 U	4.0 U
2-Hexanone	UG/L	1.21 U	1.09 U	1.09 U	5.0 U	5.0 U
Isopropylbenzene	UG/L	NA	NA	NA	NA	NA
4-Methyl-2-Pentanone	UG/L	0.94 U	1.13 U	1.13 U	5.0 U	5.0 U
Methylene Chloride	UG/L	0.18 U	0.13 U	0.13 U	3.0 U	3.0 U
Methyl acetate	UG/L	NA	NA	NA	NA	NA
Methyl tert-butyl ether	UG/L	NA	NA	NA	NA	NA
Methylcyclohexane	UG/L	NA	NA	NA	NA	NA
Styrene	UG/L	0.13 U	0.16 U	0.16 U	5.0 U	5.0 U
1,1,2,2-Tetrachloroethane	UG/L	0.3 U	0.22 U	0.22 U	1.0 U	1.0 U
Tetrachloroethene	UG/L	0.25 U	0.34 U	0.34 U	1.0 U	1.0 U
1,1,1-Trichloroethane	UG/L	0.23 U	0.37 U	0.37 U	5.0 U	5.0 U
1,1,2-Trichloroethane	UG/L	0.17 U	0.17 U	0.17 U	3.0 U	3.0 U
Trichloroethene	UG/L	0.14 U	0.25 U	0.25 U	1.0 U	1.0 U
Trichlorofluoromethane	UG/L	NA	NA	NA	NA	NA
1,2,4-Trichlorobenzene	UG/L	NA	NA	NA	NA	NA
1,1,2-Trichloro-1,2,2-trifluoroethane (Freon-113)	UG/L	880	1,000	1,000	54	12

Flags assigned during chemistry validation are shown.

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U - Non-Detect J - Estimated Result
UJ - Not detected above the estimated quantitation limit
D - Diluted sample

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[LOGDATE] >= #7/25/01# AND [MATRIX] = 'WG'

Detection Limits shown are MDL

TABLE 1
FORMER EMCA SITE
ANALYTES DETECTED IN GROUNDWATER (JUNE 2001- JULY 2004)

Location ID		MW-02	MW-02	MW-02	MW-02	MW-02
Sample ID		MW02-5-20-03DUP	DUP-7_22_03	MW02-7_22_03	MW02-091803	MW-02-121803
Matrix		Groundwater	Groundwater	Groundwater	Groundwater	Groundwater
Depth Interval (ft)		-	-	-	-	-
Date Sampled		05/20/03	07/22/03	07/22/03	09/18/03	12/18/03
Parameter	**Units**	Field Duplicate (1-1)	Field Duplicate (1-1)			
Volatiles						
Toluene	UG/L	0.49 U	0.17 U	0.17 U	5.0 U	5.0 U
Vinyl Chloride	UG/L	0.25 U	0.38 U	0.38 U	5.0 U	5.0 U
Xylene (total)	UG/L	0.89 U	7.1 J	11 J	5.0 U	5.0 U
1,2-Dichloro-1,1,2-trifluoroethane (Freon-123A)	UG/L	40	40 J	41 J	7.8	3.3 J
Dissolved Gases						
Ethane	UG/L	5.0 U	0 U	0 U	50 U	25 U
Ethene	UG/L	5.0 U	0 U	0 U	50 U	25 U
Methane	UG/L	32	54	52	410	320
Total Metals						
Iron	UG/L	28,300	30,100	30,900	63,800 J	69,000
Manganese	UG/L	NA	NA	NA	NA	NA
Dissolved Metals						
Iron	UG/L	28,200	30,500	30,500	60,900 J	69,300
Manganese	UG/L	NA	NA	NA	NA	NA
Miscellaneous Parameters						
Alkalinity, Total (As CaCO3)	MG/L	NA	NA	NA	NA	NA
Chloride	MG/L	338	307	283	839	769
Conductivity	UMHOS	NA	NA	1.65	3.17	3.28
Dissolved Oxygen	MG/L	NA	NA	0.26	0.53	0 U
Nitrogen, Ammonia (As N)	MG/L	3.4	4.1	3.8	11.5	11.9
Nitrogen, Kjeldahl, Total	MG/L	6.2	6.6	6.1	17.1	16.9
Nitrogen, Nitrate	MG/L	0.16	0 U	0.1	0.1 U	0.1 U
Nitrogen, Nitrite	MG/L	0.1 U	0 U	0 U	0.1 U	0.1 U

Flags assigned during chemistry validation are shown.

R - Rejected result   NA - Not Analyzed
U - Non-Detect   J - Estimated Result
UJ - Not detected above the estimated quantitation limit
D - Diluted sample

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Detection Limits shown are MDL

TABLE 1
FORMER EMCA SITE
ANALYTES DETECTED IN GROUNDWATER (JUNE 2001- JULY 2004)

Location ID		MW-02	MW-02	MW-02	MW-02	MW-02
Sample ID		MW02-5-20-03DUP	DUP-7_22_03	MW02-7_22_03	MW02-091803	MW-02-121803
Matrix		Groundwater	Groundwater	Groundwater	Groundwater	Groundwater
Depth Interval (ft)		-	-	-	-	-
Date Sampled		05/20/03	07/22/03	07/22/03	09/18/03	12/18/03
Parameter	**Units**	Field Duplicate (1-1)	Field Duplicate (1-1)			
Miscellaneous Parameters						
Nitrogen, Nitrate-Nitrite	MG/L	NA	NA	NA	NA	NA
Oxidation Reduction Potential	mV	NA	NA	-190	-99	-108
Phosphorus, Total (As P)	MG/L	NA	NA	NA	NA	NA
Heterotrophic Plate Count	CFU/ML	NA	NA	NA	NA	NA
Sulfate	MG/L	46	32.3	32.5	4.8	5.0 U
Sulfide	MG/L	NA	NA	NA	NA	NA
Sulfide (lab)	MG/L	NA	NA	NA	NA	NA
Sulfide (field)	MG/L	NA	NA	NA	NA	NA
Total Organic Carbon	MG/L	NA	NA	NA	NA	NA
Ferrous Iron (lab)	MG/L	NA	NA	NA	NA	NA
Ferrous Iron (field)	MG/L	NA	25.7	28.0	49.3	6.3
Ferric Iron (lab)	MG/L	3	4.4	2.9	48.3	62.7
Ferric Iron (field)	MG/L	NA	NA	NA	NA	NA
Fluoride	MG/L	0.3	0.37	0.39	0.3	0.31
TPH	MG/L	5 U	5 U	5 U	NA	5 U
Oil & Grease	MG/L	NA	NA	NA	5 U	NA
Tentatively Identified Compound						
1,1-Dichloro-1,1,2-trifluoroethane (HCFC-123B)	UG/L	0 U	0 U	0 U	0 U	0 U
1-Chloro-1,2,2-trifluoroethane (HCFC-133)	UG/L	0 U	0 U	0 U	0 U	0 U
1,1,2-Trifluoroethane (HCFC-143)	UG/L	0 U	0 U	0 U	0 U	0 U
Chlorotrifluoroethene (FREON-1113)	UG/L	0 U	0 U	0 U	0 U	0 U

Flags assigned during chemistry validation are shown.

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Detection Limits shown are MDL

TABLE 1
FORMER EMCA SITE
ANALYTES DETECTED IN GROUNDWATER (JUNE 2001- JULY 2004)

Location ID		MW-02	MW-03	MW-03	MW-03	MW-03
Sample ID		MW-02	MW-03	MW03_52103	MW03	DUP-91703
Matrix		Groundwater	Groundwater	Groundwater	Groundwater	Groundwater
Depth Interval (ft)		-	-	-	-	-
Date Sampled		07/22/04	07/26/01	05/21/03	07/23/03	09/17/03
Parameter	Units					Field Duplicate (1-1)
Volatiles						
Acetone	UG/L	NA	2,000 D	2.12 U	78	110
Benzene	UG/L	NA	10 U	0.09 U	2.3	2.2
Bromodichloromethane	UG/L	NA	10 U	0.13 U	0.08 U	1.0 U
Bromoform	UG/L	NA	10 U	0.19 U	0.24 U	4.0 U
Bromomethane	UG/L	NA	10 U	0.28 U	0.32 U	5.0 U
Methyl ethyl ketone (2-Butanone)	UG/L	NA	10 U	R	130 J	69 J
Carbon Disulfide	UG/L	NA	10 U	0.31 U	0.26 U	5.0 U
Carbon Tetrachloride	UG/L	NA	10 U	0.32 U	0.39 U	2.0 U
Chlorobenzene	UG/L	NA	10 U	0.1 U	0.08 U	5.0 U
Chloroethane	UG/L	NA	10 U	0.23 U	0.46 U	5.0 U
Chloroform	UG/L	NA	10 U	0.15 U	0.17 U	5.0 U
Chloromethane	UG/L	NA	10 U	0.16 U	0.54 U	5.0 U
Chlorotrifluoroethene (Freon-1113)	UG/L	14	NA	NA	NA	NA
Cyclohexane	UG/L	NA	2 J	NA	NA	NA
Dibromochloromethane	UG/L	NA	10 U	0.2 U	0.17 U	5.0 U
Dichlorodifluoromethane	UG/L	NA	10 U	NA	NA	NA
1,2-Dibromo-3-chloropropane	UG/L	NA	10 U	NA	NA	NA
1,2-Dibromoethane	UG/L	NA	10 U	NA	NA	NA
1,2-Dichlorobenzene	UG/L	NA	10 U	NA	NA	NA
1,3-Dichlorobenzene	UG/L	NA	10 U	NA	NA	NA
1,4-Dichlorobenzene	UG/L	NA	10 U	NA	NA	NA
1,1-Dichloroethane	UG/L	NA	10 U	0.1 U	0.24 U	5.0 U
1,2-Dichloroethane	UG/L	NA	10 U	0.19 U	0.11 U	2.0 U

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Detection Limits shown are MDL

TABLE 1
FORMER EMCA SITE
ANALYTES DETECTED IN GROUNDWATER (JUNE 2001- JULY 2004)

Location ID		MW-02	MW-03	MW-03	MW-03	MW-03
Sample ID		MW-02	MW-03	MW03_52103	MW03	DUP-91703
Matrix		Groundwater	Groundwater	Groundwater	Groundwater	Groundwater
Depth Interval (ft)		-	-	-	-	-
Date Sampled		07/22/04	07/26/01	05/21/03	07/23/03	09/17/03
Parameter	**Units**					Field Duplicate (1-1)
Volatiles						
1,1-Dichloroethene	UG/L	NA	10 U	33 J	0.24 U	2.0 U
cis-1,2-Dichloroethene	UG/L	NA	2 J	0.11 U	0.22 U	5.0 U
trans-1,2-Dichloroethene	UG/L	NA	10 U	0.17 U	0.21 U	5.0 U
1,2-Dichloropropane	UG/L	NA	10 U	0.15 U	0.17 U	1.0 U
cis-1,3-Dichloropropene	UG/L	NA	10 U	0.22 U	0.23 U	5.0 U
trans-1,3-Dichloropropene	UG/L	NA	10 U	0.12 U	0.09 U	5.0 U
Ethylbenzene	UG/L	NA	10 U	0.21 U	0.3 J	4.0 U
2-Hexanone	UG/L	NA	10 U	1.21 U	1.09 U	19
Isopropylbenzene	UG/L	NA	10 U	NA	NA	NA
4-Methyl-2-Pentanone	UG/L	NA	10 UJ	0.94 U	1.13 U	11
Methylene Chloride	UG/L	NA	10 U	0.18 U	0.13 U	3.0 U
Methyl acetate	UG/L	NA	10 U	NA	NA	NA
Methyl tert-butyl ether	UG/L	NA	10 U	NA	NA	NA
Methylcyclohexane	UG/L	NA	10 U	NA	NA	NA
Styrene	UG/L	NA	10 U	0.13 U	0.16 U	5.0 U
1,1,2,2-Tetrachloroethane	UG/L	NA	10 U	0.3 U	0.22 U	1.0 U
Tetrachloroethene	UG/L	NA	10 U	0.25 U	0.34 U	1.0 U
1,1,1-Trichloroethane	UG/L	NA	10 U	0.23 U	0.37 U	5.0 U
1,1,2-Trichloroethane	UG/L	NA	10 U	0.17 U	0.17 U	3.0 U
Trichloroethene	UG/L	NA	10 U	0.14 U	0.25 U	1.0 U
Trichlorofluoromethane	UG/L	NA	10 U	NA	NA	NA
1,2,4-Trichlorobenzene	UG/L	NA	10 UJ	NA	NA	NA
1,1,2-Trichloro-1,2,2-trifluoroethane (Freon-113)	UG/L	21 J	13,000 D	5,800	68	26

Flags assigned during chemistry validation are shown.

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Detection Limits shown are MDL

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TABLE 1
FORMER EMCA SITE
ANALYTES DETECTED IN GROUNDWATER (JUNE 2001- JULY 2004)

Location ID		MW-02	MW-03	MW-03	MW-03	MW-03
Sample ID		MW-02	MW-03	MW03_52103	MW03	DUP-91703
Matrix		Groundwater	Groundwater	Groundwater	Groundwater	Groundwater
Depth Interval (ft)		-	-	-	-	-
Date Sampled		07/22/04	07/26/01	05/21/03	07/23/03	09/17/03
Parameter	**Units**					Field Duplicate (1-1)
Volatiles						
Toluene	UG/L	NA	10 U	0.49 U	0.17 U	5.0 U
Vinyl Chloride	UG/L	NA	1 J	0.25 U	0.38 U	5.0 U
Xylene (total)	UG/L	NA	10 U	0.89 U	1.1 J	5.0 U
1,2-Dichloro-1,1,2-trifluoroethane (Freon-123A)	UG/L	4 J	NA	78 J	43	180
Dissolved Gases						
Ethane	UG/L	NA	1 U	5.0 U	0 U	250 U
Ethene	UG/L	NA	1 U	5.0 U	0 U	250 U
Methane	UG/L	140	180 D	86	56	2,400
Total Metals						
Iron	UG/L	NA	736	1,170	150,000	174,000 J
Manganese	UG/L	NA	689	NA	NA	NA
Dissolved Metals						
Iron	UG/L	NA	634	267	152,000	187,000 J
Manganese	UG/L	NA	641 J	NA	NA	NA
Miscellaneous Parameters						
Alkalinity, Total (As CaCO3)	MG/L	NA	119	NA	NA	NA
Chloride	MG/L	238	74	113	143	99.2 J
Conductivity	UMHOS	2.34	454	0.638	4.35	NA
Dissolved Oxygen	MG/L	0.91	0.22	0.58	0 U	NA
Nitrogen, Ammonia (As N)	MG/L	NA	0.44	0.36	2.7	0.86
Nitrogen, Kjeldahl, Total	MG/L	NA	0.61	1.3	10.8	4.5
Nitrogen, Nitrate	MG/L	NA	NA	2	NA	0.1 U
Nitrogen, Nitrite	MG/L	NA	NA	0.1 U	NA	0.1 U

Flags assigned during chemistry validation are shown.

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Detection Limits shown are MDL

TABLE 1
FORMER EMCA SITE
ANALYTES DETECTED IN GROUNDWATER (JUNE 2001- JULY 2004)

Location ID		MW-02	MW-03	MW-03	MW-03	MW-03
Sample ID		MW-02	MW-03	MW03_52103	MW03	DUP-91703
Matrix		Groundwater	Groundwater	Groundwater	Groundwater	Groundwater
Depth Interval (ft)		-	-	-	-	-
Date Sampled		07/22/04	07/26/01	05/21/03	07/23/03	09/17/03
Parameter	**Units**					Field Duplicate (1-1)
Miscellaneous Parameters						
Nitrogen, Nitrate-Nitrite	MG/L	NA	1.15	NA	0 UJ	NA
Oxidation Reduction Potential	mV	-133	82.3	40	-103	NA
Phosphorus, Total (As P)	MG/L	NA	0.12	NA	NA	NA
Heterotrophic Plate Count	CFU/ML	NA	49 J	NA	NA	NA
Sulfate	MG/L	15.2	50.0	32.7	26.9	5.0 U
Sulfide	MG/L	1.0 U	NA	NA	NA	NA
Sulfide (lab)	MG/L	NA	0.5 U	NA	NA	NA
Sulfide (field)	MG/L	NA	0.01 U	NA	NA	NA
Total Organic Carbon	MG/L	NA	7.9	NA	NA	NA
Ferrous Iron (lab)	MG/L	NA	0.177 J	NA	NA	NA
Ferrous Iron (field)	MG/L	NA	0.710	0.5	3.7	25.5
Ferric Iron (lab)	MG/L	NA	0.559	0.67	146	67.0
Ferric Iron (field)	MG/L	NA	0.026	NA	NA	NA
Fluoride	MG/L	0.294	NA	0.28	0.44	0.27
TPH	MG/L	NA	NA	5 U	5 U	NA
Oil & Grease	MG/L	NA	NA	NA	NA	R
Tentatively Identified Compound						
1,1-Dichloro-1,1,2-trifluoroethane (HCFC-123B)	UG/L	NA	NA	0 U	0 U	0 U
1-Chloro-1,2,2-trifluoroethane (HCFC-133)	UG/L	NA	NA	0 U	0 U	0 U
1,1,2-Trifluoroethane (HCFC-143)	UG/L	NA	NA	0 U	0 U	0 U
Chlorotrifluoroethene (FREON-1113)	UG/L	NA	NA	0 U	7.0	6.2

Flags assigned during chemistry validation are shown.

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TABLE 1
FORMER EMCA SITE
ANALYTES DETECTED IN GROUNDWATER (JUNE 2001- JULY 2004)

Location ID		MW-03	MW-03	MW-03	MW-03	MW-04
Sample ID		MW03-091703	DUP1_121703	MW-03_121703	MW-03	MW-04
Matrix		Groundwater	Groundwater	Groundwater	Groundwater	Groundwater
Depth Interval (ft)		-	-	-	-	-
Date Sampled		09/17/03	12/17/03	12/17/03	07/23/04	07/26/01
Parameter	**Units**		Field Duplicate (1-1)			
Volatiles						
Acetone	UG/L	110	130 J	120 J	NA	10 U
Benzene	UG/L	1.8	2.0 U	2.0 U	NA	10 U
Bromodichloromethane	UG/L	1.0 U	2.0 U	2.0 U	NA	10 U
Bromoform	UG/L	4.0 U	8.0 U	8.0 U	NA	10 U
Bromomethane	UG/L	5.0 U	10 U	10 U	NA	10 U
Methyl ethyl ketone (2-Butanone)	UG/L	65 J	39 J	38 J	NA	10 U
Carbon Disulfide	UG/L	5.0 U	10 U	10 U	NA	10 U
Carbon Tetrachloride	UG/L	2.0 U	4.0 U	4.0 U	NA	10 U
Chlorobenzene	UG/L	5.0 U	10 U	10 U	NA	10 U
Chloroethane	UG/L	5.0 U	10 U	10 U	NA	10 U
Chloroform	UG/L	5.0 U	10 U	10 U	NA	10 U
Chloromethane	UG/L	5.0 U	10 U	10 U	NA	10 U
Chlorotrifluoroethene (Freon-1113)	UG/L	NA	NA	NA	68 J	NA
Cyclohexane	UG/L	NA	NA	NA	NA	10 UJ
Dibromochloromethane	UG/L	5.0 U	10 U	10 U	NA	10 U
Dichlorodifluoromethane	UG/L	NA	NA	NA	NA	10 UJ
1,2-Dibromo-3-chloropropane	UG/L	NA	NA	NA	NA	10 U
1,2-Dibromoethane	UG/L	NA	NA	NA	NA	10 U
1,2-Dichlorobenzene	UG/L	NA	NA	NA	NA	10 U
1,3-Dichlorobenzene	UG/L	NA	NA	NA	NA	10 U
1,4-Dichlorobenzene	UG/L	NA	NA	NA	NA	10 U
1,1-Dichloroethane	UG/L	5.0 U	10 U	10 U	NA	10 U
1,2-Dichloroethane	UG/L	2.0 U	4.0 U	4.0 U	NA	10 U

Flags assigned during chemistry validation are shown.

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UJ - Not detected above the estimated quantitation limit
D - Diluted sample

Detection Limits shown are MDL

TABLE 1
FORMER EMCA SITE
ANALYTES DETECTED IN GROUNDWATER (JUNE 2001- JULY 2004)

Location ID		MW-03	MW-03	MW-03	MW-03	MW-04
Sample ID		MW03-091703	DUP1_121703	MW-03_121703	MW-03	MW-04
Matrix		Groundwater	Groundwater	Groundwater	Groundwater	Groundwater
Depth Interval (ft)		-	-	-	-	-
Date Sampled		09/17/03	12/17/03	12/17/03	07/23/04	07/26/01
Parameter	Units		Field Duplicate (1-1)			
Volatiles						
1,1-Dichloroethene	UG/L	2.0 U	4.0 U	4.0 U	NA	10 U
cis-1,2-Dichloroethene	UG/L	5.0 U	10 U	10 U	NA	10 U
trans-1,2-Dichloroethene	UG/L	5.0 U	10 U	10 U	NA	10 U
1,2-Dichloropropane	UG/L	1.0 U	2.0 U	2.0 U	NA	10 U
cis-1,3-Dichloropropene	UG/L	5.0 U	10 U	10 U	NA	10 U
trans-1,3-Dichloropropene	UG/L	5.0 U	10 U	10 U	NA	10 UJ
Ethylbenzene	UG/L	4.0 U	8.0 U	8.0 U	NA	10 U
2-Hexanone	UG/L	16	10 U	10 U	NA	10 U
Isopropylbenzene	UG/L	NA	NA	NA	NA	10 U
4-Methyl-2-Pentanone	UG/L	11	10 U	10 U	NA	10 U
Methylene Chloride	UG/L	3.0 U	6.0 U	6.0 U	NA	10 U
Methyl acetate	UG/L	NA	NA	NA	NA	10 U
Methyl tert-butyl ether	UG/L	NA	NA	NA	NA	1 J
Methylcyclohexane	UG/L	NA	NA	NA	NA	10 U
Styrene	UG/L	5.0 U	10 U	10 U	NA	10 U
1,1,2,2-Tetrachloroethane	UG/L	1.0 U	2.0 U	2.0 U	NA	10 U
Tetrachloroethene	UG/L	1.0 U	4.9	4.6	NA	10 U
1,1,1-Trichloroethane	UG/L	5.0 U	10 U	10 U	NA	10 U
1,1,2-Trichloroethane	UG/L	3.0 U	6.0 U	6.0 U	NA	10 U
Trichloroethene	UG/L	1.0 U	2.0 U	2.0 U	NA	10 U
Trichlorofluoromethane	UG/L	NA	NA	NA	NA	10 U
1,2,4-Trichlorobenzene	UG/L	NA	NA	NA	NA	10 U
1,1,2-Trichloro-1,2,2-trifluoroethane (Freon-113)	UG/L	16	150	150	4,900 J	10 U

Flags assigned during chemistry validation are shown.

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UJ - Not detected above the estimated quantitation limit
D - Diluted sample

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Detection Limits shown are MDL

TABLE 1
FORMER EMCA SITE
ANALYTES DETECTED IN GROUNDWATER (JUNE 2001- JULY 2004)

Location ID		MW-03	MW-03	MW-03	MW-03	MW-04
Sample ID		MW03-091703	DUP1_121703	MW-03_121703	MW-03	MW-04
Matrix		Groundwater	Groundwater	Groundwater	Groundwater	Groundwater
Depth Interval (ft)		-	-	-	-	-
Date Sampled		09/17/03	12/17/03	12/17/03	07/23/04	07/26/01
Parameter	**Units**		Field Duplicate (1-1)			
Volatiles						
Toluene	UG/L	5.0 U	10 U	10 U	NA	10 U
Vinyl Chloride	UG/L	5.0 U	10 U	10 U	NA	10 U
Xylene (total)	UG/L	5.0 U	10 U	10 U	NA	10 U
1,2-Dichloro-1,1,2-trifluoroethane (Freon-123A)	UG/L	110	170	160	3,900	NA
Dissolved Gases						
Ethane	UG/L	250 U	500 U	250 U	NA	1 U
Ethene	UG/L	250 U	500 U	250 U	NA	1 U
Methane	UG/L	2,500	7,200	4,900	2,700	430 D
Total Metals						
Iron	UG/L	178,000 J	156,000	164,000	NA	14,700
Manganese	UG/L	NA	NA	NA	NA	6,120
Dissolved Metals						
Iron	UG/L	186,000 J	167,000	176,000	NA	14,700
Manganese	UG/L	NA	NA	NA	NA	6,280 J
Miscellaneous Parameters						
Alkalinity, Total (As CaCO3)	MG/L	NA	NA	NA	NA	115
Chloride	MG/L	91.5 J	224	192	71.7	144
Conductivity	UMHOS	1.64	NA	1.99	2.40	519
Dissolved Oxygen	MG/L	0.01	NA	0.35	1.05	0.28
Nitrogen, Ammonia (As N)	MG/L	0.95	1.4	1.2	NA	1.17
Nitrogen, Kjeldahl, Total	MG/L	4.4	4.0	4.0	NA	1.94
Nitrogen, Nitrate	MG/L	0.1 U	0.1 U	0.1 U	NA	NA
Nitrogen, Nitrite	MG/L	0.1 U	0.1 U	0.1 U	NA	NA

Flags assigned during chemistry validation are shown.

R - Rejected result NA - Not Analyzed
U - Non-Detect J - Estimated Result
UJ - Not detected above the estimated quantitation limit
D - Diluted sample

Detection Limits shown are MDL

TABLE 1
FORMER EMCA SITE
ANALYTES DETECTED IN GROUNDWATER (JUNE 2001- JULY 2004)

Location ID		MW-03	MW-03	MW-03	MW-03	MW-04
Sample ID		MW03-091703	DUP1_121703	MW-03_121703	MW-03	MW-04
Matrix		Groundwater	Groundwater	Groundwater	Groundwater	Groundwater
Depth Interval (ft)		-	-	-	-	-
Date Sampled		09/17/03	12/17/03	12/17/03	07/23/04	07/26/01
Parameter	**Units**		Field Duplicate (1-1)			
Miscellaneous Parameters						
Nitrogen, Nitrate-Nitrite	MG/L	NA	NA	NA	NA	0.10 U
Oxidation Reduction Potential	mV	-90	NA	-59	-143	-58.1
Phosphorus, Total (As P)	MG/L	NA	NA	NA	NA	0.24
Heterotrophic Plate Count	CFU/ML	NA	NA	NA	NA	67 J
Sulfate	MG/L	5.0 U	5.0 U	5.0 U	5.0 U	25.7
Sulfide	MG/L	NA	NA	NA	1.0 U	NA
Sulfide (lab)	MG/L	NA	NA	NA	NA	0.5 U
Sulfide (field)	MG/L	NA	NA	NA	NA	0.02
Total Organic Carbon	MG/L	NA	NA	NA	NA	17.8
Ferrous Iron (lab)	MG/L	NA	NA	NA	NA	1.010 J
Ferrous Iron (field)	MG/L	27.9	23.5	30.0	NA	13.320
Ferric Iron (lab)	MG/L	93.0	132	134	NA	13.700
Ferric Iron (field)	MG/L	NA	NA	NA	NA	1.380
Fluoride	MG/L	0.2	0.22	0.25	0.397	NA
TPH	MG/L	NA	5.38 U	5.21 U	NA	NA
Oil & Grease	MG/L	R	NA	NA	NA	NA
Tentatively Identified Compound						
1,1-Dichloro-1,1,2-trifluoroethane (HCFC-123B)	UG/L	0 U	0 U	0 U	NA	NA
1-Chloro-1,2,2-trifluoroethane (HCFC-133)	UG/L	0 U	0 U	0 U	NA	NA
1,1,2-Trifluoroethane (HCFC-143)	UG/L	0 U	0 U	0 U	NA	NA
Chlorotrifluoroethene (FREON-1113)	UG/L	0 U	0 U	0 U	NA	NA

Flags assigned during chemistry validation are shown.

R - Rejected result NA - Not Analyzed
U - Non-Detect J - Estimated Result
UJ - Not detected above the estimated quantitation limit
D - Diluted sample

Detection Limits shown are MDL

TABLE 1
FORMER EMCA SITE
ANALYTES DETECTED IN GROUNDWATER (JUNE 2001- JULY 2004)

Location ID		MW-04	MW-04	MW-04	MW-04	MW-05
Sample ID		MW04-5-20-03	MW-04_121703	Dup1	MW-04	MW-05
Matrix		Groundwater	Groundwater	Groundwater	Groundwater	Groundwater
Depth Interval (ft)		-	-	-	-	-
Date Sampled		05/20/03	12/17/03	07/22/04	07/22/04	07/26/01
Parameter	Units			Field Duplicate (1-1)		
Volatiles						
Acetone	UG/L	2.12 U	5.0 U	NA	NA	10 U
Benzene	UG/L	0.09 U	1.0 U	NA	NA	10 U
Bromodichloromethane	UG/L	0.13 U	1.0 U	NA	NA	10 U
Bromoform	UG/L	0.19 U	4.0 U	NA	NA	10 U
Bromomethane	UG/L	0.28 U	5.0 U	NA	NA	10 U
Methyl ethyl ketone (2-Butanone)	UG/L	R	R	NA	NA	10 U
Carbon Disulfide	UG/L	0.31 U	5.0 U	NA	NA	10 U
Carbon Tetrachloride	UG/L	0.32 U	2.0 U	NA	NA	10 U
Chlorobenzene	UG/L	0.1 U	5.0 U	NA	NA	10 U
Chloroethane	UG/L	0.23 U	5.0 U	NA	NA	10 U
Chloroform	UG/L	0.15 U	5.0 U	NA	NA	10 U
Chloromethane	UG/L	0.16 U	5.0 U	NA	NA	10 U
Chlorotrifluoroethene (Freon-1113)	UG/L	NA	NA	10 U	10 U	NA
Cyclohexane	UG/L	NA	NA	NA	NA	10 UJ
Dibromochloromethane	UG/L	0.2 U	5.0 U	NA	NA	10 U
Dichlorodifluoromethane	UG/L	NA	NA	NA	NA	10 UJ
1,2-Dibromo-3-chloropropane	UG/L	NA	NA	NA	NA	10 U
1,2-Dibromoethane	UG/L	NA	NA	NA	NA	10 U
1,2-Dichlorobenzene	UG/L	NA	NA	NA	NA	10 U
1,3-Dichlorobenzene	UG/L	NA	NA	NA	NA	10 U
1,4-Dichlorobenzene	UG/L	NA	NA	NA	NA	10 U
1,1-Dichloroethane	UG/L	0.1 U	5.0 U	NA	NA	10 U
1,2-Dichloroethane	UG/L	0.19 U	2.0 U	NA	NA	10 U

Flags assigned during chemistry validation are shown.

R - Rejected result NA - Not Analyzed
U - Non-Detect J - Estimated Result
UJ - Not detected above the estimated quantitation limit
D - Diluted sample

Detection Limits shown are MDL

TABLE 1
FORMER EMCA SITE
ANALYTES DETECTED IN GROUNDWATER (JUNE 2001- JULY 2004)

Location ID		MW-04	MW-04	MW-04	MW-04	MW-05
Sample ID		MW04-5-20-03	MW-04_121703	Dup1	MW-04	MW-05
Matrix		Groundwater	Groundwater	Groundwater	Groundwater	Groundwater
Depth Interval (ft)		-	-	-	-	-
Date Sampled		05/20/03	12/17/03	07/22/04	07/22/04	07/26/01
Parameter	Units			Field Duplicate (1-1)		
Volatiles						
1,1-Dichloroethene	UG/L	0.23 U	2.0 U	NA	NA	10 U
cis-1,2-Dichloroethene	UG/L	0.11 U	5.0 U	NA	NA	10 U
trans-1,2-Dichloroethene	UG/L	0.17 U	5.0 U	NA	NA	10 U
1,2-Dichloropropane	UG/L	0.15 U	1.0 U	NA	NA	10 U
cis-1,3-Dichloropropene	UG/L	0.22 U	5.0 U	NA	NA	10 U
trans-1,3-Dichloropropene	UG/L	0.12 U	5.0 U	NA	NA	10 UJ
Ethylbenzene	UG/L	0.21 U	4.0 U	NA	NA	10 U
2-Hexanone	UG/L	1.21 U	5.0 U	NA	NA	10 U
Isopropylbenzene	UG/L	NA	NA	NA	NA	10 U
4-Methyl-2-Pentanone	UG/L	0.94 U	5.0 U	NA	NA	10 U
Methylene Chloride	UG/L	0.18 U	3.0 U	NA	NA	10 U
Methyl acetate	UG/L	NA	NA	NA	NA	10 U
Methyl tert-butyl ether	UG/L	NA	NA	NA	NA	51
Methylcyclohexane	UG/L	NA	NA	NA	NA	10 U
Styrene	UG/L	0.13 U	5.0 U	NA	NA	10 U
1,1,2,2-Tetrachloroethane	UG/L	0.3 U	1.0 U	NA	NA	10 U
Tetrachloroethene	UG/L	0.25 U	1.0 U	NA	NA	10 U
1,1,1-Trichloroethane	UG/L	0.23 U	5.0 U	NA	NA	10 U
1,1,2-Trichloroethane	UG/L	0.17 U	3.0 U	NA	NA	10 U
Trichloroethene	UG/L	0.14 U	1.0 U	NA	NA	10 U
Trichlorofluoromethane	UG/L	NA	NA	NA	NA	10 U
1,2,4-Trichlorobenzene	UG/L	NA	NA	NA	NA	10 U
1,1,2-Trichloro-1,2,2-trifluoroethane (Freon-113)	UG/L	0.24 U	5.0 U	10 UJ	0.7 J	10 U

Flags assigned during chemistry validation are shown.

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U - Non-Detect J - Estimated Result
UJ - Not detected above the estimated quantitation limit
D - Diluted sample

Detection Limits shown are MDL

TABLE 1
FORMER EMCA SITE
ANALYTES DETECTED IN GROUNDWATER (JUNE 2001- JULY 2004)

Location ID		MW-04	MW-04	MW-04	MW-04	MW-05
Sample ID		MW04-5-20-03	MW-04_121703	Dup1	MW-04	MW-05
Matrix		Groundwater	Groundwater	Groundwater	Groundwater	Groundwater
Depth Interval (ft)		-	-	-	-	-
Date Sampled		05/20/03	12/17/03	07/22/04	07/22/04	07/26/01
Parameter	Units			Field Duplicate (1-1)		
Volatiles						
Toluene	UG/L	0.49 U	5.0 U	NA	NA	10 U
Vinyl Chloride	UG/L	0.25 U	5.0 U	NA	NA	10 U
Xylene (total)	UG/L	0.89 U	5.0 U	NA	NA	10 U
1,2-Dichloro-1,1,2-trifluoroethane (Freon-123A)	UG/L	0 U	5.0 U	10 U	10 U	NA
Dissolved Gases						
Ethane	UG/L	25 U	5.0 U	NA	NA	1 U
Ethene	UG/L	25 U	5.0 U	NA	NA	1 U
Methane	UG/L	380	35	69	99	110 D
Total Metals						
Iron	UG/L	18,400	3,640	NA	NA	1,360
Manganese	UG/L	NA	NA	NA	NA	1,460
Dissolved Metals						
Iron	UG/L	18,500	3,760	NA	NA	717
Manganese	UG/L	NA	NA	NA	NA	1,370 J
Miscellaneous Parameters						
Alkalinity, Total (As CaCO3)	MG/L	NA	NA	NA	NA	346
Chloride	MG/L	238	294	158	161	71.6
Conductivity	UMHOS	1.61	0.99	NA	1.05	393
Dissolved Oxygen	MG/L	0.54	0 U	NA	0.82	0.20
Nitrogen, Ammonia (As N)	MG/L	1.6	1.2	NA	NA	0.15
Nitrogen, Kjeldahl, Total	MG/L	6.2	1.9	NA	NA	0.38
Nitrogen, Nitrate	MG/L	0.1 U	0.1 U	NA	NA	NA
Nitrogen, Nitrite	MG/L	0.1 U	0.1 U	NA	NA	NA

Flags assigned during chemistry validation are shown.

R - Rejected result NA - Not Analyzed
U - Non-Detect J - Estimated Result
UJ - Not detected above the estimated quantitation limit
D - Diluted sample

Detection Limits shown are MDL

TABLE 1
FORMER EMCA SITE
ANALYTES DETECTED IN GROUNDWATER (JUNE 2001- JULY 2004)

Location ID		MW-04	MW-04	MW-04	MW-04	MW-05
Sample ID		MW04-5-20-03	MW-04_121703	Dup1	MW-04	MW-05
Matrix		Groundwater	Groundwater	Groundwater	Groundwater	Groundwater
Depth Interval (ft)		-	-	-	-	-
Date Sampled		05/20/03	12/17/03	07/22/04	07/22/04	07/26/01
Parameter	**Units**			Field Duplicate (1-1)		
Miscellaneous Parameters						
Nitrogen, Nitrate-Nitrite	MG/L	NA	NA	NA	NA	0.15
Oxidation Reduction Potential	mV	-115	0 U	NA	-136	50.0
Phosphorus, Total (As P)	MG/L	NA	NA	NA	NA	0.05 U
Heterotrophic Plate Count	CFU/ML	NA	NA	NA	NA	56 J
Sulfate	MG/L	5.0 U	9.4	10.8	10.8	51.3
Sulfide	MG/L	NA	NA	1.0 U	1.0 U	NA
Sulfide (lab)	MG/L	NA	NA	NA	NA	0.5 U
Sulfide (field)	MG/L	NA	NA	NA	NA	0.02
Total Organic Carbon	MG/L	NA	NA	NA	NA	4.5
Ferrous Iron (lab)	MG/L	NA	NA	NA	NA	100 UJ
Ferrous Iron (field)	MG/L	17.6	2.2	NA	NA	0.700
Ferric Iron (lab)	MG/L	0.76	1.3	NA	NA	1.360
Ferric Iron (field)	MG/L	NA	NA	NA	NA	0.660
Fluoride	MG/L	0.27	0.19	0.304	0.302	NA
TPH	MG/L	5 U	5.38 U	NA	NA	NA
Oil & Grease	MG/L	NA	NA	NA	NA	NA
Tentatively Identified Compound						
1,1-Dichloro-1,1,2-trifluoroethane (HCFC-123B)	UG/L	0 U	0 U	NA	NA	NA
1-Chloro-1,2,2-trifluoroethane (HCFC-133)	UG/L	0 U	0 U	NA	NA	NA
1,1,2-Trifluoroethane (HCFC-143)	UG/L	0 U	0 U	NA	NA	NA
Chlorotrifluoroethene (FREON-1113)	UG/L	0 U	0 U	NA	NA	NA

Flags assigned during chemistry validation are shown.

R - Rejected result   NA - Not Analyzed
U - Non-Detect   J - Estimated Result
UJ - Not detected above the estimated quantitation limit
D - Diluted sample

Detection Limits shown are MDL

TABLE 1
FORMER EMCA SITE
ANALYTES DETECTED IN GROUNDWATER (JUNE 2001- JULY 2004)

Location ID		MW-05	MW-05	MW-05	MW-06	MW-06
Sample ID		MW05_52103	MW-05-121803	MW-05	MW06-6-10-03	MW06-7_22_03
Matrix		Groundwater	Groundwater	Groundwater	Groundwater	Groundwater
Depth Interval (ft)		-	-	-	-	-
Date Sampled		05/21/03	12/18/03	07/23/04	06/10/03	07/22/03
Parameter	Units					
Volatiles						
Acetone	UG/L	2.12 U	5.0 U	NA	2.12 U	1.89 U
Benzene	UG/L	0.09 U	1.0 U	NA	0.09 U	0.2 U
Bromodichloromethane	UG/L	0.13 U	1.0 U	NA	0.13 U	0.08 U
Bromoform	UG/L	0.19 U	4.0 U	NA	0.19 U	0.24 U
Bromomethane	UG/L	0.28 U	5.0 U	NA	0.28 U	0.32 U
Methyl ethyl ketone (2-Butanone)	UG/L	R	R	NA	R	R
Carbon Disulfide	UG/L	0.31 U	5.0 U	NA	0.31 U	0.26 U
Carbon Tetrachloride	UG/L	0.32 U	2.0 U	NA	0.32 U	0.39 U
Chlorobenzene	UG/L	0.1 U	5.0 U	NA	0.1 U	0.08 U
Chloroethane	UG/L	0.23 U	5.0 U	NA	0.23 U	0.46 U
Chloroform	UG/L	0.15 U	5.0 U	NA	0.15 U	0.17 U
Chloromethane	UG/L	0.16 U	5.0 U	NA	0.16 U	0.54 U
Chlorotrifluoroethene (Freon-1113)	UG/L	NA	NA	10 U	NA	NA
Cyclohexane	UG/L	NA	NA	NA	NA	NA
Dibromochloromethane	UG/L	0.2 U	5.0 U	NA	0.2 U	0.17 U
Dichlorodifluoromethane	UG/L	NA	NA	NA	NA	NA
1,2-Dibromo-3-chloropropane	UG/L	NA	NA	NA	NA	NA
1,2-Dibromoethane	UG/L	NA	NA	NA	NA	NA
1,2-Dichlorobenzene	UG/L	NA	NA	NA	NA	NA
1,3-Dichlorobenzene	UG/L	NA	NA	NA	NA	NA
1,4-Dichlorobenzene	UG/L	NA	NA	NA	NA	NA
1,1-Dichloroethane	UG/L	0.1 U	5.0 U	NA	0.1 U	0.24 U
1,2-Dichloroethane	UG/L	0.19 U	2.0 U	NA	0.19 U	0.11 U

Flags assigned during chemistry validation are shown.

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U - Non-Detect J - Estimated Result
UJ - Not detected above the estimated quantitation limit
D - Diluted sample

Detection Limits shown are MDL

TABLE 1
FORMER EMCA SITE
ANALYTES DETECTED IN GROUNDWATER (JUNE 2001- JULY 2004)

Location ID		MW-05	MW-05	MW-05	MW-06	MW-06
Sample ID		MW05_52103	MW-05-121803	MW-05	MW06-6-10-03	MW06-7_22_03
Matrix		Groundwater	Groundwater	Groundwater	Groundwater	Groundwater
Depth Interval (ft)		-	-	-	-	-
Date Sampled		05/21/03	12/18/03	07/23/04	06/10/03	07/22/03
Parameter	**Units**					
Volatiles						
1,1-Dichloroethene	UG/L	0.23 U	2.0 U	NA	0.23 U	1.2 J
cis-1,2-Dichloroethene	UG/L	0.11 U	5.0 U	NA	0.11 U	1.7 J
trans-1,2-Dichloroethene	UG/L	0.17 U	5.0 U	NA	0.17 U	0.21 U
1,2-Dichloropropane	UG/L	0.15 U	1.0 U	NA	0.15 U	0.17 U
cis-1,3-Dichloropropene	UG/L	0.22 U	5.0 U	NA	0.22 U	0.23 U
trans-1,3-Dichloropropene	UG/L	0.12 U	5.0 U	NA	0.12 U	0.09 U
Ethylbenzene	UG/L	0.21 U	4.0 U	NA	0.21 U	0.18 U
2-Hexanone	UG/L	1.21 U	5.0 U	NA	1.21 U	1.09 U
Isopropylbenzene	UG/L	NA	NA	NA	NA	NA
4-Methyl-2-Pentanone	UG/L	0.94 U	5.0 U	NA	0.94 U	1.13 U
Methylene Chloride	UG/L	0.18 U	3.0 U	NA	0.18 U	0.13 U
Methyl acetate	UG/L	NA	NA	NA	NA	NA
Methyl tert-butyl ether	UG/L	NA	NA	NA	NA	NA
Methylcyclohexane	UG/L	NA	NA	NA	NA	NA
Styrene	UG/L	0.13 U	5.0 U	NA	0.13 U	0.16 U
1,1,2,2-Tetrachloroethane	UG/L	0.3 U	1.0 U	NA	0.3 U	0.22 U
Tetrachloroethene	UG/L	0.4 J	1.0 U	NA	0.25 U	0.34 U
1,1,1-Trichloroethane	UG/L	0.23 U	5.0 U	NA	0.23 U	0.37 U
1,1,2-Trichloroethane	UG/L	0.17 U	3.0 U	NA	0.17 U	0.17 U
Trichloroethene	UG/L	0.14 U	1.0 U	NA	0.14 U	0.25 U
Trichlorofluoromethane	UG/L	NA	NA	NA	NA	NA
1,2,4-Trichlorobenzene	UG/L	NA	NA	NA	NA	NA
1,1,2-Trichloro-1,2,2-trifluoroethane (Freon-113)	UG/L	0.24 U	5.0 U	0.5 J	220	180

Flags assigned during chemistry validation are shown.

R - Rejected result NA - Not Analyzed
U - Non-Detect J - Estimated Result
UJ - Not detected above the estimated quantitation limit
D - Diluted sample

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[LOGDATE] >= #7/25/01# AND [MATRIX] = 'WG'

Detection Limits shown are MDL

TABLE 1
FORMER EMCA SITE
ANALYTES DETECTED IN GROUNDWATER (JUNE 2001- JULY 2004)

Location ID		MW-05	MW-05	MW-05	MW-06	MW-06
Sample ID		MW05_52103	MW-05-121803	MW-05	MW06-6-10-03	MW06-7_22_03
Matrix		Groundwater	Groundwater	Groundwater	Groundwater	Groundwater
Depth Interval (ft)		-	-	-	-	-
Date Sampled		05/21/03	12/18/03	07/23/04	06/10/03	07/22/03
Parameter	Units					
Volatiles						
Toluene	UG/L	0.49 U	5.0 U	NA	0.49 U	0.17 U
Vinyl Chloride	UG/L	0.25 U	5.0 U	NA	0.25 U	1.2 J
Xylene (total)	UG/L	0.89 U	5.0 U	NA	0.89 U	0.23 U
1,2-Dichloro-1,1,2-trifluoroethane (Freon-123A)	UG/L	5 U	5.0 U	10 U	8.8 J	9.5
Dissolved Gases						
Ethane	UG/L	5.0 U	5.0 U	NA	5.0 U	0 U
Ethene	UG/L	5.0 U	5.0 U	NA	5.0 U	0 U
Methane	UG/L	27	6.7	47	49	81
Total Metals						
Iron	UG/L	2,110	15,500	NA	14,400	10,500
Manganese	UG/L	NA	NA	NA	NA	NA
Dissolved Metals						
Iron	UG/L	1,670	39.7 U	NA	14,300	10,300
Manganese	UG/L	NA	NA	NA	NA	NA
Miscellaneous Parameters						
Alkalinity, Total (As CaCO3)	MG/L	NA	NA	NA	NA	NA
Chloride	MG/L	49.8	27.5	63.9	184	82.3
Conductivity	UMHOS	0.426	0.629	0.463	0.741	0.866
Dissolved Oxygen	MG/L	0.37	0 U	0.97	0.93	1.07
Nitrogen, Ammonia (As N)	MG/L	0.25	0.1 U	NA	0.19	0.33
Nitrogen, Kjeldahl, Total	MG/L	3.6	0.61	NA	0.72	1.1
Nitrogen, Nitrate	MG/L	0.22	0.18	NA	0.33	0 U
Nitrogen, Nitrite	MG/L	0.1 U	0.1 U	NA	0.1 U	0 U

Flags assigned during chemistry validation are shown.

R - Rejected result NA - Not Analyzed
U - Non-Detect J - Estimated Result
UJ - Not detected above the estimated quantitation limit
D - Diluted sample

Detection Limits shown are MDL

TABLE 1
FORMER EMCA SITE
ANALYTES DETECTED IN GROUNDWATER (JUNE 2001- JULY 2004)

Location ID		MW-05	MW-05	MW-05	MW-06	MW-06
Sample ID		MW05_52103	MW-05-121803	MW-05	MW06-6-10-03	MW06-7_22_03
Matrix		Groundwater	Groundwater	Groundwater	Groundwater	Groundwater
Depth Interval (ft)		-	-	-	-	-
Date Sampled		05/21/03	12/18/03	07/23/04	06/10/03	07/22/03
Parameter	**Units**					
Miscellaneous Parameters						
Nitrogen, Nitrate-Nitrite	MG/L	NA	NA	NA	NA	NA
Oxidation Reduction Potential	mV	26	121	46	-145	-155
Phosphorus, Total (As P)	MG/L	NA	NA	NA	NA	NA
Heterotrophic Plate Count	CFU/ML	NA	NA	NA	NA	NA
Sulfate	MG/L	50.1	61.4	42.3	32	30.5
Sulfide	MG/L	NA	NA	1.0 U	NA	NA
Sulfide (lab)	MG/L	NA	NA	NA	NA	NA
Sulfide (field)	MG/L	NA	NA	NA	NA	NA
Total Organic Carbon	MG/L	NA	NA	NA	NA	NA
Ferrous Iron (lab)	MG/L	NA	NA	NA	NA	NA
Ferrous Iron (field)	MG/L	1.7	0.07	NA	14.3	8.6
Ferric Iron (lab)	MG/L	0.43	15.4	NA	0.12	1.9
Ferric Iron (field)	MG/L	NA	NA	NA	NA	NA
Fluoride	MG/L	0.1 U	0.12	0.103	0.46	0.56
TPH	MG/L	5 U	5 U	NA	5 U	5 U
Oil & Grease	MG/L	NA	NA	NA	NA	NA
Tentatively Identified Compound						
1,1-Dichloro-1,1,2-trifluoroethane (HCFC-123B)	UG/L	0 U	0 U	NA	0 U	0 U
1-Chloro-1,2,2-trifluoroethane (HCFC-133)	UG/L	0 U	0 U	NA	0 U	0 U
1,1,2-Trifluoroethane (HCFC-143)	UG/L	0 U	0 U	NA	0 U	0 U
Chlorotrifluoroethene (FREON-1113)	UG/L	0 U	0 U	NA	0 U	5.7

Flags assigned during chemistry validation are shown.

R - Rejected result NA - Not Analyzed
U - Non-Detect J - Estimated Result
UJ - Not detected above the estimated quantitation limit
D - Diluted sample

Detection Limits shown are MDL

TABLE 1
FORMER EMCA SITE
ANALYTES DETECTED IN GROUNDWATER (JUNE 2001- JULY 2004)

Location ID		MW-06	MW-06	MW-06	MW-07	MW-07
Sample ID		MW06-091803	MW-06_121703	MW-06	MW07-6-10-03	MW07
Matrix		Groundwater	Groundwater	Groundwater	Groundwater	Groundwater
Depth Interval (ft)		-	-	-	-	-
Date Sampled		09/18/03	12/17/03	07/23/04	06/10/03	07/23/03
Parameter	Units					
Volatiles						
Acetone	UG/L	5.0 U	10 U	NA	2.12 U	1.89 U
Benzene	UG/L	1.0 U	2.0 U	NA	0.09 U	0.2 U
Bromodichloromethane	UG/L	1.0 U	2.0 U	NA	0.13 U	0.08 U
Bromoform	UG/L	4.0 U	8.0 U	NA	0.19 U	0.24 U
Bromomethane	UG/L	5.0 U	10 U	NA	0.28 U	0.32 U
Methyl ethyl ketone (2-Butanone)	UG/L	R	R	NA	R	R
Carbon Disulfide	UG/L	5.0 U	10 U	NA	0.31 U	0.26 U
Carbon Tetrachloride	UG/L	2.0 U	4.0 U	NA	0.32 U	0.39 U
Chlorobenzene	UG/L	5.0 U	10 U	NA	0.1 U	0.08 U
Chloroethane	UG/L	5.0 U	10 U	NA	0.23 U	0.46 U
Chloroform	UG/L	5.0 U	10 U	NA	0.15 U	0.17 U
Chloromethane	UG/L	5.0 U	10 U	NA	0.16 U	0.54 U
Chlorotrifluoroethene (Freon-1113)	UG/L	NA	NA	5 J	NA	NA
Cyclohexane	UG/L	NA	NA	NA	NA	NA
Dibromochloromethane	UG/L	5.0 U	10 U	NA	0.2 U	0.17 U
Dichlorodifluoromethane	UG/L	NA	NA	NA	NA	NA
1,2-Dibromo-3-chloropropane	UG/L	NA	NA	NA	NA	NA
1,2-Dibromoethane	UG/L	NA	NA	NA	NA	NA
1,2-Dichlorobenzene	UG/L	NA	NA	NA	NA	NA
1,3-Dichlorobenzene	UG/L	NA	NA	NA	NA	NA
1,4-Dichlorobenzene	UG/L	NA	NA	NA	NA	NA
1,1-Dichloroethane	UG/L	5.0 U	10 U	NA	0.1 U	0.24 U
1,2-Dichloroethane	UG/L	2.0 U	4.0 U	NA	0.19 U	0.11 U

Flags assigned during chemistry validation are shown.

R - Rejected result NA - Not Analyzed
U - Non-Detect J - Estimated Result
UJ - Not detected above the estimated quantitation limit
D - Diluted sample

Detection Limits shown are MDL

TABLE 1
FORMER EMCA SITE
ANALYTES DETECTED IN GROUNDWATER (JUNE 2001- JULY 2004)

Location ID		MW-06	MW-06	MW-06	MW-07	MW-07
Sample ID		MW06-091803	MW-06_121703	MW-06	MW07-6-10-03	MW07
Matrix		Groundwater	Groundwater	Groundwater	Groundwater	Groundwater
Depth Interval (ft)		-	-	-	-	-
Date Sampled		09/18/03	12/17/03	07/23/04	06/10/03	07/23/03
Parameter	**Units**					
Volatiles						
1,1-Dichloroethene	UG/L	2.0 U	4.0 U	NA	0.23 U	68 J
cis-1,2-Dichloroethene	UG/L	1.4 J	1.3 J	NA	0.11 U	0.22 U
trans-1,2-Dichloroethene	UG/L	5.0 U	10 U	NA	0.17 U	0.21 U
1,2-Dichloropropane	UG/L	1.0 U	2.0 U	NA	0.15 U	0.17 U
cis-1,3-Dichloropropene	UG/L	5.0 U	10 U	NA	0.22 U	0.23 U
trans-1,3-Dichloropropene	UG/L	5.0 U	10 U	NA	0.12 U	0.09 U
Ethylbenzene	UG/L	4.0 U	8.0 U	NA	0.21 U	0.18 U
2-Hexanone	UG/L	5.0 U	10 U	NA	1.21 U	1.09 U
Isopropylbenzene	UG/L	NA	NA	NA	NA	NA
4-Methyl-2-Pentanone	UG/L	5.0 U	10 U	NA	0.94 U	1.13 U
Methylene Chloride	UG/L	3.0 U	6.0 U	NA	0.18 U	0.13 U
Methyl acetate	UG/L	NA	NA	NA	NA	NA
Methyl tert-butyl ether	UG/L	NA	NA	NA	NA	NA
Methylcyclohexane	UG/L	NA	NA	NA	NA	NA
Styrene	UG/L	5.0 U	10 U	NA	0.13 U	0.16 U
1,1,2,2-Tetrachloroethane	UG/L	1.0 U	2.0 U	NA	0.3 U	0.22 U
Tetrachloroethene	UG/L	1.0 U	2.0 U	NA	0.25 U	0.34 U
1,1,1-Trichloroethane	UG/L	5.0 U	10 U	NA	0.23 U	0.37 U
1,1,2-Trichloroethane	UG/L	3.0 U	6.0 U	NA	0.17 U	0.17 U
Trichloroethene	UG/L	1.0 U	2.0 U	NA	0.14 U	0.25 U
Trichlorofluoromethane	UG/L	NA	NA	NA	NA	NA
1,2,4-Trichlorobenzene	UG/L	NA	NA	NA	NA	NA
1,1,2-Trichloro-1,2,2-trifluoroethane (Freon-113)	UG/L	97	250	140 J	5,400	8,500

Flags assigned during chemistry validation are shown.

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U - Non-Detect J - Estimated Result
UJ - Not detected above the estimated quantitation limit
D - Diluted sample

Detection Limits shown are MDL

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[LOGDATE] >= #7/25/01# AND [MATRIX] = 'WG'

TABLE 1
FORMER EMCA SITE
ANALYTES DETECTED IN GROUNDWATER (JUNE 2001- JULY 2004)

Location ID		MW-06	MW-06	MW-06	MW-07	MW-07
Sample ID		MW06-091803	MW-06_121703	MW-06	MW07-6-10-03	MW07
Matrix		Groundwater	Groundwater	Groundwater	Groundwater	Groundwater
Depth Interval (ft)		-	-	-	-	-
Date Sampled		09/18/03	12/17/03	07/23/04	06/10/03	07/23/03
Parameter	**Units**					
Volatiles						
Toluene	UG/L	5.0 U	10 U	NA	0.49 U	0.17 U
Vinyl Chloride	UG/L	5.0 U	10 U	NA	0.25 U	0.38 U
Xylene (total)	UG/L	5.0 U	10 U	NA	0.89 U	0.23 U
1,2-Dichloro-1,1,2-trifluoroethane (Freon-123A)	UG/L	8.6	14	23	68 J	130 J
Dissolved Gases						
Ethane	UG/L	5.0 U	5.0 U	NA	50 U	0 U
Ethene	UG/L	5.0 U	5.0 U	NA	50 U	0 U
Methane	UG/L	99	78	40	740	420
Total Metals						
Iron	UG/L	8,370 J	7,690	NA	21,300	21,200
Manganese	UG/L	NA	NA	NA	NA	NA
Dissolved Metals						
Iron	UG/L	8,470 J	7,670	NA	20,800	20,800
Manganese	UG/L	NA	NA	NA	NA	NA
Miscellaneous Parameters						
Alkalinity, Total (As CaCO3)	MG/L	NA	NA	NA	NA	NA
Chloride	MG/L	74.6	84.0	60.5	140	168
Conductivity	UMHOS	0.581	602	0.513	0.93	1.11
Dissolved Oxygen	MG/L	0 U	0 U	1.04	0.90	0.10
Nitrogen, Ammonia (As N)	MG/L	0.31	0.36	NA	0.39	0.6
Nitrogen, Kjeldahl, Total	MG/L	0.88	0.79	NA	1.2	1.8
Nitrogen, Nitrate	MG/L	0.1 U	0.1 UJ	NA	0.1 U	NA
Nitrogen, Nitrite	MG/L	0.1 U	0.1 UJ	NA	0.1 U	NA

Flags assigned during chemistry validation are shown.

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U - Non-Detect J - Estimated Result
UJ - Not detected above the estimated quantitation limit
D - Diluted sample

Detection Limits shown are MDL

N:\11172730.00000\DB\PROGRAM\program.mde
Printed: 2/16/2005 1:18:44 PM
[LOGDATE] >= #7/25/01# AND [MATRIX] = 'WG'

TABLE 1
FORMER EMCA SITE
ANALYTES DETECTED IN GROUNDWATER (JUNE 2001- JULY 2004)

Location ID		MW-06	MW-06	MW-06	MW-07	MW-07
Sample ID		MW06-091803	MW-06_121703	MW-06	MW07-6-10-03	MW07
Matrix		Groundwater	Groundwater	Groundwater	Groundwater	Groundwater
Depth Interval (ft)		-	-	-	-	-
Date Sampled		09/18/03	12/17/03	07/23/04	06/10/03	07/23/03
Parameter	**Units**					
Miscellaneous Parameters						
Nitrogen, Nitrate-Nitrite	MG/L	NA	NA	NA	NA	0 UJ
Oxidation Reduction Potential	mV	-143	-110	-64	-130	-108
Phosphorus, Total (As P)	MG/L	NA	NA	NA	NA	NA
Heterotrophic Plate Count	CFU/ML	NA	NA	NA	NA	NA
Sulfate	MG/L	39.2	39.1	33.5	32.8	31
Sulfide	MG/L	NA	NA	1.0 U	NA	NA
Sulfide (lab)	MG/L	NA	NA	NA	NA	NA
Sulfide (field)	MG/L	NA	NA	NA	NA	NA
Total Organic Carbon	MG/L	NA	NA	NA	NA	NA
Ferrous Iron (lab)	MG/L	NA	NA	NA	NA	NA
Ferrous Iron (field)	MG/L	6.0	8.7	NA	20.2	19.8
Ferric Iron (lab)	MG/L	8.4	1.0 U	NA	1	1.4
Ferric Iron (field)	MG/L	NA	NA	NA	NA	NA
Fluoride	MG/L	0.37	0.42	0.467	0.33	0.25
TPH	MG/L	NA	5.26 U	NA	5 U	5 U
Oil & Grease	MG/L	5 U	NA	NA	NA	NA
Tentatively Identified Compound						
1,1-Dichloro-1,1,2-trifluoroethane (HCFC-123B)	UG/L	0 U	0 U	NA	0 U	0 U
1-Chloro-1,2,2-trifluoroethane (HCFC-133)	UG/L	0 U	0 U	NA	0 U	0 U
1,1,2-Trifluoroethane (HCFC-143)	UG/L	0 U	0 U	NA	0 U	0 U
Chlorotrifluoroethene (FREON-1113)	UG/L	0 U	0 U	NA	0 U	0 U

Flags assigned during chemistry validation are shown.

R - Rejected result NA - Not Analyzed
U - Non-Detect J - Estimated Result
UJ - Not detected above the estimated quantitation limit
D - Diluted sample

Detection Limits shown are MDL

TABLE 1
FORMER EMCA SITE
ANALYTES DETECTED IN GROUNDWATER (JUNE 2001- JULY 2004)

Location ID		MW-07	MW-07	MW-07
Sample ID		MW07-91703	MW-07_121703	MW-07
Matrix		Groundwater	Groundwater	Groundwater
Depth Interval (ft)		-	-	-
Date Sampled		09/17/03	12/17/03	07/22/04
Parameter	Units			
Volatiles				
Acetone	UG/L	250 U	50 U	NA
Benzene	UG/L	50 U	14	NA
Bromodichloromethane	UG/L	50 U	10 U	NA
Bromoform	UG/L	200 U	40 U	NA
Bromomethane	UG/L	250 U	50 U	NA
Methyl ethyl ketone (2-Butanone)	UG/L	R	R	NA
Carbon Disulfide	UG/L	250 U	50 U	NA
Carbon Tetrachloride	UG/L	100 U	20 U	NA
Chlorobenzene	UG/L	250 U	50 U	NA
Chloroethane	UG/L	250 U	50 U	NA
Chloroform	UG/L	250 U	50 U	NA
Chloromethane	UG/L	250 U	50 U	NA
Chlorotrifluoroethene (Freon-1113)	UG/L	NA	NA	210
Cyclohexane	UG/L	NA	NA	NA
Dibromochloromethane	UG/L	250 U	50 U	NA
Dichlorodifluoromethane	UG/L	NA	NA	NA
1,2-Dibromo-3-chloropropane	UG/L	NA	NA	NA
1,2-Dibromoethane	UG/L	NA	NA	NA
1,2-Dichlorobenzene	UG/L	NA	NA	NA
1,3-Dichlorobenzene	UG/L	NA	NA	NA
1,4-Dichlorobenzene	UG/L	NA	NA	NA
1,1-Dichloroethane	UG/L	250 U	50 U	NA
1,2-Dichloroethane	UG/L	100 U	20 U	NA

Flags assigned during chemistry validation are shown.

R - Rejected result   NA - Not Analyzed
U - Non-Detect   J - Estimated Result
UJ - Not detected above the estimated quantitation limit
D - Diluted sample

Detection Limits shown are MDL

TABLE 1
FORMER EMCA SITE
ANALYTES DETECTED IN GROUNDWATER (JUNE 2001- JULY 2004)

Location ID		MW-07	MW-07	MW-07
Sample ID		MW07-91703	MW-07_121703	MW-07
Matrix		Groundwater	Groundwater	Groundwater
Depth Interval (ft)		-	-	-
Date Sampled		09/17/03	12/17/03	07/22/04
Parameter	Units			
Volatiles				
1,1-Dichloroethene	UG/L	100 U	20 U	NA
cis-1,2-Dichloroethene	UG/L	250 U	50 U	NA
trans-1,2-Dichloroethene	UG/L	250 U	50 U	NA
1,2-Dichloropropane	UG/L	50 U	10 U	NA
cis-1,3-Dichloropropene	UG/L	250 U	50 U	NA
trans-1,3-Dichloropropene	UG/L	250 U	50 U	NA
Ethylbenzene	UG/L	200 U	49	NA
2-Hexanone	UG/L	250 U	50 U	NA
Isopropylbenzene	UG/L	NA	NA	NA
4-Methyl-2-Pentanone	UG/L	250 U	50 U	NA
Methylene Chloride	UG/L	150 U	30 U	NA
Methyl acetate	UG/L	NA	NA	NA
Methyl tert-butyl ether	UG/L	NA	NA	NA
Methylcyclohexane	UG/L	NA	NA	NA
Styrene	UG/L	250 U	50 U	NA
1,1,2,2-Tetrachloroethane	UG/L	50 U	10 U	NA
Tetrachloroethene	UG/L	50 U	10 U	NA
1,1,1-Trichloroethane	UG/L	250 U	50 U	NA
1,1,2-Trichloroethane	UG/L	150 U	30 U	NA
Trichloroethene	UG/L	50 U	10 U	NA
Trichlorofluoromethane	UG/L	NA	NA	NA
1,2,4-Trichlorobenzene	UG/L	NA	NA	NA
1,1,2-Trichloro-1,2,2-trifluoroethane (Freon-113)	UG/L	6,100	370	110 J

Flags assigned during chemistry validation are shown.

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Detection Limits shown are MDL

TABLE 1
FORMER EMCA SITE
ANALYTES DETECTED IN GROUNDWATER (JUNE 2001- JULY 2004)

Location ID		MW-07	MW-07	MW-07
Sample ID		MW07-91703	MW-07_121703	MW-07
Matrix		Groundwater	Groundwater	Groundwater
Depth Interval (ft)		-	-	-
Date Sampled		09/17/03	12/17/03	07/22/04
Parameter	**Units**			
Volatiles				
Toluene	UG/L	250 U	50 U	NA
Vinyl Chloride	UG/L	250 U	50 U	NA
Xylene (total)	UG/L	250 U	50 U	NA
1,2-Dichloro-1,1,2-trifluoroethane (Freon-123A)	UG/L	130 J	940	50
Dissolved Gases				
Ethane	UG/L	50 U	120 U	NA
Ethene	UG/L	50 U	120 U	NA
Methane	UG/L	1,200	1,700	2,500
Total Metals				
Iron	UG/L	32,700 J	38,900	NA
Manganese	UG/L	NA	NA	NA
Dissolved Metals				
Iron	UG/L	32,500 J	38,900	NA
Manganese	UG/L	NA	NA	NA
Miscellaneous Parameters				
Alkalinity, Total (As CaCO3)	MG/L	NA	NA	NA
Chloride	MG/L	300 J	328	303
Conductivity	UMHOS	1.44	1.94	1.69
Dissolved Oxygen	MG/L	0 U	3.33	0.88
Nitrogen, Ammonia (As N)	MG/L	0.66	0.99	NA
Nitrogen, Kjeldahl, Total	MG/L	2.1	2.8	NA
Nitrogen, Nitrate	MG/L	0.1 U	0.1 U	NA
Nitrogen, Nitrite	MG/L	0.1 U	0.1 U	NA

Flags assigned during chemistry validation are shown.

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D - Diluted sample

Detection Limits shown are MDL

TABLE 1
FORMER EMCA SITE
ANALYTES DETECTED IN GROUNDWATER (JUNE 2001- JULY 2004)

Location ID		MW-07	MW-07	MW-07
Sample ID		MW07-91703	MW-07_121703	MW-07
Matrix		Groundwater	Groundwater	Groundwater
Depth Interval (ft)		-	-	-
Date Sampled		09/17/03	12/17/03	07/22/04
Parameter	**Units**			
Miscellaneous Parameters				
Nitrogen, Nitrate-Nitrite	MG/L	NA	NA	NA
Oxidation Reduction Potential	mV	-118	-115	-153
Phosphorus, Total (As P)	MG/L	NA	NA	NA
Heterotrophic Plate Count	CFU/ML	NA	NA	NA
Sulfate	MG/L	23.6	5.0 U	5.0 U
Sulfide	MG/L	NA	NA	1.0 U
Sulfide (lab)	MG/L	NA	NA	NA
Sulfide (field)	MG/L	NA	NA	NA
Total Organic Carbon	MG/L	NA	NA	NA
Ferrous Iron (lab)	MG/L	NA	NA	NA
Ferrous Iron (field)	MG/L	33.8	19.5	NA
Ferric Iron (lab)	MG/L	14.1	19.4	NA
Ferric Iron (field)	MG/L	NA	NA	NA
Fluoride	MG/L	0.24	0.19	0.190
TPH	MG/L	NA	5.26 U	NA
Oil & Grease	MG/L	5.44 U	NA	NA
Tentatively Identified Compound				
1,1-Dichloro-1,1,2-trifluoroethane (HCFC-123B)	UG/L	0 U	0 U	NA
1-Chloro-1,2,2-trifluoroethane (HCFC-133)	UG/L	0 U	0 U	NA
1,1,2-Trifluoroethane (HCFC-143)	UG/L	0 U	0 U	NA
Chlorotrifluoroethene (FREON-1113)	UG/L	0 U	0 U	NA

Flags assigned during chemistry validation are shown.

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Detection Limits shown are MDL

APPENDIX F

HEALTH RISK ASSESSMENT AND CALCULATION

QUALITATIVE HUMAN HEALTH EXPOSURE ASSESSMENT

FORMER EMCA SITE

SITE NO. 360025

MAMARONECK, NEW YORK

Prepared for:

ROHM AND HAAS COMPANY

Prepared by:

URS CORPORATION

77 GOODELL STREET

BUFFALO, NEW YORK 14203

DECEMBER 2004

TABLE OF CONTENTS

TABLES
(Following Text)

ATTACHMENTS

ACRONYMS

bgs	below ground surface
cm/s	centimeters per second
EE/CA	Engineering Evaluation/Cost Analysis
IRA	Interim Remedial Action
NYCRR	New York Code of Rules and Regulations
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
WWC	Woodward-Clyde Consultants
μg/L	micrograms per liter

1.0 INTRODUCTION

The EMCA Site is a 0.6-parcel site located in a mixed residential/industrial area in Mamaroneck, New York. The site is a listed Class 2 Inactive Hazardous Waste Site due to the presence of 1,1,2-trichloro-1,2,2-trifluoroethane (Freon 113) in groundwater. The site was formerly used for the manufacture of high conductivity precious metal paste used in circuits by the electronics industry. Manufacturing began in 1960 and ceased in 1988. Cablevision of Westchester, the current site owner, currently uses the site as a service center.

Emulsified soybean oil (EOS^{TM}, manufactured by EOS Remediation, Inc.) and sodium lactate (WILCLEAR^{TM} High Purity Sodium Lactate, manufactured by JRW Technologies, Inc.) were injected into site groundwater in 2003 as a pilot test and as an Interim Remedial Action (IRA) in 2004. Pilot study results indicate that the EOS^{TM} and WILCLEAR^{TM} injections were successful in stimulating in-situ anaerobic biodegradation of Freon 113.

There are several industrial, manufacturing, and warehousing facilities within an approximate 500-foot radius of the site including: a dry cleaner, automotive and welding facilities, an auto collision shop, a furniture restoration and stripping facility, a garbage hauling facility, and other general light industrial businesses. There are also six residential properties within the 500-foot radius. Surrounding the industrialized area, the dominant land use is medium- and high-density residential.

Topography in the immediate vicinity of the site is generally flat, although the ground surface gradually slopes northwest toward the Sheldrake River. Based upon differences in elevation between site wells and stream gauging points, there is approximately 10 feet of relief between the site and the Sheldrake River. The surface of the site is almost entirely paved or covered by buildings, although minor grassy areas exist along median strips between sidewalks and roadways.

Surface water at the former EMCA site drains into the Sheldrake River drainage basin of the lower Long Island Sound watershed. The site lies within the 100-year floodplain of the

Sheldrake River. The Sheldrake River discharges into the Mamaroneck River, which in turn discharges to the Atlantic Ocean at Mamaroneck Harbor. The Sheldrake River is classified by the New York State Department of Environmental Conservation (NYSDEC) as a "Class C" water body in Title 6 Parts 701 (Article 9) and 935 (Article 18) of the New York Code of Rules and Regulations (NYCRR). This classification indicates these waters are suitable for fishing and primary and secondary contact recreation, although other factors may limit the use for these purposes. Surface drainage is primarily controlled by a storm sewer system that likely conveys stormwater to the Sheldrake River via subsurface pipes.

Overburden stratigraphy at the site is characterized by unconsolidated glacial and alluvial deposits composed predominantly of sand, with localized zones of gravel, silt, and clay. The deepest site boring (GZ-8) was advanced to 32 feet below ground surface (bgs) and did not encounter bedrock. Generally, the top 3 to 5 feet of the overburden deposits consist of sand-gravel-silt mixtures, have been disturbed (i.e., excavated or regraded), and may contain fill (i.e., asphalt, concrete, cobbles, wood, and glass). Beneath the surficial deposits lie several feet of finer textured sand-silt-clay deposits to a depth of approximately 10 feet bgs.

2.0 EXPOSURE ASSESSMENT

According to Appendix 3B of the Draft DER Technical Guidance for Site Investigation and Remediation (NYSDEC 2000b), an exposure pathway has five elements:

1. A contaminant source
2. Contaminant release and transport mechanisms
3. A point of exposure
4. A route of exposure
5. A receptor population

An exposure pathway is complete when all five elements comprising an exposure pathway are documented. A potential exposure pathway exists when any one or more of the five elements comprising an exposure pathway is not documented. An exposure pathway may be eliminated from further evaluation when any one of the five elements comprising an exposure pathway has not existed in the past, does not exist in the present, and will never exist in the future. Each element of the exposure pathway is discussed below.

2.1 <u>Contaminant Source</u>

As discussed in the Final Engineering Evaluation/Cost Analysis (EE/CA), groundwater beneath the former EMCA site contains Freon 113, Freon 123a, and Freon 1113, which can be attributed to past operations at the site (URS 2004). Groundwater occurs in unconsolidated sand at a depth of approximately 4 to 6 feet bgs. Shallow groundwater flow is generally towards the west and northwest at a horizontal gradient of approximately 0.005 foot/foot across the site. The average horizontal hydraulic conductivities for the shallow portion of the water table aquifer calculated from slug tests performed on site wells in July 2001 ranged from approximately 7×10^{-3} centimeter/second (cm/s) to 2×10^{-2} cm/s.

Results of the most recent sampling event (July 2004) are summarized in Table F-1, which indicate that Freon 113 concentrations in on-site wells MW-02, MW-03, MW-06, MW-07, and GZ-06 exceeded the NYSDEC Class GA Groundwater Standard of 5 micrograms per liter (μg/L) (NYSDEC 2000a). Groundwater samples from downgradient monitoring wells MW-04 and MW-05, which is off site, have not contained Freon 113, Freon 123a, and Freon 1113 at concentrations above 5 μg/L prior to the injections and afterwards.

A review of local potable water supplies was previously conducted and documented in the report entitled *Risk Assessment, Former EMCA Site, Mamaroneck, New York* (WCC 1989). This review indicated that the primary water supply for Southern Westchester County was obtained from the New York City water supply system, which is taken from a reservoir greater than 8 miles from the site. There were no known domestic groundwater users within a ½-mile radius of the site, and the closest potential potable water source is the Sheldrake Reservoir, located approximately 1.5 miles upstream from the site. At the time of the study, the Sheldrake Reservoir was used as an emergency water source only.

A Remedial Investigation (RI) Report (URS 2000) and the Final EE/CA demonstrated that soil (surface and subsurface) and ambient air at the former EMCA Site are not media of concern under the current use scenario.

2.2 Contaminant Release and Transport Mechanism

In 1989, a risk assessment (WWC 1989) was performed to assess the potential for chemical contaminants from the former EMCA site to adversely impact human health or the environment. The following potential migration pathways were identified:

- Direct seepage of site groundwater to the Sheldrake River
- Off-site vaporization of VOCs from groundwater and diffusion of these compounds through the soil column into basements

The assessment concluded that there is no significant risk to human health or the environment. The RI confirmed the conclusions made in the risk assessment. The conclusions were augmented by New York State Department of Health (NYSDOH) air sampling results from residential homes and the Cablevision of Westchester facility, which verify that there is low risk to human health from Freon 113 volatilizing into local structures.

The assessment did not consider ingestion of contaminated groundwater to be a complete pathway because there is no current use of groundwater in the vicinity for municipal, domestic, or industrial purposes.

An evaluation of the potential risks to residential users of Freon 113 contaminated groundwater from the site is included as Attachment 1 given the unlikely scenario that groundwater at the site is developed as a potable supply source in the future or construction activities are performed that expose contaminated groundwater.

The known contamination in groundwater can be released in the following way:

- Volatilization into air – this may occur during excavation associated with rehabilitation of underground utilities or future site construction. Use of an approved Health and Safety Plan and Community Air Monitoring Plan will prevent unacceptable releases impacting workers or the surrounding community.
- Development of groundwater as a potable water supply – this may occur if a well(s) is (are) installed for potable water supply.

2.3 Point of Exposure

Exposure could occur to construction workers or residents of the community during site excavation into the contaminated water table. Exposure could also occur to residents if the following conditions are met:

- Groundwater is developed as a potable water supply.
- New wells are installed near the site.
- Contaminated groundwater is pumped by the new wells.

2.4 Route of Exposure

It is theoretically possible that workers or area residents could be exposed to contaminated media in the following ways:

- Inhalation of Freon contaminated air.
- Ingestion of Freon contaminated groundwater.
- Dermal contact with Freon contaminated groundwater.

2.5 Receptor Population

Currently, Cablevision of Westchester uses the site as a service center. The Freon plume is covered with asphalt pavement. During excavation for replacement or rehabilitation of underground utilities, the potential receptor populations will consist of construction workers and area residents. The potential future receptor population would include residents if the contaminated groundwater is developed for use as a potable water supply.

3.0 RESULTS

The only potential exposure pathways relate to excavation at the site (within the plume) or use of contaminated groundwater as a potable water supply. Construction workers or residents could be exposed to Freon contaminated groundwater via ingestion, inhalation, or dermal contact.

A risk calculation was performed for Freon 113 (Attachment 1). Because Freon 113 has not been designated by the USEPA as a possible human carcinogen, only non-carcinogenic risk was calculated.

Reference dose factors for Freon 123a and Freon 1113 are not available from the USEPA and a risk calculation was not performed for these compounds. Table F-2 provides a summary of select acute toxicity data for these compounds.

As shown in Attachment 1, the calculated total hazard index for Freon 113 is less than 1, which indicates that exposure to Freon 113 in contaminated groundwater is not significant. However, the following measures could be implemented to prevent possible future exposure to Freon contaminated groundwater:

- Implementation of health and safety measures that would adequately protect construction workers and residents during excavation activities in the Freon plume.
- Handling and disposal of contaminated soil/groundwater in accordance with all applicable local, State, and Federal laws, regulations, and requirements.

4.0 REFERENCES

NYSDEC. 2000a. *Ambient Water Quality Standards and Guidance Values and Groundwater Effluent Limitations.* Technical and Operational Guidance Series 1.1.1 (TOGS 1.1.1). Albany, NY: Division of Water. April.

NYSDEC. 2000b. *Draft DER-10 Technical Guidance for Site Investigation and Remediation*. Albany, NY: Division of Environmental Remediation. December.

URS. 2000. *Final Draft Remedial Investigation Report, Former EMCA Site, Mamaroneck, New York.* Buffalo, New York. December.

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TABLES

TABLE F-1
FORMER EMCA SITE
GROUNDWATER ANALYTICAL RESULTS FOR FREON (July 22-23, 2004) (1)

Compound	Criteria (2)	GZ-06	MW-02	MW-03	MW-04	MW-05	MW-06	MW-07
Freon 113	5	100	21	4,900	0.7	0.5	140	110
Freon 123a	5	36	4	3,900	ND (3)	ND	23	50
Freon 1113	5	24	14	68	ND	ND	5	210

Notes:

(1) Concentration in ug/L

(2) NYSDEC Class GA Water Quality Standards presented in Technical and Operational Guidance Series (TOGS) 1.1.1, June 1998 (amended April 2000).

(3) ND = Not Detected

Table F-2
Former EMCA Site
Comparison of Select Acute Toxicity Data(1)

Type of Test	Route of Exposure	Species Observed	Dose Data	
			Freon-113	**Freon-123a**
LCLo = Lowest Published Lethal Concentration	Inhalation	Rodent - mouse	230,000 $mg/m^3/2H$	15 pph/2M = 940,000 $mg/m^3/2M$
			Freon-113	**Freon-143**
LCLo = Lowest Published Lethal Concentration	Inhalation	Rodent - rabbit	55.12 ppm/2H = 420 $mg/m^3/2H$	25,000 $mg/m^3/6H$
LCLo = Lowest Published Lethal Concentration	Inhalation	Rodent - guinea pig	4 pph/60M = 310 gm/m3/60M	25 gm/m3/4H
			Freon-113	**Freon-1113**
LC50 - Lethal Concentration, 50% kill	Inhalation	Rodent - rat	38,500 ppm/4H	1,000 ppm/4H
LD50 - Lethal Dose, 50% kill	Oral	Rodent - rat	43,000 mg/Kg	
	Oral	Rodent - mouse		268 mg/Kg
			Freon-113	**Trifluoroethene**
TCLo = Lowest Published Toxic Concentration	Inhalation	Rodent - mouse	393,000 $mg/m^3/1H$	2,000,000 $mg/m^3/2H$

Reference:

(1) Registry of Toxic Effects of Chemical Substances, MDL Information Systems, Inc.

ATTACHMENT 1

I. Exposure Pathway

The potential risk to human health from hypothetical exposure to site groundwater, containing Freon 113, was calculated. The receptors were assumed to be **residents**. Freon 113 has not been designated by USEPA as a possible human carcinogen (i.e. no carcinogenic toxicity values are available). Therefore, only non-carcinogenic risk has been calculated. Based on USEPA's *Risk Assessment Guidance for Superfund, Vol. 1:Environmental Evaluation Manual,* EPA/540/1-89/001, the groundwater intake equations are:

A. Ingestion

Intake = (C_W x IR x EF x ED) / (BW x AT)

Where:

C_W	=	Freon 113 concentration in groundwater (mg/l)
IR	=	ingestion rate (liters/day)
EF	=	exposure frequency (days/year)
ED	=	exposure duration (years)
BW	=	body weight (kg)
AT	=	averaging time (days).

Values of parameters:

C_W	=	4.9 mg/l (maximum concentration of Freon 113 in July 2004)
IR	=	2 liters/day (USEPA 1991)
EF	=	350 days/year (USEPA 1991)
ED	=	24 years for adults; 6 years for children (USEPA 1991)
BW	=	70 kg for adults; 15 kg for children (USEPA 1991)
AT	=	8760 days for adults; 2190 days for children (USEPA 1991)

Reference: USEPA 1991*:Standard Default Exposure Parameters: Human Health Evaluation Manual, Supplemental Guidance,* OSWER Directive 9285.6-03. Cincinnati, OH.

Thus:

Adult Ingestion Intake = 0.1342 mg/kg-day

Child Ingestion Intake = 0.6265 mg/kg-day

B. Inhalation of Indoor Air

Intake = (C_A x IR x EF x ED) / (BW x AT)
Air Concentration (C_A) = C_W x VF

Where:

C_A	=	Freon 113 concentration in indoor air (mg/m^3)
IR	=	inhalation rate (m^3/day)

The remaining parameters are as defined above.

The air concentration is calculated with the use of a volatilization factor (VF), which takes into consideration chemical-specific data, (i.e. diffusivity in air and water, Henry's law constant), and site-specific data, like the depth to groundwater, thickness of vadose zone and capillary fringe, volumetric air- and water-content in the capillary fringe and vadose zone, soil porosity, and air exchange rate in enclosed space. The equation for the volatilization factor and the default parameters for site-specific parameters are given in *Standard Guide for Risk-Based Corrective Action at Petroleum Release Sites* (American Society for Testing and Materials, E 1739-95).

Values of parameters:

IR = 15 m^3/day (USEPA 1991)

VF = 0.109 (mg/m^3 air)/(mg/l water)

C_A = 0.534 mg/m^3 (based on 4.9 mg/l in groundwater, the maximum concentration of Freon 113 in July 2004)

Thus:

Adult Inhalation Intake = <u>0.1097 mg/kg-day</u>

Child Inhalation Intake = <u>0.5122 mg/kg-day</u>

C. Dermal Contact

Based on USEPA's Dermal Exposure Assessment: Principles and Applications, (EPA/600/8-91/011B), the absorbed dose from dermal contact with contaminated groundwater can be expressed as a fraction of the ingestion. The fraction depends on the permeability coefficient (K_p) of the contaminant. For Freon 113 ($K_p = 9.6 \times 10^{-3}$ cm/hr) the dermal dose is 5% of the oral ingestion.

II. Toxicity of Freon 113

Toxicity data for Freon 113 was obtained from the SmartTox database (November 2001). This database compiles toxicity data from USEPA's Integrated Risk Information System and the Health Effects Summary Tables. According to SmartTox, the following toxicity values are available for Freon 113:

Oral Reference Dose (chronic) = 30 mg/kg-day

Oral Reference Dose (subchronic) = 3 mg/kg-day

Inhalation Reference Dose (chronic) = 8.57143 mg/kg-day

Inhalation Reference Dose (subchronic) = 8.57143 mg/kg-day

III. Risk Calculation

Noncancer risks are evaluated by calculating a "hazard quotient". The hazard quotient is a unitless value obtained by dividing the exposure dose (intake) by the reference dose. A hazard quotient of 1 or greater indicates that potential noncancer impacts are possible. The hazard quotient for the hypothetical scenario described above is:

Hazard Index from Ingestion

Adult Oral Intake / Reference Dose = 0.1342 / 30 = 0.0045

Child Oral Intake / Reference Dose = 0.6265 / 3 = 0.2088

Total Hazard Index from Ingestion = 0.0045 + 0.2088 = 0.2133

Hazard Index from Dermal Contact

Total Hazard Index from Dermal Contact = 0.05 x 0.2133 = 0.0107

Hazard Index from Inhalation

Adult Inhalation Intake / Reference Dose = 0.1097 / 8.57143 = 0.0128

Child Oral Intake / Reference Dose = 0.5121 / 8.57143 = 0.0597

Total Hazard Index from Inhalation of indoor vapors = 0.0128 + 0.0597 = 0.0725

Total Hazard Index

Total Hazard Index from Freon 113 in Groundwater = 0.2133 + 0.0107+ 0.0725 = 0.2965

This value is less than 1 indicating that risk due to exposure to Freon 113 in contaminated groundwater at the EMCA site is not significant.