FINAL ANNUAL EFFECTIVENESS MONITORING REPORT No. 6
FOR THE
VESTAL WELL 1-1 TREATMENT FACILITY
WORK ASSIGNMENT NUMBER: 109-RALR-0238

PUMPHOUSE ROAD
VESTAL, NEW YORK

SUBMITTED SEPTEMBER 2003

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1000 The American Road

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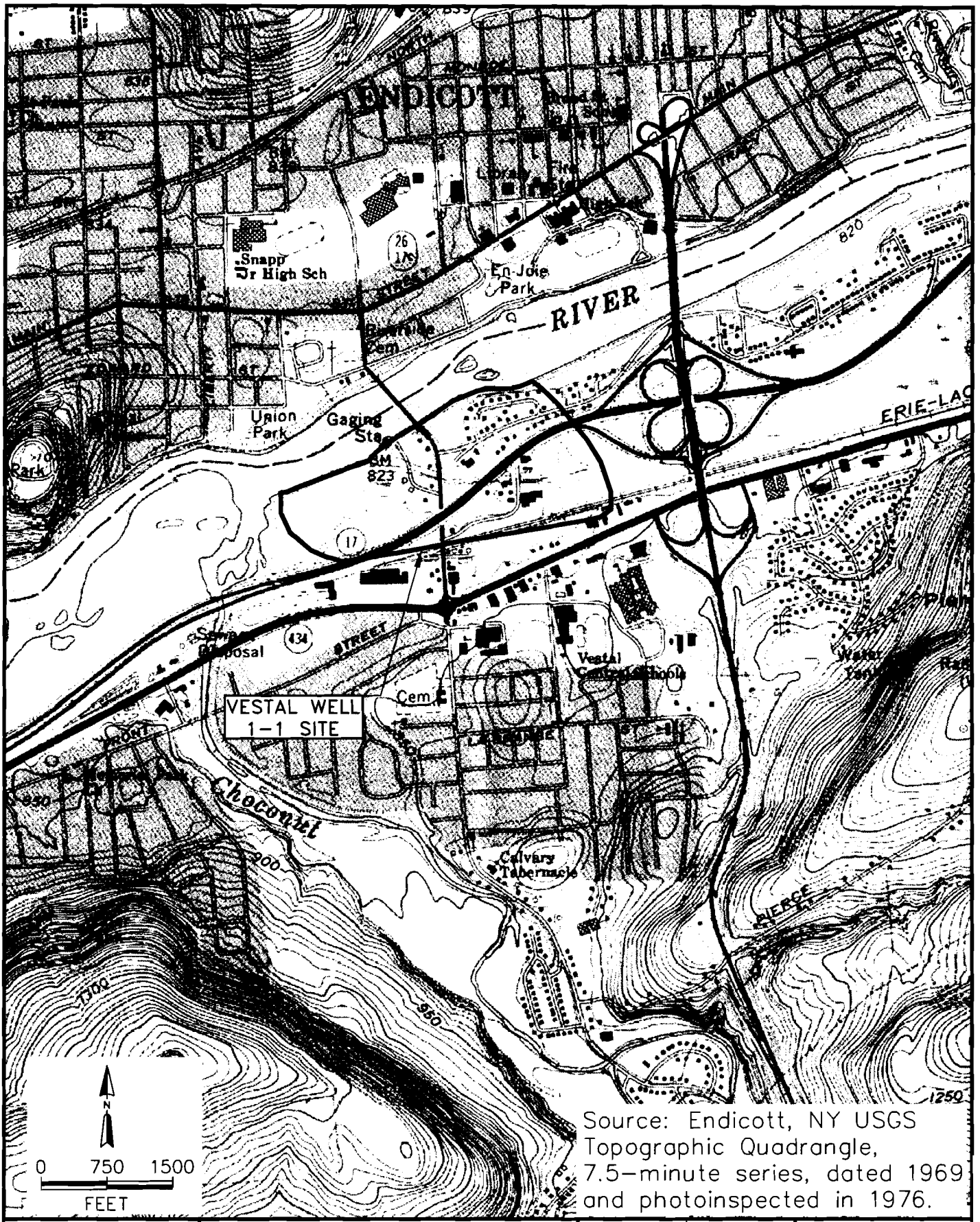
1.0 INTRODUCTION

The Town of Vestal is located in Broome County, New York, approximately five miles southwest of the City of Binghamton, on the south bank of the Susquehanna River. Figure 1-1 depicts the location of the Vestal Well 1-1 site. The Vestal Well 1-1 was one of three production wells (Wells 1-1, 1-2 and 1-3) providing drinking water to several water districts in the Vestal area. Well 1-1 was taken offline in 1980 because of contamination by volatile organic compounds (trichloroethene, 1,1-dichloroethene, 1,1-dichloroethane, 1,1,1-trichloroethane, and trans-1,2-dichloroethene). The construction of an air stripping facility for Well 1-1 was completed by the United States Environmental Protection Agency (USEPA) in early 1991 pursuant to the First Operable Unit (OU-1) Record of Decision (ROD) (USEPA, 1986). Due to problems with Well 1-1, the USEPA constructed a new (replacement) Well 1-1A to a depth of 135 feet below grade with a pumping capacity of 1,150 gallons per minute to ensure successful implementation of the remedy. In March 1995, the USEPA issued a Remedial Action Report, which determined that Well 1-1A and the associated air stripping facility were fully functional and operational as a potable water supply. However, the New York State Department of Environmental Conservation (NYSDEC), which had previously agreed through a cooperative agreement with the USEPA to provide Long-Term Response (LTR) for this facility, was unable to secure a contract with the Town of Vestal. In May 1995, the NYSDEC informed the USEPA that it no longer desired cooperative agreement funds to perform LTR. Therefore, the USEPA performs LTR to restore the groundwater aquifer and discharges the treated water to the Susquehanna River. The Town of Vestal does not use the treated water from Well 1-1A.

The OU-1 ROD also recommended that a Second Operable Unit (OU-2) Remedial Investigation/Feasibility Study (RI/FS) be undertaken to evaluate suspected contaminant source areas upgradient of Well 1-1. The USEPA initiated this RI/FS in November 1988. A Second (OU-2) ROD was signed on 28 September 1990, selecting *in situ* vacuum extraction as the remedy for two discrete areas of soil contamination, i.e., Area 2 and Area 4, located in the Stage Road Industrial Park. These are the predominant sources of contamination of Well 1-1.

USEPA completed remedial design activities for Area 2 in September 1994 and entered into an IAG with the U.S. Army Corps of Engineers to implement the Area 2 remedial action (RA). The U.S. Army Corps of Engineers started construction of the soil vacuum extraction (SVE) system in October 1996 and completed construction in January 1997. The Area 2 SVE system operation was terminated in November 2000, after the results of the Interim Soil Sampling Program confirmed that the SVE successfully achieved ROD cleanup goals. Construction of a SVE system in Area 4 was initiated on 1 April 2003. This system started operation on 28 June 2003 and is still operating. As of 8 September 2003, approximately 600 pounds of VOCs were removed.



Source: Endicott, NY USGS Topographic Quadrangle, 7.5-minute series, dated 1969 and photoinspected in 1976.

TETRA TECH FW, INC.	TITLE: Site Map Vestal Well 1-1 Site Vestal, New York	DWN: CTS	DES.: CTS	PROJECT NO.: 1945.2109.0700
		CHKD: CEM	APPD: HR	FIGURE NO.: 1-1
		DATE: 03/09/04	REV.: 1	

N:\GIS\GISKEY\GISPROJ31\VESTAL-SURVEYED\FIGURE 1-1 030904.DWG

The monitoring for OU-1 LTR consists of both monthly treatment system performance monitoring and annual groundwater effectiveness monitoring. The performance monitoring criteria are designed to evaluate the performance of the treatment system and determine whether the treated water meets the requirements for discharge to the Susquehanna River (New York State Freshwater Groundwater [Class GA] Effluent Limitations). The effectiveness monitoring criteria are designed to assess the effectiveness of groundwater contamination plume capture by Well 1-1A and determine the progress of groundwater restoration with respect to the New York State Groundwater Quality Criteria (NYSGWQC).

Table 1-1 highlights the New York State Class GA Groundwater Effluent Limitations and the New York State Class GA Groundwater Quality Criteria for the site contaminants of concern (COCs).

Table 1-1

NYS Groundwater Effluent Limitations and Groundwater Quality Criteria For the Site Contaminants of Concern

Constituent	NYS GA Groundwater Effluent Limitations (µg/L)	NYS GA Groundwater Quality Criteria (µg/L)
Chloroform	7	7
1,1-dichloroethane	5	5
1,1-dichloroethene	5	5
Trans-1,2-dichloroethene	5	5
1,1,1-trichloroethane	5	5
Trichloroethene	5	5
Total Volatile Organics	100	100
Chromium	100	50
Copper	1,000	200
Lead	50	25
Mercury	1.4	0.7
Nickel	200	100
Zinc	5,000	2,000

µg/L - micrograms per liter

This Effectiveness Monitoring Report No. 6 presents the results of the effectiveness monitoring sampling conducted during May 2003.

2.0 TECHNICAL APPROACH

2.1 Description of Sampling and Analysis Program Plan

The wells selected for performing the effectiveness monitoring sampling, as presented in the original ROD, are Wells S-1, S-2, S-6, S-7, S-8, S-11, EB-1, EB-31, EB-33, EB-41, EB-42, 1-22, 1-24, 1-29, and 1-29A (15 wells) as shown on Figure 2-1. Monitoring well EB-1 was not located and has been replaced by monitoring well 1-32A. In addition, a deep monitoring well (1-32) was installed at the same location. Therefore, a total of 16 groundwater monitoring wells were sampled during the May 2003 sampling event to evaluate the effectiveness of the remediation. Monitoring wells 1-23, 1-25, 1-25A, 1-30, and 1-30A have been located on the map to provide additional groundwater level data.

During each sampling round, groundwater purging operations and subsequent groundwater sample collection were conducted in accordance with the USEPA Region 2 Low Stress Method using adjustable-rate stainless-steel submersible pumps equipped with dedicated tubing. The stainless steel submersible pump, with polyethylene tubing and safety line was gently lowered into the well casing, to approximately the mid-point of the saturated screen level (target sampling zone). Following the installation of the pumping equipment, a water level measurement was recorded using an electronic water level indicator. These measurements were taken cautiously to the extent practicable, in order to cause minimum turbulence to the static water level. After the water level was recorded, groundwater in each monitoring well was purged. During the purging operations, the pump speed was adjusted to achieve minimal stabilized drawdown, to the extent practicable. In case the drawdown could not be stabilized, the pumping rate was reduced to the minimum allowed by the equipment. The groundwater purging was accompanied by the periodic (average of 3 to 6 minutes) measurement of the field indicator parameters including pH, temperature, specific conductivity, dissolved oxygen, turbidity, and oxidation-reduction potential (Eh) using a Horiba U-22 meter. Once the field parameters were considered to be stabilized within the limits specified in the USEPA's Low Stress Method, groundwater samples were collected from respective monitoring wells directly from the tubing into sampling vials/jars. The field log book notes, including the groundwater purging/sample data and field parameter results, are included in Appendix A.

Upon completion of sampling, the sampling jar/vials were placed in coolers with ice and maintained at 4° Celsius. Prior to overnight shipment of the sample to the analytical laboratory, sample labels were completed with sample identification number, project name/number, date, time and parameters and then placed on the sample jars/vials. The samples were wrapped with bubble wrap and placed in the coolers with the completed chain of custody and secured with shipping tape and tamper-proof labels.

Groundwater samples from all wells sampled were analyzed for Target Compound List volatile organics for all wells. Target Analyte List metals were analyzed for Wells 1-22, 1-24, 1-29 and 1-29A to evaluate the effectiveness of groundwater cleanup. The sample collection, handling, shipping and analytical protocols are presented in Appendix A, Monitoring Plan of the O&M Manual TtFW, February 1996)

2.2 Field Blank, Trip Blank and Duplicate Samples

Field blank, trip blank and duplicate samples were utilized to establish quality assurance of sampling methodology and laboratory analyses. A field blank sample consisting of distilled water poured through decontaminated field equipment was collected daily.

A trip blank sample, supplied by the laboratory, accompanied each shipment of samples to the laboratory.

A duplicate groundwater sample was collected from monitoring well 1-29 (VE-S-29-052003). The laboratory analyzed the sample for VOCs. The analyte concentrations reported for the duplicates demonstrated acceptable levels of measurement precision.

2.3 Sample Analysis and Data Validation

Groundwater samples were collected by Tetra Tech FW, Inc. (TtFW) from 16 groundwater monitoring wells (S-1, S-2, S-6, S-7, S-8, S-11, EB-31, EB-33, EB-41, EB-42, 1-22, 1-24, 1-29, 1-29A, 1-32, and 1-32A). The samples were shipped to the Ecology and Environment, Inc. for analysis. Data validation was performed by TtFW. The validation report is included in Appendix B. The laboratory data were evaluated according to USEPA Region 2 Functional Guidelines (SOW HW-6, Rev 8, CLP Organics Data Review and Preliminary Review, January, 1992).

The validation determined that the data in the report should be considered technically defensible and completely usable, except for those samples noted in the report.

3.0 EVALUATION OF SAMPLING RESULTS

3.1 Analytical Results

The groundwater sampling results from the May 2003 sampling event indicate several COCs above NYSGWQC standards at the site. The COCs exceeding NYSGWQC include 1,1,1-trichloroethane, 1,1-dichloroethane, 1,1-dichloroethylene, cis-1,2-dichloroethylene, trichloroethylene, and vinyl chloride. Table 3-1 summarizes the detected compounds and site COCs and compares them to the NYSGWGC. Figure 3-1 presents the constituents detected above the NYSGWQC for each well sampled in May 2003. Figure 3-2 depicts the iso-concentration contours for total VOCs. Based on the May 2003 groundwater sampling, the current aerial extent of site COCs appears to originate in the area of Operable Units 2 and 4, and has migrated northwest toward the treatment system. The data indicates that contaminants have not impacted the wells adjacent to the Susquehanna River. The downgradient wells 1-22 and 1-24, which are the closest to the current Vestal water supply well, were detected with low VOC concentrations below the groundwater quality criteria. The validated raw analytical data are presented in Appendix B.

As Figure 3-1 illustrates, the highest concentrations of VOCs were detected in groundwater samples collected from the monitoring wells directly downgradient from Areas 2 and 4 (i.e., EB-33, S-2, S-7, and S-11). This indicates that these areas were the source of the groundwater contamination. Table 3-1 shows that site inorganic COCs chromium, copper, lead, mercury, nickel, and zinc concentrations were below the NYSGWQC. Iron and sodium concentrations exceeded the NYSGWQC in monitoring wells 1-22, 1-24, 1-29, and 1-29A; however, iron and sodium are not COCs.

The groundwater analytical results indicate that nearly all of the wells (EB-31, EB-33, 1-29,S-2, S-6, S-7, and S-11) detected with COC concentrations above the groundwater quality criteria are installed in the shallow groundwater zone. Well 1-29 is the only deep monitoring well detected with exceedances of the groundwater quality criteria for 1,1,1-trichloroethane, 1,1-dichloroethane, and cis-1,2-dichloroethylene.

A comparison of the total VOC concentrations at each monitoring well with the results of the initial and first through sixth annual effectiveness monitoring events is presented in Table 3-2. The total VOC concentrations at S-1, S-7, S-8, S-11, EB-31, EB-33, and EB-41 decreased from the previous year, total VOC concentrations at S-2, S-6, 1-29, and 1-29A increased from the previous year, and the total VOC concentrations in the other wells remained relatively the same. The total VOC concentrations and associated iso-concentration contours from the May 2003 effectiveness monitoring results are shown in Figure 3-2 as well as the 100 ug/L total VOC iso-concentration contour from 2002. Figure 3-3 presents the individual VOCs detected in each well in May 2003.

The decreasing concentrations of total VOCs and distribution of TCE daughter products indicate that natural attenuation is likely occurring in the downgradient monitoring wells. The distribution of daughter products present in the groundwater at the site are indicative of reductive dechlorinization processes. However, it must also be noted that reduction of VOC concentrations since the previous groundwater sampling event in October 2002 may be enhanced due to dilution from increased precipitation. During the October 2002 sampling event, the northeastern United States was at the end of a significant dry period which would result in lower groundwater elevations and less water volume in the aquifer. Between October 2002 and May 2003, the region experienced significant precipitation events which increased the amount

of storage within the aquifer and increased groundwater elevation. The additional water volume would dilute the VOC concentrations and reduce the concentrations of COCs when compared to results from previous sampling rounds. Overall, the results over the last seven years indicate that total VOCs have generally decreased across the site due to the groundwater extraction, reductive dechlorinization, and dilution. The overall configuration of the plume suggests that the slug of highest contamination is beginning to migrate toward the extraction wells.

Field Blanks

The laboratory analyzed four field blank samples (VE-FB-052003, VE-FB-052103, VE-FB-052203, and VE-FB-052303) for volatile organic compounds (VOCs) and one field blank sample (VE-FB-052003) for dissolved metals. Laboratory analysis of groundwater samples indicate concentrations of acetone, bromodichloromethane, bromoform, carbon disulfide, chloroform, chloromethane, cis-1,2-dichloroethylene, and trichloroethylene below groundwater quality criteria in the field blank samples. Aluminum, barium, calcium, chromium, cobalt, copper, iron, magnesium, manganese, nickel, potassium, sodium, and zinc were detected in the field blank samples at concentrations below groundwater quality criteria.

Trip Blanks

The laboratory analyzed four trip blank samples (VE-TB-052003, VE-TB-052103, VE-TB-052203, and VE-TB-052303) for VOCs. The laboratory analysis indicated concentrations detections of bromoform, chloromethane, methyl chloride, and toluene below groundwater quality criteria in the trip blank samples.

3.2 Field Parameter Measurement Results

Table 3-3 presents the field parameters measured during groundwater sampling activities. An evaluation of the groundwater field parameters for indications of natural attenuation of the VOCs will be performed in the 2004 Annual Effectiveness Report.

3.3 Groundwater Level Measurements

On 19 May 2003, TtFW personnel measured the depth to groundwater in 21 wells. Table 3-4 presents the depth to groundwater, well casing reference surveyed elevations, total depth of monitoring wells, and calculated groundwater elevations.

Figure 3-4 depicts the groundwater surface elevation map generated from the wells screened in the upper hydrostratigraphic unit. Monitoring wells 1-23, 1-24, 1-29, 1-30, and 1-32 are screened in the deeper hydrostratigraphic unit and are not used on the shallow groundwater surface elevation map. The shallow groundwater flow is northwest toward the Susquehanna River. The plume is flowing in the direction of shallow groundwater flow and is being captured by the downgradient pumping well.

A deep groundwater potentiometric surface map was created using the monitoring wells 1-22, 1-23, 1-24, 1-25, 1-29, 1-30, and 1-32 (Figure 3-5). The deep groundwater direction is flowing to the northeast toward the Susquehanna River and pumping well based on the limited data points in the current deep monitoring well network. The deep groundwater potentiometric surface has a generally low gradient with the exception of monitoring well 1-22 which is exhibiting mounding.

An evaluation of groundwater elevation measurements from the four well clusters indicates that vertical groundwater flow is generally from the shallow to deep groundwater zones in well clusters 1-29 and 1-29A and 1-30 and 1-30A. The well cluster, 1-25 and 1-25A has an upward groundwater flow. The 1-32 and

1-32A well cluster indicates a very strong upward flow which is due to the groundwater mounding in the deep well 1-32.

The mounding in well 1-32 is likely the result of artificial recharge to the well. During the May 2003 monitoring event, field personnel noted that the well cap for 1-32 was not securely fastened. It is possible that the mounding is the result of surface runoff entering the monitoring well at the surface. In order to verify the temporary nature of the mounding, measurements were collected from 1-32 and 1-32A in December 2003. The difference in groundwater elevations between monitoring wells 1-32 and 1-32A was approximately 0.5 feet, rather than the over 12 foot difference noted in May 2003. Therefore, the mounding noted in monitoring well 1-32 was a temporary condition likely due to the well cap.

3.4 Plant Operations and Sampling

Table 3-5 presents information on plant pumping rates and sample results since the last Annual Effectiveness Monitoring performed in September 2002. An evaluation of the plant operations and sampling including apparent data trends will be performed in the 2004 Annual Effectiveness Report.

Table 3-1 (Sheet 1 of 14)
Comparison of Detected Compounds to NYS GA Groundwater Quality Criteria

Sample Location Sample ID Sample Date Units	New York Groundwater Quality Criteria	EPA Drinking Water Regulations (MCLs)	1-22 VE-1-22-052003 05/20/2003 ug/l	1-24 VE-1-24-052003 05/20/2003 ug/l	1-29 VE-1-29-052003 05/20/2003 ug/l	1-29 VE-S-29-052003 05/20/2003 ug/l
Constituents						
1,1,1-Trichloroethane	5	200	ND	4.39	**80.6D**	**60.1D**
1,1,2-Trichloro-1,2,2-trifluoroethane	NS	NS	ND	0.118J	3.89	3.81
1,1,2-Trichloroethane	1	5	ND	ND	ND	ND
1,1-Dichloroethane	5	NS	ND	0.91	**8.85**	**8.66**
1,1-Dichloroethylene	5	7	ND	ND	**6.21**	**6.22**
Benzene	1	5	0.536	ND	ND	0.132J
Bromodichloromethane	50	80	ND	ND	ND	ND
Bromoform	50	80	ND	ND	ND	ND
Carbon disulfide	NS	NS	ND	ND	ND	ND
Chloroethane	5	NS	ND	ND	ND	ND
Chloroform	7	80	ND	ND	ND	ND
Chloromethane	5	NS	0.336BJ	ND	ND	ND
cis-1,2-Dichloroethylene	5	70	ND	1.19	**58.6D**	**50.3D**
Dibromochloromethane	50	80	ND	ND	ND	ND
Dichlorodifluoromethane	NS	NS	ND	ND	ND	ND
Ethylbenzene	5	700	ND	ND	ND	ND
Isopropylbenzene	NS	NS	ND	ND	ND	ND
Methyl tert-butyl ether	NS	NS	ND	ND	0.182J	0.19J
Methylene chloride	5	5	ND	ND	ND	ND
Tetrachloroethene	5	5	ND	ND	ND	ND
Toluene	5	1000	0.965	ND	0.179J	0.148J
trans-1,2-Dichloroethylene	5	100	ND	ND	0.242J	0.18J
Trichloroethene	5	5	ND	ND	**41.5D**	**33.4D**
Vinyl chloride	2	2	ND	ND	ND	ND
Xylene (Total)	5	10000	ND	ND	ND	ND
Aluminum	NS	NS	108B	46.6B	127B	139B
Arsenic	25	0.4	8.1B	ND	8.3B	8.1B
Barium	1000	5500	11B	7.7B	51.3B	50.2B
Beryllium	3	160	ND	0.26B	ND	ND
Calcium	NS	NS	59700	53300	115000	115000
Chromium	50	230	R	R	R	R

Table 3-1 (Sheet 2 of 14)
Comparison of Detected Compounds to NYS GA Groundwater Quality Criteria

Sample Location Sample ID Sample Date Units	New York Groundwater Quality Criteria	EPA Drinking Water Regulations (MCLs)	1-22 VE-1-22-052003 05/20/2003 ug/l	1-24 VE-1-24-052003 05/20/2003 ug/l	1-29 VE-1-29-052003 05/20/2003 ug/l	1-29 VE-S-29-052003 05/20/2003 ug/l
Constituents						
Cobalt	NS	NS	1.5B	0.96B	4.3B	4.6B
Copper	200	NS	3.3B	2.6B	2.4B	3.5B
Iron	300	NS	**9630EJ**	R	**5740EJ**	**6870EJ**
Lead	25	400	ND	ND	5J	11.9J
Magnesium	35000	NS	80.2B	8420	19100	19000
Manganese	300	NS	65.6	16.9	44.1	48
Mercury	0.7	23	0.11B	ND	ND	ND
Nickel	100	1600	7.4B	ND	4.7B	4.5B
Potassium	NS	NS	4220B	1130B	1600B	1650B
Selenium	10	390	ND	ND	R	R
Sodium	20000	NS	**24700**	**23100**	**67000**	**66300**
Zinc	2000	23000	16B	25.5	9B	11.1B

Notes:

ND - Non-detect

NA - Not analyzed

NS - No Standard

J - Estimated

B (organics) - Found in blank

B (inorganics) - Concentration is greater than the instrument detection limit but less than the contract required detection limit

D - Dilution

R - Rejected

E - Estimated due to interference

ug/l - microgram per liter

BOLD - Exceeds New York Groundwater Quality Criteria

Table 3-1 (Sheet 3 of 14)
Comparison of Detected Compounds to NYS GA Groundwater Quality Criteria

Sample Location Sample ID Sample Date Units	New York Groundwater Quality Criteria	EPA Drinking Water Regulations (MCLs)	1-29A VE-1-29A-052003 05/20/2003 ug/l	1-32 VE-1-32R-052203 05/22/2003 ug/l	1-32A VE-1-32AR-052203 05/22/2003 ug/l
Constituents					
1,1,1-Trichloroethane	5	200	**9.93**	ND	ND
1,1,2-Trichloro-1,2,2-trifluoroethane	NS	NS	0.888	ND	ND
1,1,2-Trichloroethane	1	5	ND	ND	ND
1,1-Dichloroethane	5	NS	**9.45**	ND	ND
1,1-Dichloroethylene	5	7	2.26	ND	ND
Benzene	1	5	ND	ND	ND
Bromodichloromethane	50	80	ND	ND	ND
Bromoform	50	80	ND	ND	ND
Carbon disulfide	NS	NS	ND	0.578	ND
Chloroethane	5	NS	ND	ND	ND
Chloroform	7	80	ND	ND	0.144J
Chloromethane	5	NS	ND	ND	ND
cis-1,2-Dichloroethylene	5	70	**22.4**	ND	ND
Dibromochloromethane	50	80	ND	ND	ND
Dichlorodifluoromethane	NS	NS	ND	ND	ND
Ethylbenzene	5	700	ND	ND	ND
Isopropylbenzene	NS	NS	ND	ND	ND
Methyl tert-butyl ether	NS	NS	ND	ND	ND
Methylene chloride	5	5	ND	ND	ND
Tetrachloroethene	5	5	ND	ND	ND
Toluene	5	1000	ND	ND	ND
trans-1,2-Dichloroethylene	5	100	0.132J	ND	ND
Trichloroethene	5	5	4.12	ND	ND
Vinyl chloride	2	2	ND	ND	ND
Xylene (Total)	5	10000	ND	ND	ND
Aluminum	NS	NS	ND	NA	NA
Arsenic	25	0.4	7.7B	NA	NA
Barium	1000	5500	41.9B	NA	NA
Beryllium	3	160	ND	NA	NA
Calcium	NS	NS	108000	NA	NA
Chromium	50	230	R	NA	NA

Table 3-1 (Sheet 4 of 14)
Comparison of Detected Compounds to NYS GA Groundwater Quality Criteria

Sample Location Sample ID Sample Date Units	New York Groundwater Quality Criteria	EPA Drinking Water Regulations (MCLs)	1-29A VE-1-29A-052003 05/20/2003 ug/l	1-32 VE-1-32R-052203 05/22/2003 ug/l	1-32A VE-1-32AR-052203 05/22/2003 ug/l
Constituents					
Cobalt	NS	NS	ND	NA	NA
Copper	200	NS	2B	NA	NA
Iron	300	NS	**1840EJ**	NA	NA
Lead	25	400	ND	NA	NA
Magnesium	35000	NS	19400	NA	NA
Manganese	300	NS	**348**	NA	NA
Mercury	0.7	23	ND	NA	NA
Nickel	100	1600	1.9B	NA	NA
Potassium	NS	NS	1600B	NA	NA
Selenium	10	390	R	NA	NA
Sodium	20000	NS	**68000**	NA	NA
Zinc	2000	23000	4.8B	NA	NA

Notes:

ND - Non-detect

NA - Not analyzed

NS - No Standard

J - Estimated

B (organics) - Found in blank

B (inorganics) - Concentration is greater than the instrument detection limit but less than the contract required detection limit

D - Dilution

R - Rejected

E - Estimated due to interference

ug/l - microgram per liter

BOLD - Exceeds New York Groundwater Quality Criteria

Table 3-1 (Sheet 5 of 14)
Comparison of Detected Compounds to NYS GA Groundwater Quality Criteria

Sample Location Sample ID Sample Date Units	New York Groundwater Quality Criteria	EPA Drinking Water Regulations (MCLs)	EB-31 VE-EB-31-052103 05/21/2003 ug/l	EB-33 VE-EB-33-052103 05/21/2003 ug/l	EB-41 VE-EB-41-052103 05/21/2003 ug/l	EB-42 VE-EB-42-052103 05/21/2003 ug/l
Constituents						
1,1,1-Trichloroethane	5	200	0.316J	0.85	ND	0.77
1,1,2-Trichloro-1,2,2-trifluoroethane	NS	NS	0.522	23	ND	ND
1,1,2-Trichloroethane	1	5	ND	ND	ND	ND
1,1-Dichloroethane	5	NS	4.02	**5.1**	0.349J	ND
1,1-Dichloroethylene	5	7	1.95	ND	ND	ND
Benzene	1	5	ND	ND	ND	ND
Bromodichloromethane	50	80	ND	ND	ND	0.1J
Bromoform	50	80	ND	ND	ND	ND
Carbon disulfide	NS	NS	ND	ND	ND	ND
Chloroethane	5	NS	ND	ND	ND	ND
Chloroform	7	80	ND	ND	ND	ND
Chloromethane	5	NS	ND	ND	ND	ND
cis-1,2-Dichloroethylene	5	70	**8.2**	**120D**	4.94	ND
Dibromochloromethane	50	80	0.628J	0.607J	0.509J	0.575J
Dichlorodifluoromethane	NS	NS	ND	0.376J	ND	ND
Ethylbenzene	5	700	ND	0.406J	ND	ND
Isopropylbenzene	NS	NS	ND	0.444J	ND	ND
Methyl tert-butyl ether	NS	NS	ND	ND	1.76	ND
Methylene chloride	5	5	ND	ND	ND	ND
Tetrachloroethene	5	5	ND	0.531	ND	ND
Toluene	5	1000	ND	ND	ND	ND
trans-1,2-Dichloroethylene	5	100	0.311J	2.13	ND	ND
Trichloroethene	5	5	**44.9D**	**8.16**	0.86	ND
Vinyl chloride	2	2	0.655	**14.6**	ND	ND
Xylene (Total)	5	10000	ND	0.112J	ND	ND
Aluminum	NS	NS	NA	NA	NA	NA
Arsenic	25	0.4	NA	NA	NA	NA
Barium	1000	5500	NA	NA	NA	NA
Beryllium	3	160	NA	NA	NA	NA
Calcium	NS	NS	NA	NA	NA	NA
Chromium	50	230	NA	NA	NA	NA

Table 3-1 (Sheet 6 of 14)
Comparison of Detected Compounds to NYS GA Groundwater Quality Criteria

Sample Location Sample ID Sample Date Units	New York Groundwater Quality Criteria	EPA Drinking Water Regulations (MCLs)	EB-31 VE-EB-31-052103 05/21/2003 ug/l	EB-33 VE-EB-33-052103 05/21/2003 ug/l	EB-41 VE-EB-41-052103 05/21/2003 ug/l	EB-42 VE-EB-42-052103 05/21/2003 ug/l
Constituents						
Cobalt	NS	NS	NA	NA	NA	NA
Copper	200	NS	NA	NA	NA	NA
Iron	300	NS	NA	NA	NA	NA
Lead	25	400	NA	NA	NA	NA
Magnesium	35000	NS	NA	NA	NA	NA
Manganese	300	NS	NA	NA	NA	NA
Mercury	0.7	23	NA	NA	NA	NA
Nickel	100	1600	NA	NA	NA	NA
Potassium	NS	NS	NA	NA	NA	NA
Selenium	10	390	NA	NA	NA	NA
Sodium	20000	NS	NA	NA	NA	NA
Zinc	2000	23000	NA	NA	NA	NA

Notes:

ND - Non-detect

NA - Not analyzed

NS - No Standard

J - Estimated

B (organics) - Found in blank

B (inorganics) - Concentration is greater than the instrument detection limit but less than the contract required detection limit

D - Dilution

R - Rejected

E - Estimated due to interference

ug/l - microgram per liter

BOLD - Exceeds New York Groundwater Quality Criteria

Table 3-1 (Sheet 7 of 14)
Comparison of Detected Compounds to NYS GA Groundwater Quality Criteria

Sample Location Sample ID Sample Date Units	New York Groundwater Quality Criteria	EPA Drinking Water Regulations (MCLs)	S-1 VE-S-1-052303 05/23/2003 ug/l	S-2 VE-S-2-052203 05/22/2003 ug/l	S-6 VE-S-6-052203 05/22/2003 ug/l	S-7 VE-S-7-052303 05/23/2003 ug/l
Constituents						
1,1,1-Trichloroethane	5	200	ND	**57.9D**	ND	**135D**
1,1,2-Trichloro-1,2,2-trifluoroethane	NS	NS	ND	20.9D	0.352J	0.183J
1,1,2-Trichloroethane	1	5	ND	ND	ND	ND
1,1-Dichloroethane	5	NS	ND	**85.5D**	0.426J	**39.3D**
1,1-Dichloroethylene	5	7	ND	**24.3**	ND	**8.27**
Benzene	1	5	ND	0.993	ND	0.147J
Bromodichloromethane	50	80	ND	ND	ND	ND
Bromoform	50	80	ND	ND	ND	ND
Carbon disulfide	NS	NS	ND	ND	ND	ND
Chloroethane	5	NS	ND	ND	ND	ND
Chloroform	7	80	ND	ND	ND	ND
Chloromethane	5	NS	ND	ND	ND	ND
cis-1,2-Dichloroethylene	5	70	0.171J	**320D**	**23D**	**38.4D**
Dibromochloromethane	50	80	ND	ND	0.31J	ND
Dichlorodifluoromethane	NS	NS	ND	0.692	ND	ND
Ethylbenzene	5	700	ND	0.113J	ND	ND
Isopropylbenzene	NS	NS	ND	0.342J	ND	ND
Methyl tert-butyl ether	NS	NS	2.36	0.946	ND	ND
Methylene chloride	5	5	ND	ND	ND	ND
Tetrachloroethene	5	5	ND	ND	ND	ND
Toluene	5	1000	ND	2.36	ND	0.281J
trans-1,2-Dichloroethylene	5	100	ND	1.83J	ND	0.769
Trichloroethene	5	5	0.356J	**34D**	**53.8D**	**23.7**
Vinyl chloride	2	2	ND	**191D**	0.475J	**40.3D**
Xylene (Total)	5	10000	ND	0.308J	ND	0.139J
Aluminum	NS	NS	NA	NA	NA	NA
Arsenic	25	0.4	NA	NA	NA	NA
Barium	1000	5500	NA	NA	NA	NA
Beryllium	3	160	NA	NA	NA	NA
Calcium	NS	NS	NA	NA	NA	NA
Chromium	50	230	NA	NA	NA	NA

Table 3-1 (Sheet 8 of 14)
Comparison of Detected Compounds to NYS GA Groundwater Quality Criteria

Sample Location Sample ID Sample Date Units	New York Groundwater Quality Criteria	EPA Drinking Water Regulations (MCLs)	S-1 VE-S-1-052303 05/23/2003 ug/l	S-2 VE-S-2-052203 05/22/2003 ug/l	S-6 VE-S-6-052203 05/22/2003 ug/l	S-7 VE-S-7-052303 05/23/2003 ug/l
Constituents						
Cobalt	NS	NS	NA	NA	NA	NA
Copper	200	NS	NA	NA	NA	NA
Iron	300	NS	NA	NA	NA	NA
Lead	25	400	NA	NA	NA	NA
Magnesium	35000	NS	NA	NA	NA	NA
Manganese	300	NS	NA	NA	NA	NA
Mercury	0.7	23	NA	NA	NA	NA
Nickel	100	1600	NA	NA	NA	NA
Potassium	NS	NS	NA	NA	NA	NA
Selenium	10	390	NA	NA	NA	NA
Sodium	20000	NS	NA	NA	NA	NA
Zinc	2000	23000	NA	NA	NA	NA

Notes:

ND - Non-detect

NA - Not analyzed

NS - No Standard

J - Estimated

B (organics) - Found in blank

B (inorganics) - Concentration is greater than the instrument detection limit but less than the contract required detection limit

D - Dilution

R - Rejected

E - Estimated due to interference

ug/l - microgram per liter

BOLD - Exceeds New York Groundwater Quality Criteria

Table 3-1 (Sheet 9 of 14)
Comparison of Detected Compounds to NYS GA Groundwater Quality Criteria

Sample Location Sample ID Sample Date Units	New York Groundwater Quality Criteria	EPA Drinking Water Regulations (MCLs)	S-8 VE-S-8-052203 05/22/2003 ug/l	S-11 VE-S-11-052103 05/21/2003 ug/l	Field Blank VE-FB-052003 305226 ug/l	Field Blank VE-FB-052103 05/22/2003 ug/l
Constituents						
1,1,1-Trichloroethane	5	200	ND	**77.4D**	ND	ND
1,1,2-Trichloro-1,2,2-trifluoroethane	NS	NS	ND	21.7	ND	ND
1,1,2-Trichloroethane	1	5	ND	0.171J	ND	ND
1,1-Dichloroethane	5	NS	ND	**21.1J**	ND	ND
1,1-Dichloroethylene	5	7	ND	ND	ND	ND
Benzene	1	5	ND	ND	ND	ND
Bromodichloromethane	50	80	ND	0.12J	0.115	ND
Bromoform	50	80	ND	ND	4.4	4.3
Carbon disulfide	NS	NS	ND	ND	ND	ND
Chloroethane	5	NS	ND	1.27	ND	ND
Chloroform	7	80	0.116J	0.369J	0.456	ND
Chloromethane	5	NS	ND	ND	0.273	0.284
cis-1,2-Dichloroethylene	5	70	ND	**167D**	ND	0.114
Dibromochloromethane	50	80	ND	0.529J	0.41	ND
Dichlorodifluoromethane	NS	NS	ND	0.453J	ND	ND
Ethylbenzene	5	700	ND	ND	ND	ND
Isopropylbenzene	NS	NS	ND	ND	ND	ND
Methyl tert-butyl ether	NS	NS	ND	0.891	ND	ND
Methylene chloride	5	5	ND	ND	ND	ND
Tetrachloroethene	5	5	ND	1.02	ND	ND
Toluene	5	1000	ND	ND	ND	ND
trans-1,2-Dichloroethylene	5	100	ND	1.69	ND	ND
Trichloroethene	5	5	ND	**98D**	ND	0.136
Vinyl chloride	2	2	ND	**2.24**	ND	ND
Xylene (Total)	5	10000	ND	ND	ND	ND
Aluminum	NS	NS	NA	NA	47.9	NA
Arsenic	25	0.4	NA	NA	ND	NA
Barium	1000	5500	NA	NA	1.1	NA
Beryllium	3	160	NA	NA	ND	NA
Calcium	NS	NS	NA	NA	435	NA
Chromium	50	230	NA	NA	11.5	NA

Table 3-1 (Sheet 10 of 14)
Comparison of Detected Compounds to NYS GA Groundwater Quality Criteria

Sample Location Sample ID Sample Date Units	New York Groundwater Quality Criteria	EPA Drinking Water Regulations (MCLs)	S-8 VE-S-8-052203 05/22/2003 ug/l	S-11 VE-S-11-052103 05/21/2003 ug/l	Field Blank VE-FB-052003 305226 ug/l	Field Blank VE-FB-052103 05/22/2003 ug/l
Constituents						
Cobalt	NS	NS	NA	NA	4.5	NA
Copper	200	NS	NA	NA	3.4	NA
Iron	300	NS	NA	NA	293	NA
Lead	25	400	NA	NA	ND	NA
Magnesium	35000	NS	NA	NA	84.1	NA
Manganese	300	NS	NA	NA	4.2	NA
Mercury	0.7	23	NA	NA	ND	NA
Nickel	100	1600	NA	NA	7.2	NA
Potassium	NS	NS	NA	NA	252	NA
Selenium	10	390	NA	NA	ND	NA
Sodium	20000	NS	NA	NA	1340	NA
Zinc	2000	23000	NA	NA	14.8	NA

Notes:

ND - Non-detect

NA - Not analyzed

NS - No Standard

J - Estimated

B (organics) - Found in blank

B (inorganics) - Concentration is greater than the instrument detection limit but less than the contract required detection limit

D - Dilution

R - Rejected

E - Estimated due to interference

ug/l - microgram per liter

BOLD - Exceeds New York Groundwater Quality Criteria

Table 3-1 (Sheet 11 of 14)
Comparison of Detected Compounds to NYS GA Groundwater Quality Criteria

Sample Location Sample ID Sample Date Units	New York Groundwater Quality Criteria	EPA Drinking Water Regulations (MCLs)	Field Blank VE-FB-052203 05/23/2003 ug/l	Field Blank VE-FB-052303 05/24/2003 ug/l	Trip Blank VE-TB-052003 05/21/2003 ug/l	Trip Blank VE-TB-052103 05/22/2003 ug/l
Constituents						
1,1,1-Trichloroethane	5	200	ND	ND	ND	ND
1,1,2-Trichloro-1,2,2-trifluoroethane	NS	NS	ND	ND	ND	ND
1,1,2-Trichloroethane	1	5	ND	ND	ND	ND
1,1-Dichloroethane	5	NS	ND	ND	ND	ND
1,1-Dichloroethylene	5	7	ND	ND	ND	ND
Benzene	1	5	ND	ND	ND	ND
Bromodichloromethane	50	80	ND	ND	ND	ND
Bromoform	50	80	4.34	4.44	4.06	4.3
Carbon disulfide	NS	NS	ND	ND	ND	ND
Chloroethane	5	NS	ND	ND	ND	ND
Chloroform	7	80	ND	ND	0.294	ND
Chloromethane	5	NS	0.239	0.253	0.296	0.318
cis-1,2-Dichloroethylene	5	70	ND	ND	ND	ND
Dibromochloromethane	50	80	ND	ND	ND	ND
Dichlorodifluoromethane	NS	NS	ND	ND	ND	ND
Ethylbenzene	5	700	ND	ND	ND	ND
Isopropylbenzene	NS	NS	ND	ND	ND	ND
Methyl tert-butyl ether	NS	NS	ND	ND	ND	ND
Methylene chloride	5	5	ND	ND	0.138	0.114
Tetrachloroethene	5	5	ND	ND	ND	ND
Toluene	5	1000	ND	ND	ND	0.139
trans-1,2-Dichloroethylene	5	100	ND	ND	ND	ND
Trichloroethene	5	5	ND	ND	ND	ND
Vinyl chloride	2	2	ND	ND	ND	ND
Xylene (Total)	5	10000	ND	ND	ND	ND
Aluminum	NS	NS	NA	NA	NA	NA
Arsenic	25	0.4	NA	NA	NA	NA
Barium	1000	5500	NA	NA	NA	NA
Beryllium	3	160	NA	NA	NA	NA
Calcium	NS	NS	NA	NA	NA	NA
Chromium	50	230	NA	NA	NA	NA

Table 3-1 (Sheet 12 of 14)
Comparison of Detected Compounds to NYS GA Groundwater Quality Criteria

Sample Location Sample ID Sample Date Units	New York Groundwater Quality Criteria	EPA Drinking Water Regulations (MCLs)	Field Blank VE-FB-052203 05/23/2003 ug/l	Field Blank VE-FB-052303 05/24/2003 ug/l	Trip Blank VE-TB-052003 05/21/2003 ug/l	Trip Blank VE-TB-052103 05/22/2003 ug/l
Constituents						
Cobalt	NS	NS	NA	NA	NA	NA
Copper	200	NS	NA	NA	NA	NA
Iron	300	NS	NA	NA	NA	NA
Lead	25	400	NA	NA	NA	NA
Magnesium	35000	NS	NA	NA	NA	NA
Manganese	300	NS	NA	NA	NA	NA
Mercury	0.7	23	NA	NA	NA	NA
Nickel	100	1600	NA	NA	NA	NA
Potassium	NS	NS	NA	NA	NA	NA
Selenium	10	390	NA	NA	NA	NA
Sodium	20000	NS	NA	NA	NA	NA
Zinc	2000	23000	NA	NA	NA	NA

Notes:

ND - Non-detect

NA - Not analyzed

NS - No Standard

J - Estimated

B (organics) - Found in blank

B (inorganics) - Concentration is greater than the instrument detection limit but less than the contract required detection limit

D - Dilution

R - Rejected

E - Estimated due to interference

ug/l - microgram per liter

BOLD - Exceeds New York Groundwater Quality Criteria

Table 3-1 (Sheet 13 of 14)
Comparison of Detected Compounds to NYS GA Groundwater Quality Criteria

Sample Location Sample ID Sample Date Units	New York Groundwater Quality Criteria	EPA Drinking Water Regulations (MCLs)	Trip Blank VE-TB-052203 05/23/2003 ug/l	Trip Blank VE-TB-052303 05/24/2003 ug/l
Constituents				
1,1,1-Trichloroethane	5	200	ND	ND
1,1,2-Trichloro-1,2,2-trifluoroethane	NS	NS	ND	ND
1,1,2-Trichloroethane	1	5	ND	ND
1,1-Dichloroethane	5	NS	ND	ND
1,1-Dichloroethylene	5	7	ND	ND
Benzene	1	5	ND	ND
Bromodichloromethane	50	80	ND	ND
Bromoform	50	80	4.11	4.42
Carbon disulfide	NS	NS	ND	ND
Chloroethane	5	NS	ND	ND
Chloroform	7	80	ND	ND
Chloromethane	5	NS	0.281	0.258
cis-1,2-Dichloroethylene	5	70	ND	ND
Dibromochloromethane	50	80	ND	ND
Dichlorodifluoromethane	NS	NS	ND	ND
Ethylbenzene	5	700	ND	ND
Isopropylbenzene	NS	NS	ND	ND
Methyl tert-butyl ether	NS	NS	ND	ND
Methylene chloride	5	5	0.112	0.118
Tetrachloroethene	5	5	ND	ND
Toluene	5	1000	0.142	0.122
trans-1,2-Dichloroethylene	5	100	ND	ND
Trichloroethene	5	5	ND	ND
Vinyl chloride	2	2	ND	ND
Xylene (Total)	5	10000	ND	ND
Aluminum	NS	NS	NA	NA
Arsenic	25	0.4	NA	NA
Barium	1000	5500	NA	NA
Beryllium	3	160	NA	NA
Calcium	NS	NS	NA	NA
Chromium	50	230	NA	NA

Table 3-1 (Sheet 14 of 14)
Comparison of Detected Compounds to NYS GA Groundwater Quality Criteria

Sample Location Sample ID Sample Date Units	New York Groundwater Quality Criteria	EPA Drinking Water Regulations (MCLs)	Trip Blank VE-TB-052203 05/23/2003 ug/l	Trip Blank VE-TB-052303 05/24/2003 ug/l
Constituents				
Cobalt	NS	NS	NA	NA
Copper	200	NS	NA	NA
Iron	300	NS	NA	NA
Lead	25	400	NA	NA
Magnesium	35000	NS	NA	NA
Manganese	300	NS	NA	NA
Mercury	0.7	23	NA	NA
Nickel	100	1600	NA	NA
Potassium	NS	NS	NA	NA
Selenium	10	390	NA	NA
Sodium	20000	NS	NA	NA
Zinc	2000	23000	NA	NA

Notes:

ND - Non-detect

NA - Not analyzed

NS - No Standard

J - Estimated

B (organics) - Found in blank

B (inorganics) - Concentration is greater than the instrument detection limit but less than the contract required detection limit

D - Dilution

R - Rejected

E - Estimated due to interference

ug/l - microgram per liter

BOLD - Exceeds New York Groundwater Quality Criteria

Table 3-2

Total VOC Concentrations

Monitoring Well Identification	November 1996 (initial)	November 1997 (first)	June 1999 (second)	June 2000 (third)	June 2001 (fourth)	October 2002 (fifth)	May 2003 (sixth)
Well S-1	NS	NS	NS	NS	NS	22.26	2.9
Well S-2	1572.5	504.9*	994	1472	807	533.68	741
Well S-6	NS	NS	NS	NS	NS	55.35*	78
Well S-7	380	561.22	NS	NS	NS	1445.3	286
Well S-8	ND	NS	NS	NS	NS	35.5	0.1
Well S-11	5131	441.7	383	4154	417	467.9	394
Well EB-31	128.5	106	67	79	81	97.62	62
Well EB-33	2384.4	1285.23	1321	833	552	355.35	176
Well EB-41	ND	4.6	6	6	8	31.2	8.4
Well EB-42	2	1	ND	1	ND	ND	1.5
Well 1-22	NS	NS	NS	NS	NS	ND	1.8
Well 1-23	NS	1	ND	ND	ND	NS	NS
Well 1-24	3.6	8.33	4	9	5	ND	6.6
Well 1-29	963	249.3	217*	58.5*	NS	175.7	200
Well 1-29A	30	97.4	69	NS	51	43.86	49
Well 1-30	ND	1	ND	ND	ND	NS	NS
Well 1-28	NS	NS	NS	NS	ND	NS	NS
Well 1-28A	NS	NS	NS	NS	ND	NS	NS
Well 1-32	NS	NS	NS	NS	NS	ND	0.6
Well 1-32A	NS	NS	NS	NS	NS	ND	0.1
Total VOCs	9220	2351.76	2775	6554	1870	1485.75	1389.5

(initial) – indicates annual effectiveness report
NS – Not Sampled
* -Average of duplicate data
ND – Not Detected
Monitoring Wells 1-23, 1-30, 1-28, and 1-28A were not sampled in October 2002 and May 2003 because they are not required to be sampled by the ROD.
Total VOCs are calculated using the results of monitoring wells S-2, S-11, EB-31, EB-33, EB-41, EB-42, and 1-24.

Table 3-3
Field Parameter Measurements

Monitoring Well ID	S-1	S-2	S-6	S-7	S-8	S-11	EB-31	EB-33	EB-41	EB-42	1-22	1-24	1-29	1-29A	1-32R	1-32AR
Final Field Parameter Meas.																
Dissolved Oxygen (mg/L)	0.20	0.13	0.00	0.03	1.22	0.90	2.09	0.38	0.83	6.94	0.36	0.90	1.06	0.03	0.08	0.43
ORP (mv)	-33	-29	-141	-100	-122	-49	93	-90	32	58	-199	-125	-66	-164	-132	44
pH (SU)	6.89	5.89	6.73	6.56	6.95	6.91	6.71	7.01	6.44	6.78	11.89	9.16	7.64	774	7.02	6.04
Temperature (°C)	14.11	15.25	15.22	15.42	15.07	15.24	13.25	13.60	13.87	14.22	12.85	14.0	12.26	13.96	12.80	16.86
Conductivity (mS/cm)	1.23	9.35	1.62	1.16	0.937	1.34	1.13	1.18	1.68	1.69	0.716	0.382	0.941	0.926	1.53	0.524
Turbidity (NTU)	24.9	40.5	14.9	47.9	15	35.6	61.5	29.4	54.7	39.2	66.5	-3.4	47.9	30.4	72	50

Table 3-4
Well Elevation Data

Monitoring Well Identification	Elevation of Monitoring Well Reference Point (feet msl)	Total Depth of Monitoring Well (feet)	Depth to Groundwater (feet)	Groundwater Elevation (feet msl)
1-22*	817.61	132	11.60	806.01
1-23	820.91	136	16.38	804.53
1-24*	826.76	129	23.37	804.39
1-25	827.02	155	22.38	804.64
1-25A	826.92	49	22.43	804.49
1-29*	823.55	119	19.59	803.96
1-29A*	824.03	64	20.02	804.01
1-30	816.54	114	11.87	804.67
1-30A**	816.42	30	11.09	805.33
1-32A**	830.86	35	26.75	804.11
1-32**	831.08	152	14.66	816.42
EB-31*	825.77	53	18.07	807.70
EB-33*	828.59	35	18.20	810.39
EB-41*	825.38	28	19.17	806.21
EB-42*	831.54	29	25.15	806.39
S-1*	827.16	25	18.02	809.14
S-2*	824.73	32	17.71	807.02
S-6*	822.46	41	11.29	811.17
S-7*	823.72	32	16.02	807.70
S-8*	832.2	25	7.22	824.98
S-11*	822.78	40	16.19	806.59

Qualifiers:
* - Part of the original monitoring well network in the ROD
** - Replaced monitoring well
msl – Mean Sea Level

Table 3-5
Plant Operation & Sampling Data

	Pump Rate	Operational Days	Gallons Treated (million gallons)	Total VOC Influent Concentration (ug/l)
Oct 2002	-	0	-	-
Nov 2002	-	0	-	-
Dec 2002	-	0	-	-
Jan 2003	76%	29	36.5	454.9
Feb 2003	76%	28	36.0	319.2
March 2003	60%	31	30.3	271.7
April 2003	59%	30	29.3	204.9
May 2003	56%	31	25.0	222.1

APPENDIX B
Validation Report and Laboratory Data

4.0 CONCLUSIONS AND RECOMMENDATIONS

The groundwater elevation data collected in May 2003 indicate that shallow groundwater is flowing northwest toward the Susquehanna River. The deep groundwater direction is flowing to the northeast based on the limited data points in the current deep monitoring well network. The vertical groundwater flow is generally from the shallow to deep groundwater zones. After repairs were made to the treatment system in November 2002, the system has a pumping rate (approximately 550 gpm) similar to the pump test results from 1994, therefore hydraulic control continues to be maintained. In addition, analytical results indicate that the contaminant plume has not migrated westerly beyond the Vestal Well 1-1 area.

The mounding in deep well 1-32 is likely the result of artificial recharge to the well due to a compromised well cap. The condition appears to be localized and may be related to surface runoff. Groundwater elevation measurements collected in December 2003 verified the mounding as a temporary condition.

The analytical results over the last six years indicate that the concentrations of total VOCs have generally decreased, thus indicating that aquifer restoration is continuing. The total VOC concentrations have been reduced in monitoring well S-7 from 1,454 ppb in October 2002 to 286 ppb in May 2003. The recent groundwater sampling results indicate that the highest VOC concentrations were present at monitoring well S-2 which is northwest of monitoring well S-7. The groundwater plume appears to be migrating northwest as a result of the groundwater extraction activities.

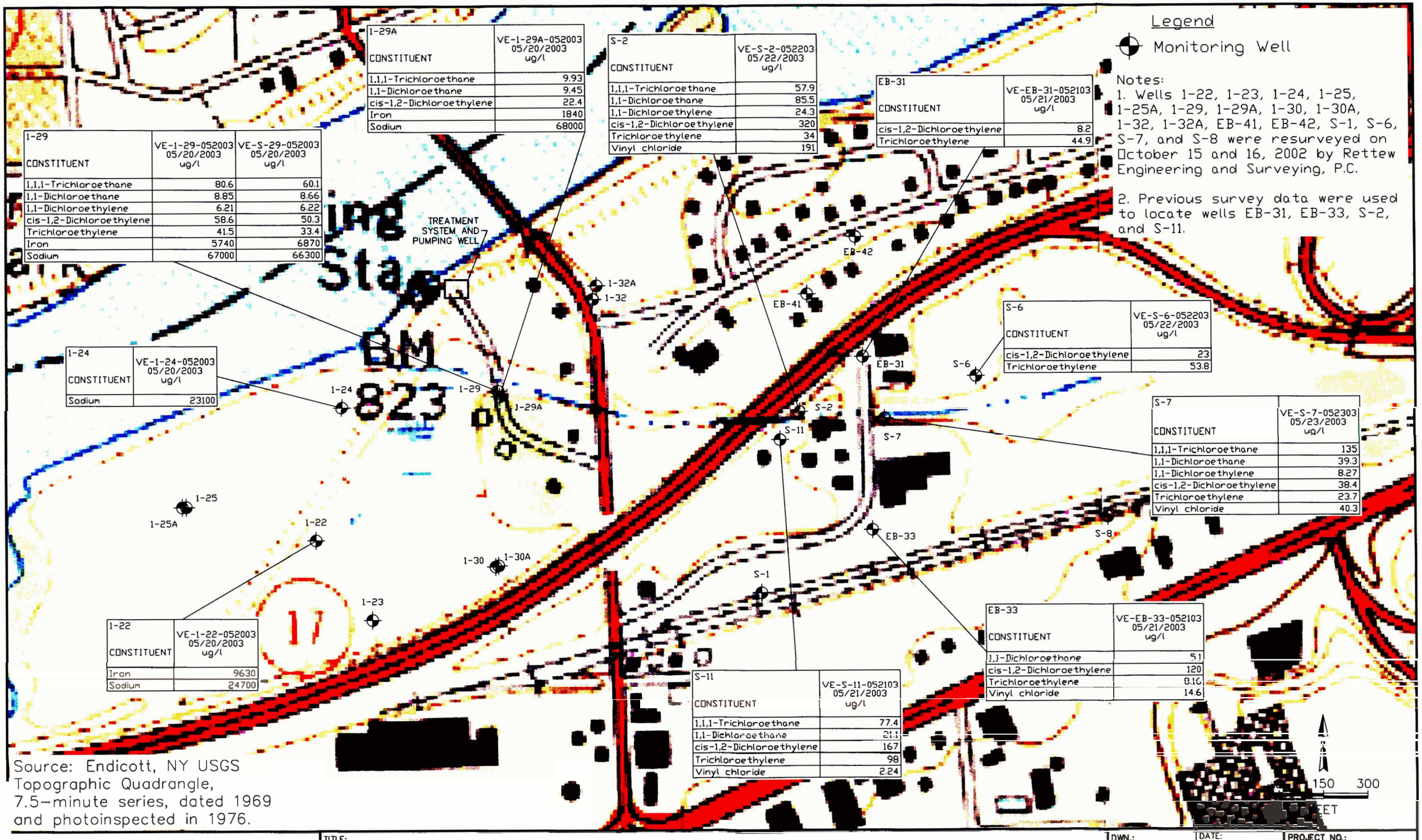
Site COCs chromium, copper, lead, mercury, nickel, and zinc concentrations were below the NYSGWQC. Iron and sodium concentrations exceeded the NYSGWQC in monitoring wells 1-22, 1-24, 1-29, and 1-29A; however, iron and sodium are not COCs.

The current sampling program does not include any clean wells at the shallow horizon along the western margin of the plume. It is recommended that monitoring wells 1-25A, 1-30, and 1-30A be added to the groundwater sampling program to eliminate this data gap. It also recommended that monitoring well 1-22 be removed from the sampling program because the data point will be duplicated due to the inclusion of 1-30.

The continuing presence of daughter products in the groundwater and the decreasing concentrations of total VOCs in the nearby monitoring wells indicates that natural attenuation may be occurring and thus limiting the migration of source contaminants. Based on this observation, it is recommended that dissolved total organic carbon, alkalinity, nitrate, sulfate, chloride, ethylene, methane, ethane, and ferrous iron parameters be added to the list of analytes for the next groundwater sampling event to better evaluate natural attenuation.

APPENDIX A

Copy of Field Log Book Entries



Source: Endicott, NY USGS Topographic Quadrangle, 7.5-minute series, dated 1969 and photoinspected in 1976.

TETRA TECH FW, INC.

TITLE:
Constituents Detected Above New York Groundwater Quality Standards
Vestal Well 1-1 Site
Vestal, New York

DWN.: CTS	DATE: 03/09/04	PROJECT NO.: 1945.2109.0700	
CHKD: MJM	REV.: 1	FIGURE NO.: 3-1	
DES.: CTS	APPD: HR		

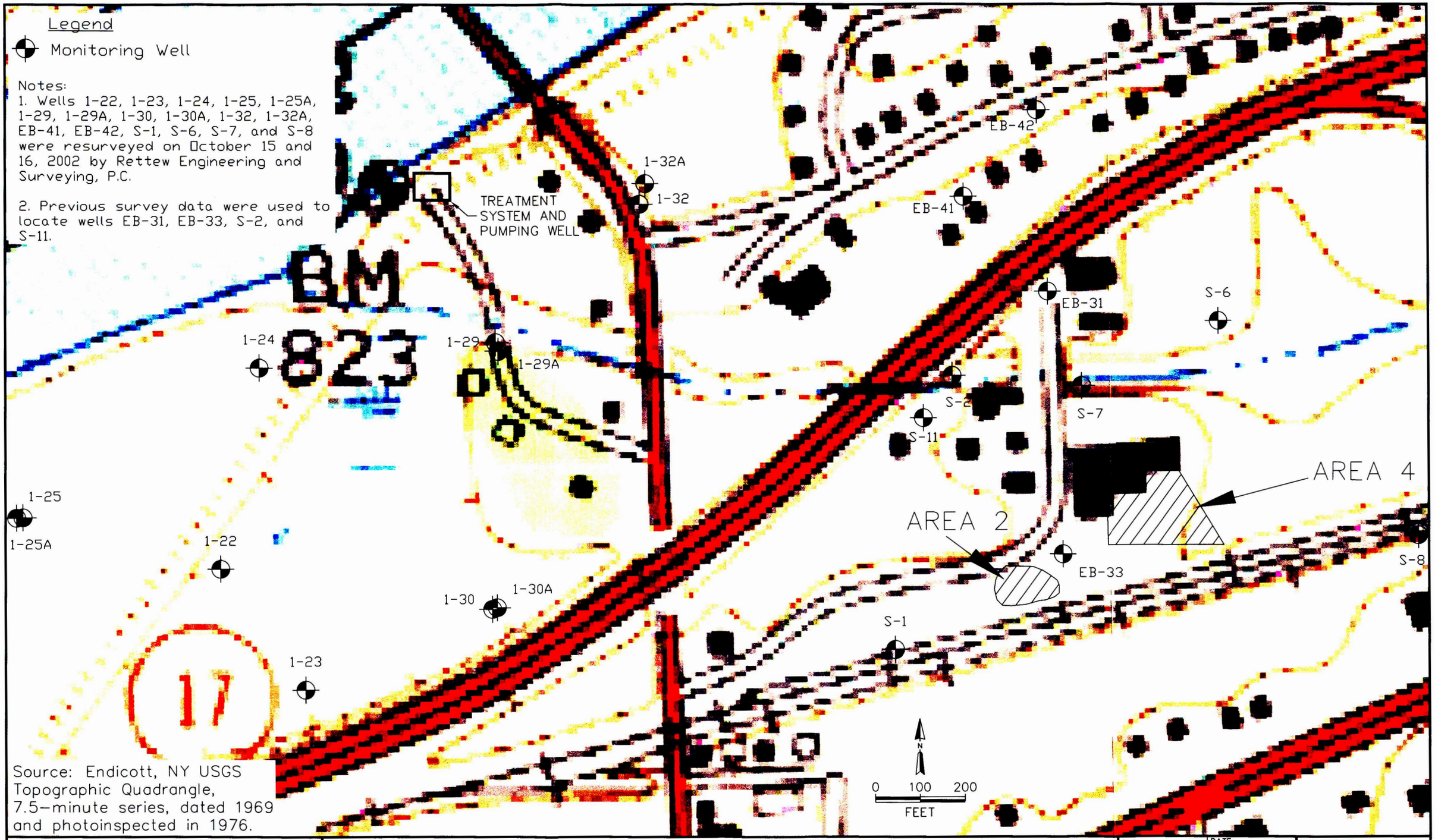
N:\GIS\GISKEY\GISPROJ31\VESTAL-SURVEYED\FIGURE 3-1 030904.DWG

Legend

Monitoring Well

Notes:
1. Wells 1-22, 1-23, 1-24, 1-25, 1-25A, 1-29, 1-29A, 1-30, 1-30A, 1-32, 1-32A, EB-41, EB-42, S-1, S-6, S-7, and S-8 were resurveyed on October 15 and 16, 2002 by Rettew Engineering and Surveying, P.C.

2. Previous survey data were used to locate wells EB-31, EB-33, S-2, and S-11.



Source: Endicott, NY USGS Topographic Quadrangle, 7.5-minute series, dated 1969 and photoinspected in 1976.

TETRA TECH FW, INC.

TITLE:
Monitoring Well Locations
Vestal Well 1-1 Site
Vestal, New York

DWN.: CTS	DATE: 03/09/04	PROJECT NO.: 1945.2109.0700	
CHKD: MJM	REV.: 1	FIGURE NO.: 2-1	
DES.: CTS	APPD: HR		

N:\GIS\GISKEY\GISPROJ31\VESTAL-SURVEYED\FIGURE 2-1 030904.DWG

Legend

Monitoring Well

—806— Groundwater Elevation (ft. msl)

Notes:
1. Wells 1-22, 1-23, 1-24, 1-25, 1-25A, 1-29, 1-29A, 1-30, 1-30A, 1-32, 1-32A, EB-41, EB-42, S-1, S-6, S-7, and S-8 were resurveyed on October 15 and 16, 2002 by Rettew Engineering and Surveying, P.C.

2. Previous survey data were used to locate wells EB-31, EB-33, S-2, and S-11.

3. Monitoring wells 1-22, 1-23, 1-24, 1-25, 1-29, 1-30, and 1-32 were not used to determine groundwater flow.

1-32A
1-32
TREATMENT SYSTEM AND PUMPING WELL
EB-42 806.39
EB-41 806.21
1-24
1-29
1-29A 804.01
EB-31 807.70
S-6 811.17
S-7 807.70
S-2 807.02
S-11 806.59
1-25
1-25A 804.49
1-22
1-30A
1-30 805.33
AREA 2
AREA 4
EB-33 810.39
S-8 824.98
S-1 809.14
1-23
804
805
806
807
808
809
810
812
814
816
818
820
822
824
0 100 200
FEET
N

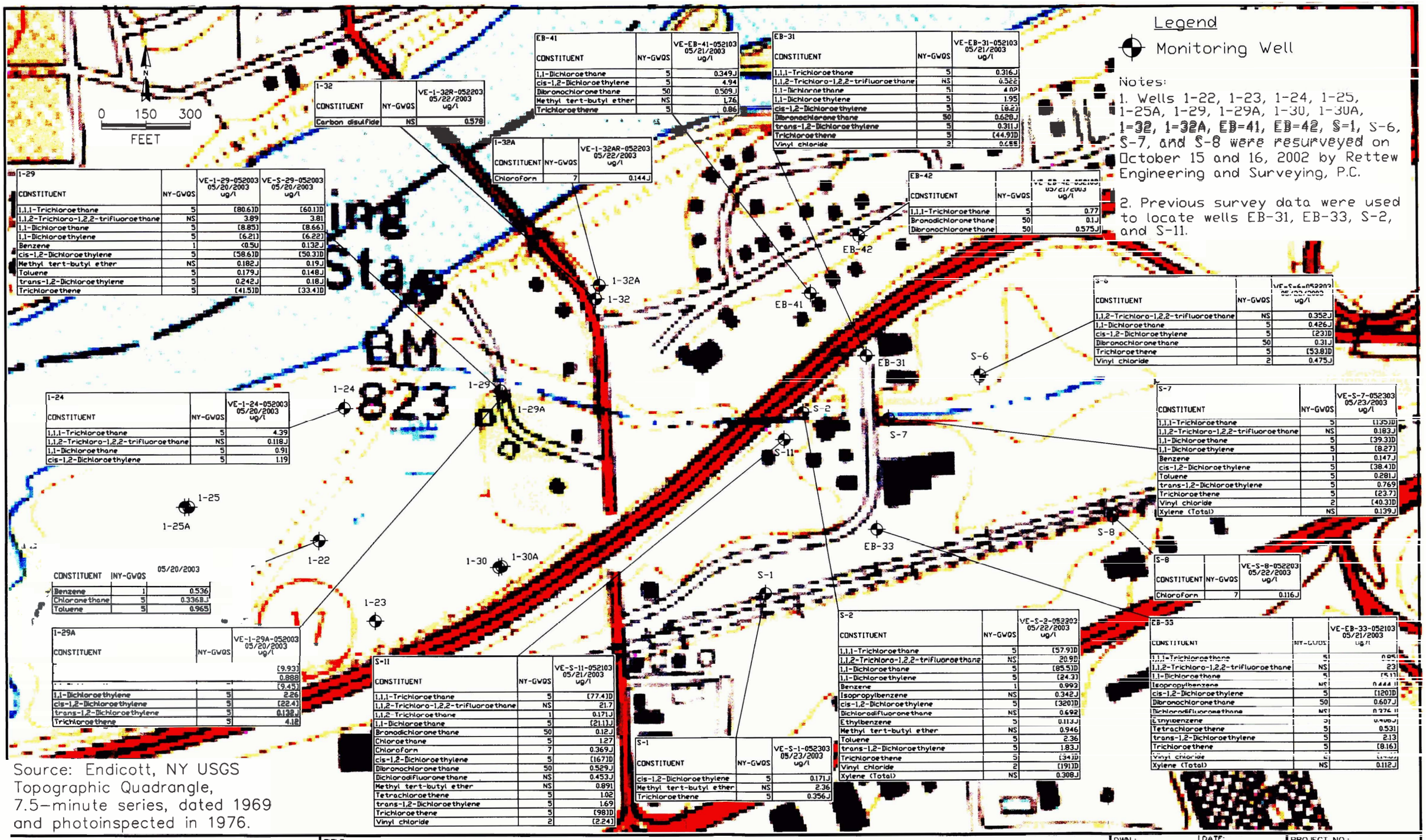
Source: Endicott, NY USGS Topographic Quadrangle, 7.5-minute series, dated 1969 and photoinspected in 1976.

TETRA TECH FW, INC.

TITLE:
Shallow Groundwater Surface Elevation Map
Vestal Well 1-1 Site
Vestal, New York

DWN.: CTS	DATE: 03/09/04	PROJECT NO.: 1945.2109.0700	
CHKD: MJM	REV.: 1	FIGURE NO.: 3-4	
DES.: CTS	APPD: HR		

N:\GIS\GISKEY\GISPROJ31\VESTAL-SURVEYED\FIGURE 3-4 030904.DWG



Source: Endicott, NY USGS Topographic Quadrangle, 7.5-minute series, dated 1969 and photoinspected in 1976.

TETRA TECH FW, INC.

TITLE:
Volatile Organic Compounds Detected in the Groundwater
Vestal Well 1-1 Site
Vestal, New York

DWN.: CTS	DATE: 03/09/04	PROJECT NO.: 1945.2109.0700	
CHKD: MJM	REV.: 1	FIGURE NO.: 3-3	
DES.: CTS	APPD: HR		

N:\GIS\GISKEY\GISPROJ31\VESTAL-SURVEYED\FIGURE 3-3 030904.DWG

Legend

Monitoring Well

—806— Groundwater Elevation (ft. msl)

Notes:
1. Wells 1-22, 1-23, 1-24, 1-25, 1-25A, 1-29, 1-29A, 1-30, 1-30A, 1-32, 1-32A, EB-41, EB-42, S-1, S-6, S-7, and S-8 were resurveyed on October 15 and 16, 2002 by Rettew Engineering and Surveying, P.C.

2. Previous survey data were used to locate wells EB-31, EB-33, S-2, and S-11.

1-32A
804.11
1-32

TREATMENT SYSTEM AND PUMPING WELL

EB-42

EB-41

EB-31

S-6

S-7

S-2

S-11

AREA 4

AREA 2

EB-33

S-8

S-1

1-24
804.39

1-29
803.96

1-25
804.64

1-25A

1-22
806.01

1-30
804.67

1-30A

1-23
804.53

804
804.4
804.6
804.8
805
805.2
805.4
805.6
805.8

BM 823

17

0 100 200
FEET

Source: Endicott, NY USGS Topographic Quadrangle, 7.5-minute series, dated 1969 and photoinspected in 1976.

TETRA TECH FW, INC.

TITLE:
Deep Groundwater Surface Elevation Map
Vestal Well 1-1 Site
Vestal, New York

DWN.: CTS	DATE: 03/09/04	PROJECT NO.: 1945.2109.0700	
CHKD: MJM	REV.: 1	FIGURE NO.: 3-5	
DES.: CTS	APPD: HR		

N:\GIS\GISKEY\GISPROJ31\VESTAL-SURVEYED\FIGURE 3-5 030904.DWG

Legend

Monitoring Well

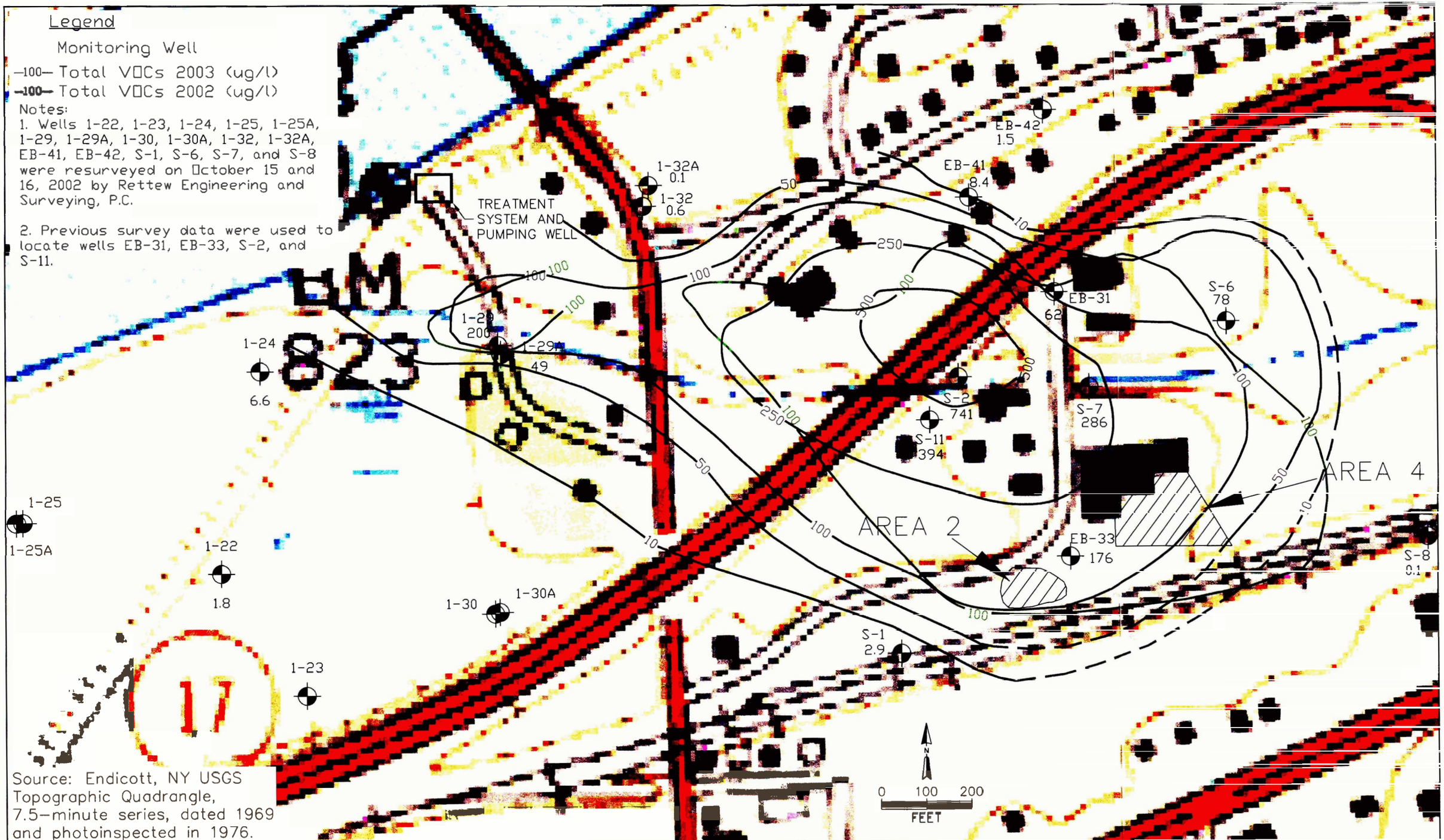
—100— Total VOCs 2003 (ug/l)

—100— Total VOCs 2002 (ug/l)

Notes:

1. Wells 1-22, 1-23, 1-24, 1-25, 1-25A, 1-29, 1-29A, 1-30, 1-30A, 1-32, 1-32A, EB-41, EB-42, S-1, S-6, S-7, and S-8 were resurveyed on October 15 and 16, 2002 by Rettew Engineering and Surveying, P.C.

2. Previous survey data were used to locate wells EB-31, EB-33, S-2, and S-11.



Source: Endicott, NY USGS Topographic Quadrangle, 7.5-minute series, dated 1969 and photoinspected in 1976.

TETRA TECH FW, INC.

TITLE:
Total Volatile Organic Compounds in Groundwater
Vestal Well 1-1 Site
Vestal, New York

DWN.: CTS	DATE: 03/09/04	PROJECT NO 1945.2109.0700	
CHKD MJM	REV 1	FIGURE NO.: 3-2	
DES.: CTS	APPD: HR		

N:\GIS\GISKEY\GISPROJ31\VESTAL-SURVEYED\FIGURE 3-2 030904.DWG