Corporate Environmental Affairs

REMEDIAL ALTERNATIVES INVESTIGATION REPORT FOR THE NORTHERN PLUME & PARKING LOT 001 AREA FORMER IBM FACILITY OWEGO, NEW YORK 6NYCRR PART 373 PERMIT NO. 7-4930-00095/00005

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September 26, 2018

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Professional Geologist Certification
Remedial Alternatives Investigation Report
for the Northern Plume & Parking Lot 001 Area
Former IBM Facility
Owego, New York

6NYCRR Part 373 Permit No. 7-4930-00095/00005

September 26, 2018

As the person with primary responsibility for the performance of the geological services and activities associated with the captioned report, I certify that I have reviewed the document entitled "*Remedial Alternatives Investigation Report for the Northern Plume & Parking Lot 001 Area, Former IBM Facility, Owego, New York"* prepared pursuant to 6NYCRR Part 373 Permit No. 7-4930-00095/00005. This report is dated September 26, 2018 and was prepared by Groundwater Sciences Corporation (GSC) for IBM Corporation.

I certify that the associated geological services and this report have been prepared under my direct supervision. To the best of my knowledge, all such information contained in this report is complete and accurate.

This report bears the seal of a professional geologist. No alterations may be made to the information contained in this report unless made in accordance with Title 8, Article 145, Section 7209 of New York State Education Law.

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1 INTRODUCTION

This Remedial Alternatives Investigation Report (Report) has been prepared by Groundwater Sciences Corporation (GSC) on behalf of International Business Machines Corporation (IBM) Corporate Environmental Affairs (CEA). The Report presents the findings of a Remedial System Optimization Work Plan[1] (the "Work Plan") and an updated assessment of potential remedial measures to supplement and enhance the existing groundwater extraction system in the Parking Lot 001 Area (P001 Area) of the former IBM Facility in Owego, Tioga County, New York (the "Site"). **Figure 1-1** is a Site Location Map and **Figure 1-2** is an Aerial Site Map showing locations of buildings, roadways, parking lots, and undeveloped portions of the Site.

1.1 Background Information

The Site is owned and operated by Lockheed Martin Corporation (Lockheed) for industrial manufacturing activities. The northern plume of volatile organic compounds (VOCs) in groundwater (the "northern VOC plume area") comprises the former Tank Farm Area, including Building 002, Building 001, and Building 306; the P001 Area; and the leading edges of the VOC plumes that extend off-Site onto the area of the Moore Tire property. The groundwater plumes in the northern VOC plume area appear to originate from beneath the northwestern portion of Lockheed's Building 002 and from a former chemical distribution facility, hereinafter referred to as the Tank Farm Area. The primary VOC plume constituents include: (1) 1,1,1-trichloroethane (111-TCA) and its breakdown products 1,1-dichloroethane (11-DCA) and 1,1-dichloroethene (11-DCE), hereinafter referred to as "TCA-series" constituents; and (2) trichloroethene (TCE) and its breakdown products cis-1,2-dichloroethene (c12-DCE) and vinyl chloride (VC), hereinafter referred to as "TCE-series" constituents. The TCA-series and TCE-series plumes are present in a shallow unconfined upper water-bearing zone in alluvial sediments referred to in this report as the alluvial zone, and in a deeper thin confined water-bearing zone within weathered bedrock along the interface between glacial till and the underlying competent bedrock referred to in this report as the till/bedrock interface zone or till/bedrock zone. Further details of the hydrogeology at the Site are provided in Sections 2.2 and 2.5 of the Work Plan.

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[1] *Preliminary Remedial Assessment Report and Remedial System Optimization Work Plan for the Parking Lot 001 Area, Former IBM Facility, Owego, New York, 6NYCRR Part 373 Permit No. 7-4930-00095/00005*, prepared by Groundwater Sciences Corporation for IBM Corporate Environmental Affairs, August 15, 2017.

Extraction well 415 in the Tank Farm Area operates to provide near-source groundwater extraction. Three groundwater extraction wells in the P001 Area - 413, 416, and 414 - oriented north-south in a row operate to cut off the westward migration of the TCA-series and TCE-series plumes before these plumes extend off-Site to property currently occupied by Moore Tire. The P001 Area groundwater extraction operations were initiated in 1983 and appear to have successfully intercepted the westerly transport of VOC mass flux in the shallow unconfined upper water-bearing zone in the alluvium. However, a portion of the VOC plumes in the deeper water-bearing zone at the till/bedrock interface in the P001 Area do not appear to have been entirely captured, as TCA-series and TCE-series concentrations have been slowly increasing in downgradient areas to the west.

Since its implementation in 1983, IBM has made many modifications to Tank Farm Area and P001 Area extraction operations with the goals of (1) maintaining near-source control of dissolved VOC mass in the till/bedrock interface zone beneath the Tank Farm Area of the Site, (2) maintaining or improving capture of dissolved VOC mass flux in the till/bedrock interface zone beneath the P001 Area of the Site, and (3) reducing off-Site VOC concentrations in the till/bedrock interface zone beneath the Moore Tire property. Despite these efforts, concentration trends of contaminants of concern in the till/bedrock interface water-bearing zone beneath the off-Site Moore Tire property have been flat or increasing in recent years. In light of these trends, the New York State Department of Environmental Conservation (NYSDEC) requested that IBM provide a "preliminary remedial assessment of potential options and a remedial system optimization work plan for the groundwater extraction system which controls the offsite portion of the plume near Moore Tire."[2]

1.2 Purpose and Objectives

The Work Plan describes a program of field explorations and testing to collect additional Site characterization data. This data would be used to support optimization of the existing groundwater extraction system in the P001 Area and to further assess other potential remedial alternatives.

[2] J. LaClair, NYSDEC, May 23, 2017, Letter to B. Ashby of IBM CEA, Re: 2016 Annual Report for the Former IBM Facility in Owego, New York.

Although the northern portion of the Site and the area to the west has been extensively investigated over the past three decades, the Work Plan recommended the following additional investigation activities:

1. Delineation of potential source areas east of the P001 Area that could be targeted by an *in situ* source reduction treatment technology,
2. Assessment of the possible presence of a location in the P001 Area with a till/bedrock interface zone of sufficient transmissivity to be considered for a new extraction well installation, and
3. Collection of geochemical groundwater quality data to assess the potential for on-Site and off-Site degradation of VOC plume constituents under current groundwater quality conditions.

In light of these three objectives, the scope of the additional investigation activities in the Work Plan was developed to produce data of sufficient quantity and quality to support development, screening, and design of potential remedial alternatives focused on reducing mass flux from apparent source areas, enhancing mass flux control in the P001 Area, and reducing the size of dissolved TCE-series and TCA-series plumes in the on-Site and off-Site areas west of the P001 groundwater extraction system.

1.3 Organization

This Report is organized as follows: Section 2 describes the activities that were performed as presented in Section 4 of the Work Plan, Section 3 presents the findings of these investigation activities, Section 4 presents an updated conceptual site model, Section 5 presents the results of a remedial alternatives analysis based on the findings of the investigation activities, and Section 6 presents conclusions and recommendations with regard to optimizing VOC mass flux control in the P001 Area.

2 SCOPE OF WORK

Field activities consisted of two primary work tasks designed to further understand hydrogeologic conditions in the northern VOC plume area of the Owego site: (1) delineation of potential VOC source areas east of the P001 Area extraction wells and (2) installation of additional monitoring wells west of the P001 Area extraction wells to produce data of sufficient quantity and quality to support the installation of an additional extraction well to more effectively control the till/bedrock VOC plume in the P001 Area.

2.1 Source Delineation

Soil borings were drilled in two areas shown on **Figure 2-1**: (1) the area around Building 306 attached to the northern end of Building 002, west of the former Tank Farm Area, and (2) the northern parking lot area east of the P001 Area extraction wells.

2.1.1 Building 002/Building 306 (Former Tank Farm) Area

The area around the northern end of Building 002 was investigated by drilling 17 soil borings, designated B-809 through B-825, around the western, northern, and eastern sides of Building 306, which is attached to the northern end of Building 002, as shown on **Figure 2-1**.

2.1.1.1 Geophysical Survey

In preparation for drilling, a geophysical survey was performed in November 17, 2017 to identify and mark the locations of underground utilities on the southwestern and northwestern sides of Building 306. Advanced Geological Services (AGS) of Malvern, PA used a combination of the radio frequency (RF) utility method, the hand-held electromagnetic (EM) metal detection method, and the ground penetrating radar (GPR) method. The report prepared by AGS is presented in **Appendix A**.

2.1.1.2 Test Borings and Soil Sampling

Test borings were drilled using sonic methods from April 9 to May 3, 2018. Fifteen of the 17 borings were drilled on a series of three transects, labeled Transect 1, Transect 2, and Transect 3 on **Figure 2-1**. Borings B-824 and B-825 were drilled on the southern and eastern sides of Building 306, as shown on **Figure 2-1**. Continuous soil samples were collected via sonic drilling methods

and were screened in the field with an 11.7 eV photoionization detector (PID) for both TCE-series and TCA-series parameters, using jar headspace analysis techniques. One soil sample from the vadose zone and one soil sample from the saturated zone were selected from each boring for VOC analysis by SW-846 Method 8260C. Geologic logs for these test borings are presented in **Appendix B** and the analytical results are discussed in **Section 3.1**.

2.1.1.3 Monitoring Well Installation and Groundwater Sampling

Upon completion of the test borings, nominal two-inch diameter PVC monitoring wells were installed with five-foot PVC screen intervals set approximately 2.5 feet into competent bedrock, straddling the till/bedrock interface. Well construction details are presented on the geologic logs in **Appendix B**. The monitoring wells were sampled in late April and early May 2018 and the samples were analyzed for 16 SW-846 Method 8260C VOCs listed in the facility's Groundwater Monitoring Plan. The analytical results are discussed in **Section 3.3**.

2.1.1.4 Location Survey

A location and elevation survey of the test borings/monitoring wells was performed by Butler Land Surveying LLC of Warren Center, Pennsylvania. Consistent with previous Site investigations, the wells were surveyed relative to the New York State Central NAD83 coordinate system. The locations were surveyed to the nearest 0.1 foot and reference point elevations were surveyed to the nearest 0.01 foot. The physical well data is summarized below on **Table 2-1**.

Table 2-1: Physical Well Data and Boring Specifications
P001 Remedial Alternatives Investigation
Owego, New York

Boring/Well Number	Northing (NYS Grid feet)	Easting (NYS Grid feet)	Installation Date	Ground Surface Elevation (feet amsl)	Depth to Weathered Bedrock (feet bgs)	Depth to Bedrock (feet bgs)	Bedrock Surface Elevation (ft amsl)	Depth to Top of Screen (feet bgs)	Well Depth (feet bgs)	Drilled Depth (feet bgs)	Location
B-800	767167.9	918386.6	04/10/18	897.8	–	48.0	849.8	45.0	50.0	50.0	near well 609
B-801	767169.9	918336.5	04/10/18	896.1	–	49.0	847.1	47.0	52.0	52.0	near well 609
B-802	767219.9	918336.0	04/11/18	894.5	–	52.5	842.0	48.5	53.5	55.0	near well 609
B-803	767218.1	918385.9	04/12/18	896.3	–	40.0	856.3	37.5	42.5	50.0	near well 609
B-804	766972.3	918288.8	04/16/18	904.7	–	59.0	845.7	56.5	61.5	61.5	near well 612
B-805	767022.2	918287.9	04/17/18	902.4	–	53.5	848.9	51.0	56.0	56.5	near well 612
B-806	767020.2	918337.9	04/17/18	903.2	–	54.5	848.7	51.5	56.5	59.0	near well 612
B-807	766970.2	918338.7	04/18/18	905.6	–	56.0	849.6	53.0	58.0	59.0	near well 612
B-808	767216.3	918435.8	04/19/18	898.1	–	41.0	857.1	38.5	43.5	44.8	near well 609
B-809	766863.8	918754.5	04/19/18	913.3	25.0	28.0	885.3	24.5	29.5	30.0	NE corner of Bldg 002
B-810	766903.1	918768.0	04/23/18	912.5	–	28.0	884.5	25.0	30.0	31.0	NE corner of Bldg 002
B-811	766939.5	918774.9	04/24/18	912.4	–	29.0	883.4	26.0	31.0	31.0	west of Bldg 306
B-812	766978.3	918784.5	04/25/18	912.0	–	29.5	882.5	26.5	31.5	32.0	west of Bldg 306
B-813	767023.4	918797.3	04/30/18	911.3	–	31.0	880.3	28.0	33.0	34.0	west of Bldg 306
B-814	767059.1	918801.1	04/26/18	910.7	–	30.5	880.2	27.5	32.5	32.5	NW of Bldg 306
B-815	767098.9	918811.1	04/30/18	910.4	21.0	26.0	884.4	21.0	26.0	30.0	NW of Bldg 306
B-816	767140.5	918819.5	05/01/18	909.1	24.5	28.0	881.1	24.0	29.0	29.0	NW of Bldg 306
B-817	766895.0	918814.5	04/25/18	913.5	–	28.5	885.0	26.0	31.0	31.0	NE corner of Bldg 002
B-818	766933.7	918824.6	04/26/18	913.3	28.0	28.5	884.8	26.0	31.0	31.0	west of Bldg 306
B-819	766972.8	918833.1	04/27/18	912.5	–	31.0	881.5	28.0	33.0	34.0	west of Bldg 306
B-820	766916.2	918736.1	04/20/18	912.0	26.0	28.0	884.0	25.0	30.0	30.0	west of Bldg 306
B-821	766954.2	918742.0	04/24/18	911.3	–	27.0	884.3	24.5	29.5	31.0	west of Bldg 306
B-822	766993.3	918749.4	04/24/18	910.8	28.0	29.5	881.3	25.0	30.0	31.0	west of Bldg 306
B-823	767031.3	918759.1	04/26/18	910.5	–	28.0	882.5	25.5	30.5	31.0	west of Bldg 306
B-824	766980.3	918914.0	05/01/18	912.5	–	23.0	889.5	20.0	25.0	25.0	NE of Bldg 306
B-825	767072.8	918958.3	05/01/18	913.7	23.5	26.0	887.7	23.5	28.5	28.5	west of Bldg 306
B-826	767024.4	918238.0	05/02/18	901.7	–	70.0	831.7	66.5	71.5	71.5	near well 612
B-827	767072.1	918287.5	05/03/18	900.0	–	60.5	839.5	57.5	62.5	64.0	near well 612
B-828	767243.9	918360.0	05/03/18	894.5	–	37.5	857.0	35.5	40.5	40.5	near well 609
700	766967.5	917950.5	04/18/18	889.3	–	62.8	826.5	57.0	67.0		western P001 Area
701	767000.2	918002.8	04/24/18	888.7	62.0	62.7	826.0	60.0	65.0		western P001 Area
418A	766895.6	918197.3	04/24/18	891.1	NA	NA	NA	NA	NA	42.0	western P001 Area

Notes: Measurements are from the geologic and well construction logs in Appendix B.
feet amsl = feet above mean sea level
feet bgs = feet below ground surface

2.1.1.5 Groundwater Elevations

Groundwater elevations were recorded at the time of groundwater sampling for the monitoring wells. The depth to water was measured using an electronic water level measurement device capable of measuring in increments of 0.01 feet. The elevations were used to calculate hydraulic gradients, groundwater flow directions and sample purge volumes. Groundwater elevations were also measured in a single event in June 2018, as discussed in **Section 3.2**.

2.1.2 Northern Parking Lot Area East of P001 Extraction Wells

The borings in the northern parking lot area east of the P001 Area extraction wells were drilled using the same sonic methods as the borings in the Building 002/Tank Farm Area. The purpose of these borings is to better delineate two areas of elevated concentrations of VOCs in groundwater previously mapped in the vicinity of monitoring wells 609 and 612. Drilling began near wells 609 and 612 (the areas of highest historical VOC concentrations) and moved progressively outward toward the plume edges. Boring locations were eliminated or relocated as necessary depending on the jar headspace results.

2.1.2.1 Parking Lot 001 Area Near Well 609

As explained in the Work Plan, elevated concentrations at monitoring well 609 suggested the presence of a source of 111-TCA near a former drum storage area. Consequently, the area near well 609 was investigated by drilling six soil borings, designated B-800, B-801, B-802, B-803, B-808 and B-828, and shown on **Figure 2-1**. Continuous soil samples were collected by the sonic drilling device and were screened in the field with an 11.7 eV photoionization detector (PID) for both TCE-series and TCA-series parameters, using jar headspace analysis techniques. One soil sample from the vadose zone and one soil sample from the saturated zone were selected from each boring for VOC analysis by SW-846 Method 8260C. Upon completion of these soil borings, nominal two-inch diameter PVC monitoring wells were installed with five-foot PVC screen intervals set approximately 2.5 feet into competent bedrock, straddling the till/bedrock interface. Geologic logs and well construction details for these soil borings are presented in **Appendix B**. The monitoring wells were sampled in late April and early May 2018 and the samples were analyzed for 16 SW-846 Method 8260C VOCs listed in the facility's Groundwater Monitoring Plan. The results are discussed in **Section 3.3**.

2.1.2.2 Parking Lot 001 Area Near Well 612

Historically-elevated concentrations of TCE near well 612 also suggested the presence of a possible source area, an area of residual contamination, or an area of emergence of groundwater from the till/bedrock interface zone in the vicinity of that well. Consequently, the area near well 612 was investigated by drilling six soil borings, designated B-804, B-805, B-806, B-807, B-826 and B-827, and shown on **Figure 2-1**. Continuous soil samples were collected using sonic drilling methods and were screened in the field with an 11.7 eV photoionization detector (PID) for both TCE-series and TCA-series parameters, using jar headspace analysis techniques. One soil sample from the vadose zone and one soil sample from the saturated zone were selected from each boring for VOC analysis by SW-846 Method 8260C. Upon completion of these soil borings, nominal two-inch diameter PVC monitoring wells were installed with five-foot PVC screen intervals set approximately 2.5 feet into competent bedrock, straddling the till/bedrock interface. Geologic logs and well construction details for these soil borings are presented in **Appendix B**. The monitoring wells were sampled in late April and early May 2018 and the samples were analyzed for 16 SW-846 Method 8260C VOCs listed in the facility's Groundwater Monitoring Plan. The results are discussed in **Section 3.3**.

2.2 Siting of New P001 Extraction Well

Two monitoring wells, designated 700 and 701, were sited, installed, developed, and sampled in the western part of the P001 Area. The locations of these wells are shown on **Figure 2-2**. Soil samples were collected as the borings for these monitoring wells were advanced, and the completed monitoring wells were hydraulically tested. Data collected from these test borings and monitoring wells was used to select a viable location for a new groundwater extraction well screened at the till/bedrock interface.

2.2.1 Geophysical Survey

A geophysical survey was performed by AGS in November 2017 to facilitate selection of an optimal location for an extraction well in the northern parking lot area, west of the existing P001 extraction wells. The geophysical survey assessed the apparent extent and thickness of transmissive weathered and/or fractured bedrock zones in the area of the competent bedrock surface trough (refer to **Section 3.1**) west of extraction wells 413 and 416. The seismic refraction method was used to identify the bedrock surface and map the bedrock topography. The very low frequency (VLF)

electromagnetic (EM) method was used to identify bedrock fractures possibly coinciding with topographic lows in the bedrock or with weathered bedrock zones determined from the seismic refraction results. The report prepared by AGS is presented in **Appendix A**.

Four seismic refraction lines (SR-1 through SR-4) oriented from south-southeast to north-northwest were run in southwestern part of the northern parking lot area east of Lake View Parkway to support siting of test boring locations with the ultimate goal of identifying a suitable location for an extraction well screened in the till/bedrock interface zone. A fifth seismic refraction line (SR-5) oriented from southwest to northeast was run east of the other four seismic refraction lines. All seismic lines were approximately 350 feet in length.

VLF EM was performed along five traverses (VLF-1 through VLF-5) oriented from south-southeast to north-northwest. The westernmost traverse was situated along the western side of Lake View Parkway and the easternmost traverses were situated in the parking lot areas east of extraction wells 413 and 416. VLF EM traverses ranged from approximately 590 to 780 feet in length.

2.2.2 Installation of Test Monitoring Wells

Test monitoring wells 700 and 701 were installed in the till/bedrock interface zone using hollow stem auger techniques with continuous split-spoon sampling and wireline coring as necessary to the top of bedrock, as specified in the Work Plan. Geologic logs and well construction details for these two wells are presented in **Appendix B**. Soil samples were collected from each split spoon interval and from core intervals that encountered soil for sieve analysis to facilitate the design of the screen for the proposed extraction well. Split spoon and core soil samples were screened in the field using an 11.7 eV PID for both TCE-series and TCA-series parameters, using jar headspace analysis techniques.

2.2.3 Groundwater Sampling

Consideration of *in-situ* biodegradation as a remedial alternative for both source reduction and plume reduction requires (1) delineating residual VOC mass in soil in the Tank Farm Area and in the P001 Area east of the P001 extraction wells, and (2) groundwater sampling and analysis for inorganic parameters and transformation indicator parameters such as oxidation-reduction potential

(ORP), pH, dissolved oxygen (DO), nitrate, sulfate, and iron (ferrous, ferric, total) to understand the existing groundwater geochemistry throughout the northern VOC plume area.

To this end, test monitoring wells 700 and 701, together with other monitoring wells located along the axis of the groundwater plume in the northern VOC plume area and completed in the bedrock or till/bedrock interface zone, were sampled for the organic, inorganic, and field screening parameters listed in Table 4-1 of the Work Plan and using procedures described in the Appendix A-4 of the Work Plan. From east to southwest, these wells are 128, 610, 612, 395, 701, 700, 393, 378, 522, 521, and 397. Six wells completed in the alluvial zone or till and located along the plume axis were also sampled at the same time: 613, 394, 379, 529, 608, and 398. The locations of all of these wells are highlighted on **Figure 2-3**.

2.2.4 Hydraulic Testing

Pulse (slug) tests were performed on monitoring wells 700 and 701 to provide additional hydraulic conductivity data for the northern VOC plume area and determine the location with the highest hydraulic conductivity in an effort to select the most favorable location for the proposed extraction well. The slug tests were performed using a physical displacement slug and automated water level recorder, and were analyzed using aquifer testing software. The test results yielded hydraulic conductivities of 6.5 feet/day for well 700 and 3.0 feet/day for well 701, which are typical rates for unconsolidated deposits consisting of silty sand or fine sand. Hydraulic testing results are presented in **Appendix C**.

2.3 Replacement for Extraction Well 414

The performance of existing P001 area extraction well 414 continued to decline during the course of the P001 investigation in April 2018. Well 414 is a low yielding, dual-zone extraction well screened from the till/bedrock interface zone up to the base of the alluvial zone. The well was installed in 1990 and replaced extraction well 402, which was installed in 1981. For the past several years, well 414 has experienced intermittent issues associated with a degraded/corroded casing, failing pumps, and fouling. The steel-cased section of the well was stabilized several years ago by relining with a thin fiberglass liner. It is believed that the lower fiberglass liner failed on August 3, 2018, allowing formation material (rock fragments) to enter and plug well 414. Attempts to remove

the well pump using a heavy hoist truck were unsuccessful due to binding of the pump with collapsed formation material.

Although not a task described in the August 2017 Work Plan, the replacement of well 414 has long been anticipated. With the drilling rig already on site for the planned P001 investigation activities, soil boring 418A was drilled five feet northeast of well 414 near a potential location for a replacement extraction well. The purpose of boring 418A is to generate a detailed well log for installing a replacement well solely in the alluvial zone and fill, and to collect soil samples for sieve analysis and selection of a well screen size. A geologic log for boring 418A is presented in **Appendix B**. The replacement extraction well (well 418) will be installed on an accelerated schedule (in mid-September 2018) due to the failure of well 414.

3 FINDINGS

The findings of the remedial alternatives investigation in the P001 Area are provided in this section.

3.1 Source Delineation Borings

As detailed in **Section 2.1**, 17 soil borings were drilled for the purpose of source delineation in the area around Building 306, west of the former Tank Farm Area, and six soil borings were drilled in each of the two areas of elevated concentrations of VOCs east of the P001 Area extraction wells in the vicinity of monitoring wells 609 and 612.

All borings were completed down to bedrock, and the elevation of the bedrock surface was calculated from the difference between the surveyed surface elevation shown in **Table 2-1** and the depth to bedrock indicated on the geologic logs in **Appendix B**. The additional bedrock surface elevation points obtained in this manner were used to refine the existing bedrock elevation contour map for the northern area of the Site. **Figure 3-1** shows the bedrock elevations at each of the borings installed for the current investigation as well as bedrock elevations for monitoring wells installed during earlier investigations in the 1980s and 1990s. The new bedrock elevation data confirms the presence of a trough or buried valley in the surface of competent bedrock on the western edge of the P001 Area.

Based on jar headspace results, one soil sample from the vadose zone and one soil sample from the saturated zone in each boring were analyzed for SW-846 Method 8260C VOCs. The analytical chemistry results for two groups of VOCs - TCA-series parameters and TCE-series parameters plus PCE - in all 58 of these soil samples are summarized below on **Table 3-1** and are shown as pie charts on **Figure 3-2**. The complete analytical results are presented in **Appendix D**.

Table 3-1. Summary of Analytical Chemistry Results for Soil Samples

Boring No.	Depth (ft bgs)	111-TCA	11-DCA	11-DCE	PCE	TCE	c12-DCE	VC
800	18-19'	ND@6	ND@6	ND@6	ND@6	ND@6	ND@6	ND@6
	47-48'	ND@4	4 J	ND@4	ND@4	ND@4	ND@4	ND@4
801	19-20'	ND@7	ND@7	ND@7	ND@7	ND@7	ND@7	ND@7
	48-49'	ND@4	ND@4	ND@4	ND@4	ND@4	ND@4	ND@4
802	11-12'	ND@4	ND@4	ND@4	ND@4	ND@4	ND@4	ND@4
	52-53'	110 J	260 J	34 J	ND@5	6 J	12 J	ND@5
803	20-21'	ND@5	ND@5	ND@5	ND@5	ND@5	ND@5	ND@5

Table 3-1. Summary of Analytical Chemistry Results for Soil Samples								
Boring No.	**Depth (ft bgs)**	**111-TCA**	**11-DCA**	**11-DCE**	**PCE**	**TCE**	**c12-DCE**	**VC**
	39-40'	ND@5	ND@5	ND@5	ND@5	ND@5	ND@5	ND@5
804	19-20'	ND@4	ND@4	ND@4	ND@4	ND@4	ND@4	ND@4
	58-59'	50 J	1300 J	1500 J	ND@4 J	17 J	140 J	4 J
805	29-30'	ND@6	ND@6	ND@6	ND@6	ND@6	ND@6	ND@6
	46-47'	ND@4	6	1 J	0.9 J	44	4 J	ND@4
806	26-27'	ND@6	ND@6	ND@6	ND@6	2 J	ND@6	ND@6
	47-48'	8	200	140	ND@4	150	79	5
807	15-16'	ND@5	ND@5	ND@5	ND@5	ND@5	ND@5	ND@5
	54-55'	6	1900	1100	ND@5	14	250	8
808	06-07'	ND@6	ND@6	ND@6	ND@6	ND@6	ND@6	ND@6
	25-26'	ND@5	ND@5	ND@5	ND@5	ND@5	ND@5	ND@5
809	10-11'	ND@5	ND@5	ND@5	ND@5	1 J	ND@5	ND@5
	24-25'	ND@5	ND@5	ND@5	ND@5	ND@5	ND@5	ND@5
810	05-06'	ND@5	ND@5	ND@5	ND@5	ND@5	ND@5	ND@5
	25-26'	ND@5	1 J	19	ND@5	7	ND@5	ND@5
811	11-12'	ND@6	ND@6	ND@6	ND@6	ND@6	ND@6	ND@6
	23-24'	4 J	ND@5	30	ND@5	ND@5	ND@5	ND@5
812	04-05'	ND@5	ND@5	ND@5	ND@5	ND@5	ND@5	ND@5
	19-20'	15	2 J	26	5	49	2 J	ND@5
813	09-10'	ND@5	ND@5	ND@5	ND@5	1 J	ND@5	ND@5
	26-27'	15 J	2300 J	150 J	ND@5 J	9 J	1600 J	1 J
814	09-10'	2 J	ND@5	ND@5	ND@5	6	ND@5	ND@5
	23-24'	14	6	3 J	16	58	7	ND@5
815	09-10'	4 J	ND@5	ND@5	ND@5	27	ND@5	ND@5
	19-20'	4 J	8	4 J	ND@5	30	12	ND@5
816	09-10'	13	1 J	2 J	ND@5	100	ND@5	ND@5
	20-21'	21	150	20	2 J	1900	11	ND@4
817	14-15'	5	2 J	61	ND@5	180	3 J	ND@5
	19-20'	58	82	630 J	ND@5	1300 J	75	1 J
818	10-11'	ND@4	ND@4	ND@4	ND@4	2 J	ND@4	ND@4
	18-19'	7	1 J	45	ND@5	2 J	1 J	ND@5
819	10-11'	ND@5	ND@5	ND@5	ND@5	ND@5	ND@5	ND@5
	30-31'	2 J	1700 J	89 J	ND@5	ND@5	1300 J	3 J
820	05-06'	ND@4	ND@4	ND@4	ND@4	ND@4	ND@4	ND@4
	16-17'	3 J	ND@5	10	ND@5	34	ND@5	ND@5
821	10-11'	ND@5	ND@5	ND@5	ND@5	ND@5	ND@5	ND@5
	21-22'	ND@5	ND@5	ND@5	ND@5	ND@5	ND@5	ND@5
822	10-11'	ND@6	ND@6	ND@6	ND@6	ND@6	ND@6	ND@6
822	25-26'	ND@5	ND@5	ND@5	ND@5	ND@5	ND@5	ND@5
823	09-10'	ND@5	ND@5	ND@5	ND@5	2 J	ND@5	ND@5

Table 3-1. Summary of Analytical Chemistry Results for Soil Samples								
Boring No.	**Depth (ft bgs)**	**111-TCA**	**11-DCA**	**11-DCE**	**PCE**	**TCE**	**c12-DCE**	**VC**
	19-20'	38	3 J	11	30	270	5	ND@5
824	09-10'	ND@5	ND@5	ND@5	ND@5	ND@5	ND@5	ND@5
	14-15'	9	44	30	ND@5	13	ND@5	ND@5
825	09-10'	4 J	3 J	1 J	ND@4	50	13	ND@4
	22-23'	180 J	590	2400	ND@240	5600	460	ND@240
826	09-10'	ND@5	ND@5	ND@5	ND@5	ND@5	ND@5	ND@5
	54-55'	29	13	11	ND@5	1300	11	ND@5
827	24-25'	ND@6	ND@6	ND@6	ND@6	ND@6	ND@6	ND@6
	54-55'	8	8	7	ND@5	44	5	ND@5
828	19-20'	ND@5	ND@5	ND@5	ND@5	ND@5	ND@5	ND@5
	25-26'	ND@5	ND@5	ND@5	ND@5	ND@5	ND@5	ND@5

All units are micrograms per kilogram (mg/kg).
ft bgs = feet below ground surface.
ND = Not detected
J = Estimated value

The results from the vadose zone are shown above the results from the saturated zone for each boring listed on **Table 3-1**. The depth of each soil sample is also noted.

The pie charts display soil VOC concentrations data as proportional slices of a circle on a map of the P001 Area and Tank Farm Area. Each concentration is divided by the sum of all concentrations to determine the size of the slice. VOC concentrations with the largest proportions appear as the largest slices and the circles (pies) with the larger diameters indicate larger total VOC concentrations. Pie maps for soil samples collected from the vadose zone (above the water table) are shown at the top of **Figure 3-2** and pie maps for soil samples collected from the saturated zone (below the water table) are shown at the bottom of **Figure 3-2**. The two VOC groups are (1) TCE and its daughter product c12-DCE along with tetrachloroethene (PCE), and (2) 111-TCA and its daughter products 11-DCA and 11-DCE. VC, a daughter product of TCE and c12-DCE, was detected in only six soil samples at concentrations ranging from 1 to 8 ug/kg and is not displayed on the pie charts.

The pie charts on **Figure 3-2** show that soils in the saturated zone still contain some sorbed VOC mass, with the highest concentrations of TCA-series and TCE-series compounds detected at boring B-825 near the former Tank Farm Area, at borings B-816, B-813, and B-819 west and north of Building 306, and at boring B-817 near the northwest corner of Building 002. At borings B-813 and B-819, c12-DCE concentrations are hundreds of times higher than the parent TCE

concentrations, and 11-DCA concentrations are hundreds of times higher than the parent 111-TCA concentrations. At soil borings B-804, B-806, and B-807 in the vicinity of well 612, concentrations of daughter products of 111-TCA and TCE predominate. However, none of the VOC concentrations detected during this investigation suggests the presence of significant residual non-aqueous phase liquid (NAPL) in soil.

VOC concentrations in vadose zone soils are significantly lower than in saturated soils, and the only significant detections of TCA-series and TCE-series compounds were at B-816, north of Building 306, and at B-817 near the northwest corner of Building 002. These vadose zone concentrations may be sourced from elevated concentrations of VOCs in groundwater beneath these areas.

3.2 Water Levels and Flow Directions

Groundwater elevations in the till/bedrock interface zone were measured on June 6, 2018 in all of the temporary 800-series monitoring wells/borings, in monitoring wells 700 and 701, and in other monitoring wells in the P001 Area. This groundwater elevation data is summarized below on **Table 3-2** and is shown on **Figure 3-3**, which is a groundwater elevation contour map of the potentiometric surface in the till/bedrock interface zone. **Figure 3-3** shows patterns of groundwater flow and capture consistent with those shown in the Site's annual and semiannual reports, with groundwater generally flowing from east to west or northeast to southwest in the till/bedrock interface zone beneath manufacturing Building 002 and the P001 Area (except where influenced by extraction wells). The apparent limits of hydraulic capture of till/bedrock extraction well 415 extend north of the Tank Farm Area and beneath Building 306 and the northern portion of Building 002. The apparent limits of hydraulic capture of P001 Area extraction wells 413, 416, and 414 in the till/bedrock interface zone extend across much of the parking lot areas in the northern portion of the Site.

Table 3-2: Groundwater Elevaton Data
P001 Area Remedial Alternatives Investigation
Measurement Date: June 6, 2018

Well	M.P. Elev. (feet amsl)	Depth to Water (feet)	Groundwater Elevation (feet amsl)
124	911.43	6.70	904.73
125	905.36	8.10	897.26
126	908.95	8.22	900.73
127	909.65	4.64	905.01
128	914.23	18.88	895.35
129	912.10	2.82	909.28
140R	889.14	30.58	858.56
143	884.81	6.45	878.36
146	868.04	5.40	862.64
324	892.67	33.00	859.67
364	897.72	34.20	863.52
366	912.48	39.12	873.36
367	910.15	45.79	864.36
393	892.69	29.90	862.79
395	890.07	27.13	862.94
413	889.16	46.47	842.69
414	893.11	53.42	839.69
415	914.38	21.48	892.90
416	890.58	66.82	823.76
605	885.23	17.45	867.78
607	900.64	35.12	865.52
609	895.16	NM	NM
610	909.10	15.44	893.66
612	903.93	32.45	871.48
616	888.18	6.33	881.85
617	895.77	5.28	890.49
618	909.29	5.51	903.78
700	889.06	26.30	862.76
701	888.24	25.12	863.12

Well	M.P. Elev. (feet amsl)	Depth to Water (feet)	Groundwater Elevation (feet amsl)
B-800	897.44	24.05	873.39
B-801	895.75	24.07	871.68
B-802	894.13	21.55	872.58
B-803	895.84	18.53	877.31
B-804	904.40	38.14	866.26
B-805	902.12	35.05	867.07
B-806	902.79	29.10	873.69
B-807	905.04	33.00	872.04
B-808	897.72	16.41	881.31
B-809	912.89	12.80	900.09
B-810	912.10	11.90	900.20
B-811	912.06	12.95	899.11
B-812	911.71	13.52	898.19
B-813	910.95	12.98	897.97
B-814	910.26	11.78	898.48
B-815	910.17	10.72	899.45
B-816	908.73	7.93	900.80
B-817	913.03	12.18	900.85
B-818	913.02	15.32	897.70
B-819	912.06	16.47	895.59
B-820	911.73	12.30	899.43
B-821	910.97	12.34	898.63
B-822	910.37	11.90	898.47
B-823	910.37	11.62	898.75
B-824	912.04	10.38	901.66
B-825	913.25	6.56	906.69
B-826	901.36	38.37	862.99
B-827	899.53	30.94	868.59
B-828	894.23	17.01	877.22

NM = Not measured (reading determined to be erroneous)
M.P. Elev. = Measuring Point Elevation
feet amsl = feet above mean sea level

3.3 VOC Plume Delineation

Groundwater samples were collected from all 29 of the temporary 800-series monitoring wells/borings, from test monitoring wells 700 and 701, and from other monitoring wells in the P001 Area in late April and early May 2018. The samples were analyzed by SW-846 Method 8260C for 16 VOCs listed in the facility's Groundwater Monitoring Plan and the analytical chemistry data is summarized in **Appendix E**. Shaded isoconcentration contour maps depicting the VOC plumes in the till-bedrock interface zone beneath the northern portion of the Site are provided as **Figures 3-4 through 3-11**. In addition to the composite TCA-series and TCE-series plumes shown on **Figures 3-4 and 3-8**, plume maps are provided for six individual VOCs comprising the TCA-series and TCE-series: 111-TCA, 11-DCA, 11-DCE, TCE, c12-DCE, and VC.

All of these figures show VOC plumes originating from the vicinity of the former Tank Farm Area and the northwestern portion of Building 002, and are consistent with the representation of those plumes as presented in the Work Plan. The additional groundwater chemistry data obtained from the temporary monitoring wells installed around monitoring wells 609 and 612 also confirms the representation of the VOC plumes in those two areas as presented in the Work Plan. The additional groundwater chemistry data obtained from the temporary 800-series monitoring wells allowed for the refinement of existing VOC plume boundaries, particularly in the area between extraction well 415 and monitoring well 610, and in the areas around monitoring wells 609 and 612.

Both the TCE and TCA series VOC plumes extend off-Site in the till/bedrock interface zone beneath the Moore Tire property. A comparison of **Figures 3-4 and 3-8** shows that the TCA-series plume is generally higher in concentration than the TCE-series plume, although both plumes are similar in lateral extent. Both plumes narrow as they extend off-Site beneath the Moore Tire property and this off-Site extension corresponds roughly with the base of a buried bedrock valley oriented southwest-to-northeast and shown on **Figure 3-1**. The leading edges of both plumes in the till/interface zone appear to attenuate beneath the Moore Tire property.

3.4 Results of Transformation Indicator Parameter Screening/Analyses

As described in **Section 2.2.3**, groundwater sampling and analysis was performed for inorganic parameters and transformation indicator parameters including ORP, pH, DO, CO_2, nitrate, sulfate, and iron (ferrous, ferric) to develop an understanding of the groundwater geochemistry throughout

the northern VOC plume area. Analytical results for these and other parameters in 17 monitoring wells located along the axis of the groundwater plume in the P001 Area are summarized below on **Table 3-3**. The complete analytical results for inorganic and transformation indicator parameters are presented in Appendix E.

Table 3-3: Summary of Transformation Indicator Parameters
P001 Area Remedial Alternatives Investigation, Owego, New York
May 2018

	Location on Figure 2-3:	*West*			*Moore Tire*	*Lakeview Pkwy*				*Extraction Wells*		*East/B306*	
Parameter	**Value most amenable to biodegradation (reducing conditions)**	**Well**	**398**	**608**	**529**		**379**	**394**			**613**		*Alluvial Zone and Till*
		Zone	Alluvial	Alluvial	Alluvial		Till	Alluvial			Alluvial		
		Units											
DOC	>1.0	mg/L	1.3	1.4	0.66		0.9	3.1			1.6		
DO	<0.5	mg/L	6.48	0.16	0.2		0.27	0.11			0.1		
ETHANE	if present	ug/L	ND@5	ND@5	ND@5		0.2	0.23			1.1		
ETHENE	if present	ug/L	0.23	ND@5	0.39		ND@5	ND@5			1.7		
FREE CO2	<50000	ug/L	56000	65000	26000		89000	240000			260000		
METHANE	if present	ug/L	6.2	63	60		27	90			1800		
ORP	if negative	mV	167.3	-17.4	-61.9		-11.4	45.5			227.8		
PH	6 to 8	SU	6.41	6.78	7		6.54	6.43			5.09		
NO3-N	<1.0	mg/L	ND@0.5	ND@0.5	ND@0.5		ND@0.5	ND@0.5			0.54		
SO4	<11	mg/L	8.2	10.1	9.3		18.2	10.8			46.7		
FE+2	if present	mg/L	0.046	0.76	0.45		11.6	13.1			0.12		
TCA:11-DCA	<2.0 (anaerobic)	--	1.4	0.9	2.0		1.2	2.8			2.7		
TCA:11-DCE	>5.0 (abiotic)	--	2.1	1.6	4.0		5.2	3.8			2.8		
TCE:CIS	<2.0 (anaerobic)	--	5.6	11.4	8.0		6.4	7.5			4.6		
TCE:VC	<20 (anaerobic)	--	--	120.0	--		--	180.0			80.0		

Parameter	**Value most amenable to biodegradation (reducing conditions)**	**Well**	**397**		**521**	**522**	**378**	**393**	**700**	**701**	**395**	**612**	**610**	**128**	*Till/Bedrock Interface Zone and Bedrock*
		Zone	T/BR		T/BR	T/BR	Bedrock	T/BR	T/BR	T/BR	T/BR	T/BR	T/BR	T/BR	
		Units													
DOC	>1.0	mg/L	ND@1		0.84	0.66	0.81	0.76	1.9	0.95	0.75	1.4	1.1	1.1	
DO	<0.5	mg/L	0.09		0.07	0.68	0.03	0.16	0.04	0.03	0	0.39	0.07	0.94	
ETHANE	if present	ug/L	ND@5		0.57	0.52	0.42	0.68	0.99	0.82	0.72	2	ND@5	ND@5.0	
ETHENE	if present	ug/L	ND@5		3.3	2.8	2	3.8	3.3	3.1	2.7	1.4	ND@5	1.3	
FREE CO2	<50000	ug/L	4000		39000	48000	78000	53000	45000	44000	48000	220000	220000	31000	
METHANE	if present	ug/L	20		140	130	88	150	130	130	130	1700	230	ND@5.0	
ORP	if negative	mV	-98.7		-62.3	-23.7	-42.8	-82.9	-91.3	-118.3	-58.9	190.5	214.7	216.8	
PH	6 to 8	SU	7.84		6.94	6.81	6.63	6.74	6.82	6.74	6.89	5.62	5.09	6.27	
NO3-N	<1.0	mg/L	ND@0.5		ND@0.5	ND@0.5	ND@0.5	ND@2.0	ND@0.5	ND@0.5	ND@0.5	ND@0.5	1.7	5	
SO4	<11	mg/L	7.9		17.8	17.2	21.8	27.2	20.3	19.9	21.1	37.8	95.1	112	
FE+2	if present	mg/L	2.4		3.4	3.2	8.6	4	5.2	13.1	24.7	4	0.11	ND@0.050	
TCA:11-DCA	<2.0 (anaerobic)	--	2.1		0.2	0.4	0.6	0.7	0.7	0.7	0.9	2.1	3.2	4.7	
TCA:11-DCE	>5.0 (abiotic)	--	3.2		3.5	5.1	6.8	7.9	7.7	7.6	10.1	2.5	2.4	2.2	
TCE:CIS	<2.0 (anaerobic)	--	8.3		0.2	0.6	1.1	1.4	1.3	1.1	1.5	4.7	4.7	0.7	
TCE:VC	<20 (anaerobic)	--	--		0.7	3.5	9.8	12.7	11.7	10.8	15.8	85.5	480.0	12.9	

Key: *Color Coding for Biodegradation Conditions:*
- Most amenable
- Marginally amenable
- Least amenable
- Indeterminate

DOC = Dissolved organic carbon
DO = Dissolved oxygen
ORP = Oxidation-Reduction Potential
NO3-N = Nitrate-Nitrogen
SO4 = Sulfate
FE+2 = Ferrous iron

TCA = 1,1,1-Trichloroethane
11-DCA = 1,1-Dichloroethane
11-DCE = 1,1-Dichloroethene
TCE = Trichloroethene
CIS = cis-1,2-Dichloroethene
VC = Vinyl Chloride

Sulfide was not detected in any sample at reporting imits ranging from 2 to 4 mg/L.
FE+3 (ferric iron) was not detected in any sample at reporting limits ranging from 0.4 to 5 mg/L.

The data on **Table 3-3** are arranged according to water-bearing unit and well position along the plume axis, as shown on Figure 2-3. Results for westernmost wells are on the left side of the table, easternmost wells closer to the source areas are on the right side, wells screened in the alluvial zone

or till are at the top of the table, and deeper wells screened in the till/bedrock interface zone or bedrock are at the bottom. Various VOC concentration ratios indicating progressive transformation via dechlorination of the parent chemicals 111-TCA and TCE are also shown on **Table 3-3**.

Table entries are highlighted according to whether the analytical result or concentration ratio suggests that conditions are amenable to biodegradation of TCA-series or TCE-series compounds. For each parameter listed on Table 3-3, the second column of Table 3-3 lists values or conditions (e.g., >1.0, <0.5, "if present", etc.) most amenable to biodegradation (reducing conditions). "Green" table entries are most amenable for reducing conditions, "yellow" entries are less amenable for reducing conditions, and "brown" entries are least amenable for reducing conditions. Entries that are not highlighted neither favor nor disfavor reducing conditions amenable to biodegradation of VOCs.

Geochemical conditions in till/bedrock zone east of P001 extraction wells 413, 416, and 414 are less conducive to biodegradation of TCA and TCE-series compounds, as indicated by the predominant brown and yellow highlighted entries for wells 612, 610, and 128. These less favorable conditions include elevated concentrations of free CO_2, sulfate, and nitrate; positive ORP results; and elevated concentrations of 111-TCA and TCE relative to the concentrations of their daughter products. Similarly, geochemical conditions in the alluvial zone wells are less conducive to biodegradation of TCA-series and TCE-series compounds, as indicated by elevated concentrations of free CO_2, positive ORP and elevated concentrations of 111-TCA and TCE relative to the concentrations of their daughter products, particularly at wells 398, 608, 394, and 613.

The data on **Table 3-3** suggest natural reducing conditions in the till/bedrock zone west of the P001 extraction wells, as indicated by many green highlighted entries, beginning with on-Site well 395 near extraction well 416 and ranging westward through test monitoring wells 700 and 701, on-Site wells 393 and 378, and off-Site wells 522 and 521 on the Moore Tire property.

4 UPDATED CONCEPTUAL SITE MODEL

A Conceptual Site Model (CSM) was developed as part of the Work Plan preparation to aid in focusing the scope of the remedial investigation field explorations and testing. The CSM was developed based on Site history, Site hydrogeology, and the nature and extent of VOCs detected in soil and groundwater by previous investigations and by decades of groundwater corrective action monitoring. The findings of this remedial investigation were used to prepare an updated CSM to support review of potential remedial measures with the goals of: (1) accelerating overall VOC reductions in the northern VOC plume Area; and (2) supplementing or enhancing the existing groundwater extraction system in the P001 Area. Descriptions of the elements of the updated CSM are provided in the following subsections.

4.1 Site Hydrogeology

A cross-section depicting the Site hydrogeologic conditions in the northern VOC plume area is provided as **Plate 4-1**. As shown on the plate, the geologic strata consist of a downward sequence of soil fill, alluvium, glacial till, and bedrock. An organic silt stratum of limited extent is located between the soil fill and the underlying alluvium in the area of the parking lot west of the P001 Area extraction wells and east of the Lake View Parkway entrance road. Thin discontinuous horizons of weathered bedrock are also present at the contact between the glacial till and competent bedrock.

A review of boring logs for the northern VOC plume area indicates the soil fill consists of reworked alluvium, till, and bedrock, including numerous cobbles and boulders in some locations. The alluvium consists of post-glacial and late-glacial stratified deposits of reworked glacial till and other unconsolidated sediments. The glacial till is typically very dense, has a silty matrix and includes numerous cobbles and boulders. The bedrock consists of shale and siltstone with nearly horizontal, flat-lying bedding. The alluvium and the weathered bedrock along the till/bedrock interface have higher relative transmissivity and are considered water-bearing zones, whereas the very dense, silty glacial till and the deeper competent shale and siltstone bedrock are considered to be aquitards. As shown on cross-section A-A' on **Plate 4-1**, the alluvium pinches out in the Building 002/Building 306 Tank Farm Area to the east, whereas the thickness of soil fill is greater than 20 feet beneath much of the P001 Area. As shown schematically on cross-section A-A', near-horizontal bedding-parallel joints (fractures) are most common in the competent bedrock, and the density and interconnection of the fractures are inferred to decrease significantly with depth.

The hydraulic characteristics of the two water-bearing zones are highly variable and were studied extensively in the early 1990s when *in situ* hydraulic conductivity tests ("pulse" tests or "slug" tests) were performed on 41 monitoring wells by GSC and others. For the alluvial zone, the range in hydraulic conductivities (K) spans four orders and magnitude, from 0.3 to 300 feet per day, and indicates a high degree of variability in the water-transmitting capabilities of this unit. The median K in the alluvial zone is 7 feet per day from 19 well tests. For the till/bedrock interface zone, the hydraulic conductivity ranges over more than three orders and magnitude, from 0.7 to greater than 100 feet per day, with a median of 50 feet per day from 16 well tests (combined results from wells screened across the till/bedrock interface and screened within the weathered bedrock).

Groundwater elevation data recorded in July 2016 and equipotential contours inferred from the July 2016 water levels are included on the **Plate 4-1** cross-section. As shown on the cross-section, the water table in the Tank Farm Area is located within the glacial till, whereas the water table in the P001 Area and the off-Site area of Moore Tire is primarily located within the alluvium. The inferred equipotential contours and flow directions depicted on cross-section A-A' indicate capture of till/bedrock interface zone groundwater in the Tank Farm Area by extraction well 415, and capture of the alluvial zone and till/bedrock interface zone groundwater in the P001 Area by the line of extraction wells operating in July 2016 (wells 413, 416, and 414 - note the location of extraction well 416 on **Plate 4-1**).

As indicated on **Figure 3-3**, except where influenced by the extraction wells, groundwater flow in the till/bedrock zone beneath manufacturing Building 002 and the P001 Area is generally from east to west or northeast to southwest. The apparent limits of hydraulic capture of till/bedrock extraction well 415 extend north of the Tank Farm Area and beneath the northern portion of Building 002. The apparent limits of hydraulic capture of P001 Area extraction wells 413, 414, and 416 in the till/bedrock zone extend across much of the northern parking lot areas. Groundwater flow in the till/bedrock zone beneath the Moore Tire property is from northeast to southwest, flowing back on-Site in the Waste Management Area located in the west-central portion of the Site. As depicted by the size and orientation of the flow arrows on the **Plate 4-1** cross-section, the relatively higher transmissivity of the till/bedrock interface zone is inferred to serve as a preferential flow pathway for groundwater seepage from the overlying dense, silty glacial till and the underlying competent bedrock.

4.2 Apparent Nature and Extent of VOC Sourcing

The plumes of TCA-series and TCE-series constituents in the northern VOC plume area appear to originate in the immediate vicinity of the former Tank Farm Area and the northwest portion of Building 002. The former Tank Farm Area has been the suspected source of the P001 Area TCA-series and TCE-series plumes since their discovery in the 1980s. More recent sub-slab soil vapor sampling beneath Building 002 indicates that the plumes also originate from historical releases of 111-TCA and TCE from solvent stills formerly located in the northwestern portion of Building 002. The timing of the releases is unknown but likely occurred prior to 1979. The VOCs are inferred to have been released in the form of small leaks of dense non-aqueous phase liquids (DNAPL) and as aqueous phase mass dissolved in "general rinse" wastewaters. DNAPL associated with historical leaks would have migrated downward through the soil column and would have been deflected horizontally at the capillary fringe of the water table and at the surface of competent bedrock.

In 1980, about 255 tons of unsaturated soil containing 111-TCA, TCE, and methylene chloride at concentrations greater than one part per million were removed from the former Tank Farm Area near the northeastern corner of Building 002[3]. The findings of the source delineation borings completed as part of this remedial alternatives investigation did not identify evidence of significant VOC sourcing in the soil or weathered bedrock. These findings suggest that the majority of the remaining VOC mass is likely isolated in discrete portions of the soil and weathered bedrock beneath Building 002 and Building 306 and along fractures in the underlying competent bedrock.

Given the very dense, fine-grained nature of the glacial till and the discrete fracturing in the underlying competent bedrock, the DNAPL penetration at the time of the releases is inferred to have been localized to fractures in the till and bedrock. As depicted schematically on **Plate 4-1**, the extent of the DNAPL penetration in fractures in the bedrock is expected to decrease significantly with depth, based on (1) historical observations of blown yield during the drilling of extraction well 416 and (2) data from the former Gun Club at the former IBM Endicott facility, where the bedrock geology - flat-lying siltstones and shales of the Upper Devonian West Falls Group - appears to be

[3] *RCRA Facility Investigation Task I Report - Description of Current Conditions*, prepared by Malcolm Pirnie for IBM-Owego, July 1992, Page 3-12 and Figure 3-3.

identical to that of the Owego facility[4]. Well 416 shown on cross section A-A' (**Plate 4-1**) was drilled 100 feet into competent bedrock using air rotary methods without encountering any measureable water-bearing zones. At the former Gun Club, an extensive coring investigation determined that DNAPL did not penetrate deeply into the bedrock. After more than four decades, much of the DNAPL is expected to no longer be present due to partitioning to soil and bedrock via diffusion and sorption, and partitioning to groundwater via dissolution.

4.3 Fate and Transport of Northern VOC Plumes

The plumes of TCA-series and TCE-series constituents in the northern VOC plume area have had at least 40 years to develop west of the former Tank Farm Area and Building 002. The diffused and sorbed VOC mass in the soil and bedrock beneath the former Tank Farm Area and Building 002 serves as an ongoing source for maintaining the plumes. As groundwater flows from the east to the west, the plumes are replenished by VOC mass transfer from soil/bedrock to groundwater via "reverse" or "back" diffusion and desorption processes.

The inferred distribution of the TCA-series plume is depicted on cross-section A-A' (**Plate 4-1**) using data from July 2016. As shown on the cross-section, the TCA-series plume originates at the till/bedrock interface beneath the former Tank farm Area and Building 002 and extends westward within fractures in shallow bedrock. Elevated TCA-series concentrations in the alluvium, glacial till, and till/bedrock interface wells in the P001 Area can be explained by seepage of VOCs sourced from the competent bedrock to the east. As shown on **Figures 3-4 and 3-8**, the TCA-series plume is generally higher in concentration than the TCE-series plume, but both plumes are similar in lateral extent. Both plumes narrow as they extend off-Site beneath the Moore Tire property. The off-Site extension of both plumes roughly coincides with the base of a trough oriented southwest-to-northeast in the surface of competent bedrock, as noted in **Section 3.1** and confirmed by the geophysical survey. Based on the geometry of the competent bedrock surface and the relatively higher transmissivity of the till/bedrock interface zone as compared to the glacial till and competent

[4] *Geologic Map of New York, Finger Lakes Sheet*, published by the New York State Museum and Sciences Service, Map and Chart Series No. 15, 1970.

bedrock, groundwater extraction in the till/bedrock interface zone near test well 700 has the potential to intercept the majority of VOC mass flux beneath the northern parking lot area.

The leading edges of both plumes in the till/bedrock interface zone attenuate beneath the Moore Tire property due to the processes of diffusion, sorption, and sorption-retarded intragranular aqueous diffusion (associated with sorption onto organic carbon particles within the matrix of the till/bedrock rock fragments rather than on the surface of the till/bedrock rock fragments). Abiotic transformation of TCA to 1,1-DCE and reductive dechlorination of TCA-series and TCE-series constituents results in further attenuation of the VOC plumes throughout the northern VOC plume area. Biodegradation via reductive dechlorination appears to be greatest within the till/bedrock interface zone beneath the P001 Area and the Moore Tire property where groundwater exhibits natural reducing conditions. Reductive dechlorination appears to be a less prevalent attenuation mechanism in the alluvial zone and in the till/bedrock interface zone east of the P001 Area extraction wells, where natural reducing conditions are more localized due to groundwater recharge and water table fluctuations that result in the addition of oxygenated water to the groundwater system.

5 REMEDIAL ALTERNATIVES ANALYSIS

As summarized in the Work Plan, the results of preliminary screening using the criteria of short-term, long-term effectiveness, and implementability identified four remedial technologies for further consideration as part of this remedial alternatives investigation. Based on the findings of this investigation, the results of a remedial alternatives analysis of those four technologies is summarized in the following table.

Table 5-1. Evaluation of Remedial Technologies for the Northern Plume and Parking Lot 001 Area

Remedial Technology	Effectiveness Issues	Implementability Issues
In Situ Chemical Reduction (targeted injection of ZVI for source reduction)	1. No apparent distinct, accessible source area was identified. 2. Potential for incomplete reduction and rebound of dissolved VOC concentrations in groundwater due to reverse diffusion and desorption.	1. Site access restrictions in the area northwest of Building 002 and former Tank Farm Area due to subsurface utilities and nearby vibration-sensitive manufacturing operations. 2. Difficulties of drilling through dense till and boulders and delivering ZVI uniformly to target residual VOC mass. 3. Large number of injection wells would be needed to successfully deliver this technology due to the nature of the site's geology.
Enhanced Groundwater Extraction (one well screened in till/bedrock interface zone and one well screened in alluvial zone)	None, other than need for frequent extraction well rehabilitations to remove fouling due to natural reducing conditions.	None, other than Site access restrictions due to Site infrastructure and manufacturing operations.
In Situ Biodegradation (targeted injection of emulsified vegetable oil or other electron donor substances for source or plume reduction)	1. No apparent distinct, accessible source area was identified. 2. Demonstrated effectiveness for source or plume reduction but potential for incomplete reduction to harmless end products is a long-term concern. 3. Potential to enhance fouling of groundwater extraction wells and	1. Site access restrictions in the area northwest of Building 002 and former Tank Farm Area due to subsurface utilities and nearby vibration-sensitive manufacturing operations. 2. Difficulties of drilling through dense till and boulders and delivering emulsified vegetable oil or other substances uniformly to

	decrease their effectiveness at controlling VOC mass flux.	target residual VOC mass. 3. Difficulties in maintaining reducing conditions near the water table where conditions are naturally oxidizing. 4. Large number of injection wells would be needed to successfully deliver this technology due to the nature of the site's geology.
In Situ Sorption Combined with Biodegradation (targeted injection of suspended carbon)	1. Technology has a limited track record and has the potential for rebound if VOC mass sequestered onto carbon is not subsequently destroyed by biodegradation.	1. Difficulties of drilling through dense till and boulders and delivering carbon uniformly in a transect through weathered bedrock of the till/bedrock interface zone. 2. Difficulties in maintaining reducing conditions near the water table where conditions are naturally oxidizing. 3. Large number of injection points would be needed to successfully deliver this technology due to the nature of the site's geology.

In summary, based on the totality of the data collected in this and previous investigations conducted at the Site, we conclude that there are no accessible, distinct VOC source areas that could be targeted with *in situ* remedial technologies as presented above in Table 5-1. The groundwater plume and limited areas of elevated VOC concentrations in the vadose zone are simply too diffuse to be targeted in a cost-effective, efficient and logical manner using said technologies. Additionally, the groundwater geochemistry across significant portions of the most impacted areas of the Site does not appear conducive to a single *in situ* approach to address Site COCs in soil and groundwater. By contrast, groundwater extraction has a proven record of long-term effectiveness in controlling VOC mass flux and reducing the extent of VOC groundwater plumes. Therefore, the most effective remedial alternative for the Northern Parking Lot Area is to continue to operate, augment, and improve the groundwater pump-and-treat system.

6 CONCLUSIONS AND RECOMMENDATIONS

The following conclusions and recommendations are based on the findings of this Remedial Alternatives Investigation Report.

6.1 Conclusions

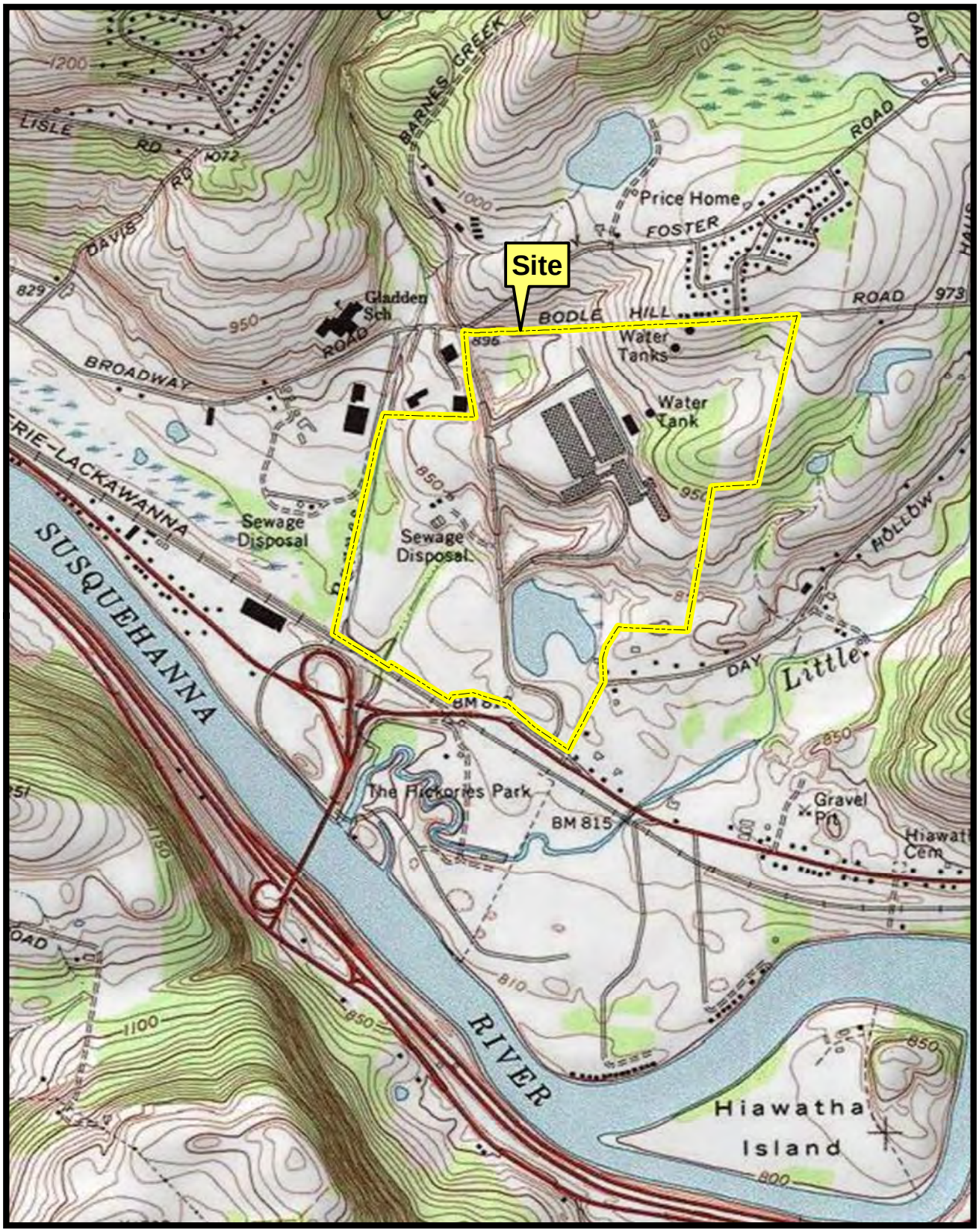
1. Based on the analytical chemistry results from 58 soil samples collected from 29 new soil borings, and from 51 groundwater samples collected from monitoring wells and from temporary monitoring points installed in the soil borings, there does not appear to be significant sourcing of VOCs within the vadose and saturated zones in the exterior areas adjacent to and downgradient from the suspected source area near Building 002 and Building 306. Furthermore, this investigation did not reveal significant VOC source areas in the western portion of the P001 Area.
2. Site stratigraphic conditions, groundwater elevations and corresponding flow directions are consistent with past site investigations and long-term groundwater monitoring performed in conjunction with RCRA corrective actions. The nature and extent of VOCs in groundwater in the area around Building 002 and Building 306 as identified by multiple temporary monitoring wells installed for this investigation indicate conditions similar to those identified by previous investigations and long-term groundwater monitoring.
3. Elevated concentrations of TCA- and TCE-series parameters in alluvium, glacial till, and till/bedrock interface wells in the P001 Area do not appear to identify areas of significant sourcing in soils. Elevated concentrations in the till/bedrock interface zone in vicinity of wells 609 and 612 are likely the result of downgradient transport of VOCs via fractures in competent bedrock that are connected to sources in bedrock beneath the former Tank Farm Area.
4. Geochemical conditions in the till/bedrock zone east of the P001 Area extraction wells are less conducive to biodegradation of TCA-series and TCE-series compounds than in the till/bedrock zone west of the extraction wells. Geochemical conditions in the alluvial zone across the northern VOC plume area are generally not conducive to biodegradation of TCA-series and TCE-series compounds. Natural reducing conditions conducive to biodegradation of TCA and TCE-series compounds are present in the till/bedrock interface zone west of the P001 extraction wells.

5. The overall nature and extent of VOC mass present in the Northern Plume Area is not conducive to *in situ* source reduction technologies. Enhancing groundwater extraction operations to optimize control of VOC mass flux has the most potential to reduce the VOC presence in the Northern Parking Lot Area and off-Site areas to the west.

6.2 Recommendations

The following recommendations are offered based on the findings, evaluations, and conclusions presented in Sections 3, 5, and 6.1 of this Report.

1. Based on the results from geophysical tests, test borings, and hydraulic testing, an optimal location for a new groundwater extraction well (417) completed in the till/bedrock zone near test well 700 was identified. This location is at a low point in the bedrock surface and is concordant with a significant east-west fracture extending across the northern parking lot area that may offer a preferential pathway for transport across the Site and into the Moore Tire area. The location also coincides with the off-Site extension of the TCE plume and would be a better location for intercepting VOC mass flux in the till/bedrock zone of the northern parking lot area than the current line of extraction wells (413, 414, and 416). We recommend installation of new extraction well 417 in the immediate vicinity of test well 700.
2. Based on the geologic log and sieve analysis of soil samples from test boring 418A, capture of the VOC plume in the alluvial zone in central portion of the P001 Area can be optimized with an extraction well (418) screened solely in the alluvium. Well 418 would have a greater influence on the alluvial zone than former extraction well 414, which was screened across multiple water-bearing zones. We recommend installation of new extraction well 418 in the immediate vicinity of test well 418A. As discussed in Section 2.3, this work will begin in September of 2018.
3. Quarterly sampling of till/bedrock zone wells in the northern VOC plume area is recommended for a period of two years. Although some of the wells in this area are currently sampled on a quarterly frequency, many are sampled only semiannually. Increasing the sampling frequency to quarterly will allow the progress of remediation to be closely monitored following installation and startup of groundwater extraction well 417.



Portion of the Apalachin, NY
USGS 7.5-Minute Quadrangle

Figure 1-1

IBM
Owego, New York

Site Location Map

N
W E
S

Scale (feet)
0 500 1,000 2,000

GROUNDWATER SCIENCES CORPORATION
Q:\93000\93004\GIS\Projects\Figs 09-2018\Fig1-1_SiteLocTopo.mxd • 9/7/2018

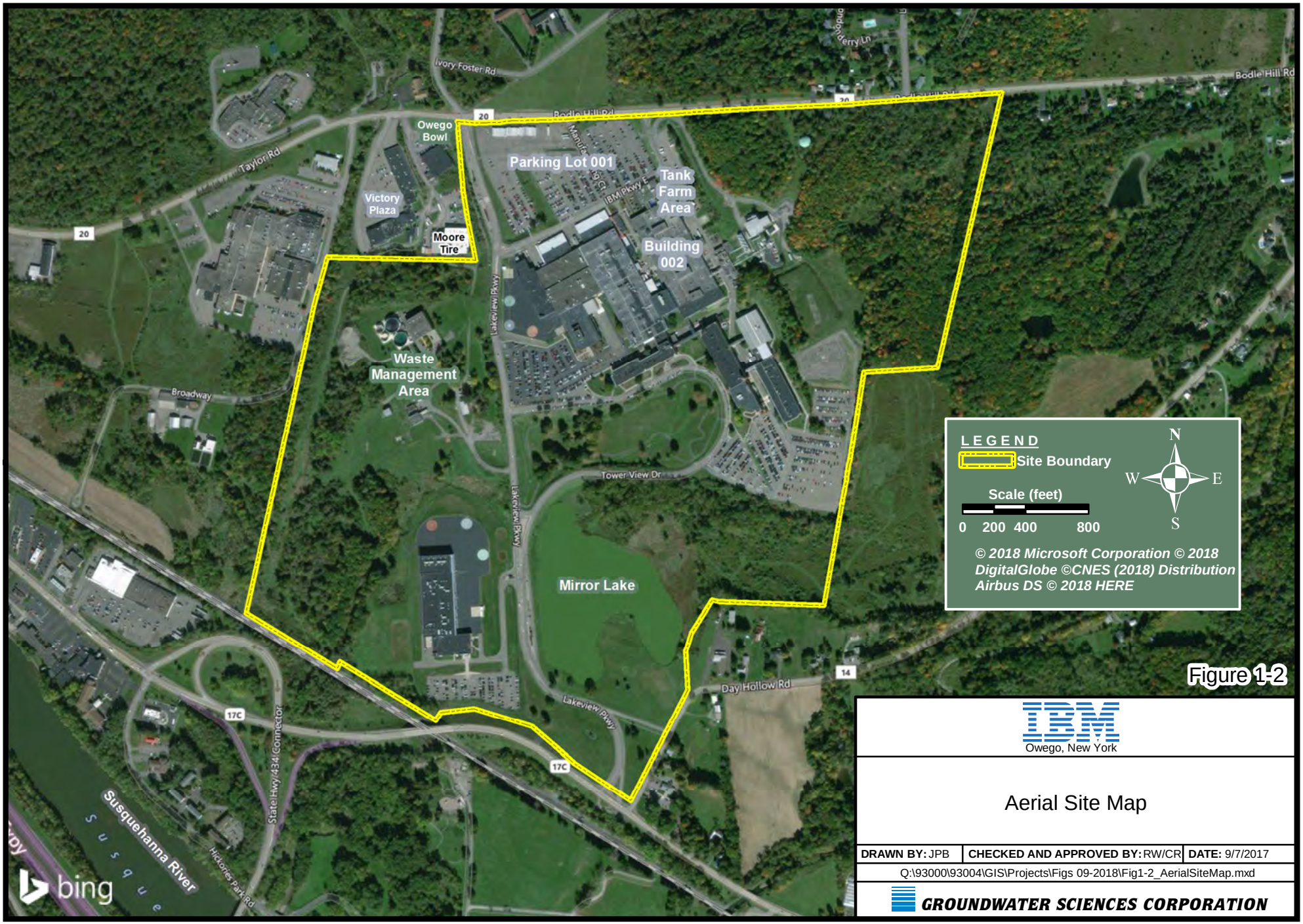


Figure 1-2

IBM
Owego, New York

Aerial Site Map

DRAWN BY: JPB	CHECKED AND APPROVED BY: RW/CR	DATE: 9/7/2017

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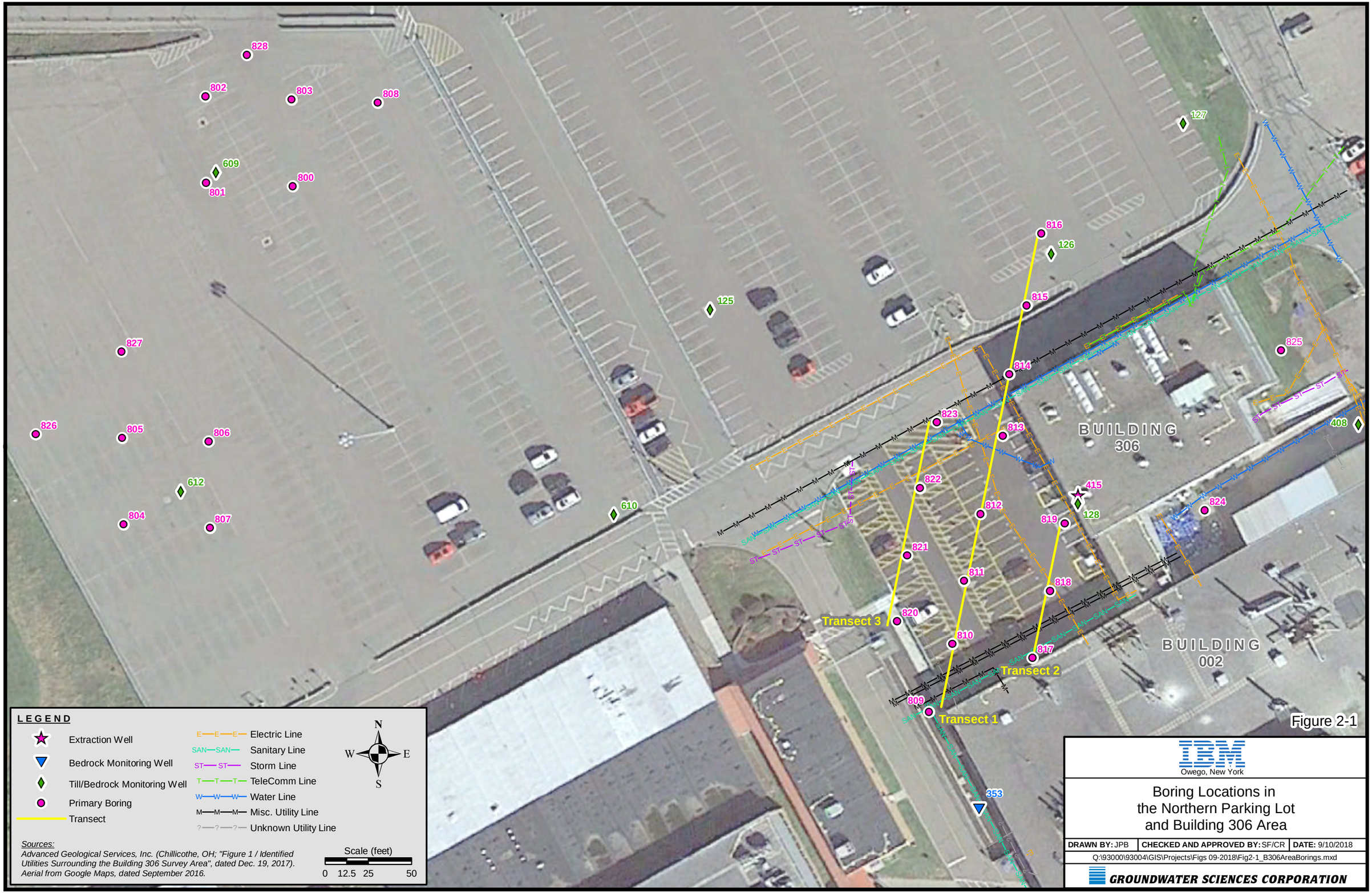
828
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126
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825
814
823
813
408
822
415
812
824
128
819
821
811
818
Transect 3
820
810
817
Transect 2
809
Transect 1
353
BUILDING 306
BUILDING 002
LEGEND
Extraction Well
Bedrock Monitoring Well
Till/Bedrock Monitoring Well
Primary Boring
Transect
Electric Line
Sanitary Line
Storm Line
TeleComm Line
Water Line
Misc. Utility Line
Unknown Utility Line
N
W
E
S
Sources:
Advanced Geological Services, Inc. (Chillicothe, OH; "Figure 1 / Identified Utilities Surrounding the Building 306 Survey Area", dated Dec. 19, 2017).
Aerial from Google Maps, dated September 2016.
Scale (feet)
0 12.5 25 50
Figure 2-1
IBM
Owego, New York
Boring Locations in the Northern Parking Lot and Building 306 Area
DRAWN BY: JPB
CHECKED AND APPROVED BY: SF/CR
DATE: 9/10/2018
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Figure 2-2

IBM
Owego, New York

Western P001 Area Wells and Boring Location Map

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Bodle Hill Road

Lake View Pkwy.

Power House Drive

Industrial Drive

Owego Bowl

Victory Plaza

Moore Tire

908
907
906
905
910
909
902
901
900
309
306
304
004
002
301

618
143
616
617
124
123
127
126
125
609
605
604
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366
382
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383
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601
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608
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397
157
602
615
361
147
181

LEGEND

- Extraction Well
- Soil Monitoring Well
- Till/Bedrock Monitoring Well
- Till Monitoring Well
- Bedrock Monitoring Well
- Sampled for Inorganics Data
- Property Line

N

Scale
0 150'

Figure 2-3

IBM
Owego, New York

Sampling Location Map for Inorganic and Transformation Indicator Parameters

DRAWN BY: JPB/MHM	DATE: 6/27/18	DRAWING NO.
CHECKED & APPROVED BY: SMF		93004-114-A1

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LEGEND

- ★ - Extraction Well
- - Decommissioned Extraction Well
- ♦ - Till/Bedrock Monitoring Well
- ◇ - Decommissioned Till/Bedrock Monitoring Well
- ◭ - Till Monitoring Well
- ◬ - Decommissioned Till Monitoring Well
- ▼ - Bedrock Monitoring Well
- ▽ - Decommissioned Bedrock Monitoring Well
- ● - Temporary Boring
- 880 - Bedrock Elevation Contour (feet amsl) (dashed where inferred)
- 881 - Supplemental Bedrock Elevation Contour (feet amsl)
- 850.11 - Bedrock Elevation (feet amsl)
- - Property Line

Scale

0 50' 100' 150'

Bodle Hill Road

Lake View Pkwy.

Power House Drive

Industrial Drive

Owego Bowl

Victory Plaza

Moore Tire

908 907 909 910 905 906 902 901 900 304 001 004 306 002 309 082

Figure 3-1

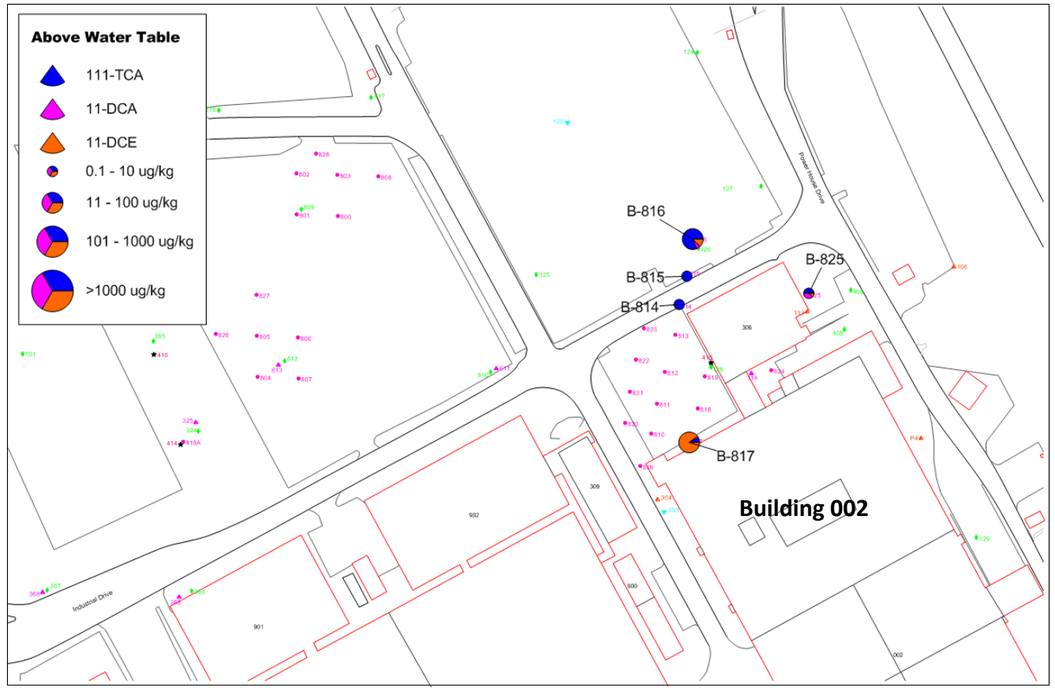
IBM
Owego, New York

Bedrock Surface Elevation Contour Map

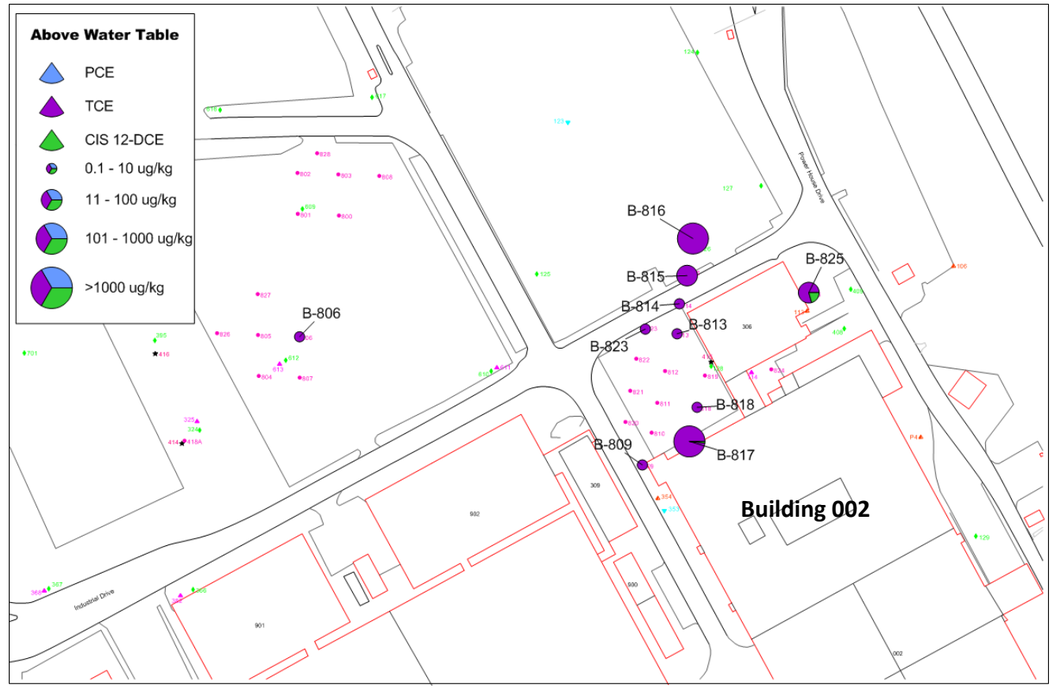
DRAWN BY: JPB/MHM	DATE: 6/22/18	DRAWING NO. 93004-113-A1
CHECKED & APPROVED BY: SMF		

GROUNDWATER SCIENCES CORPORATION

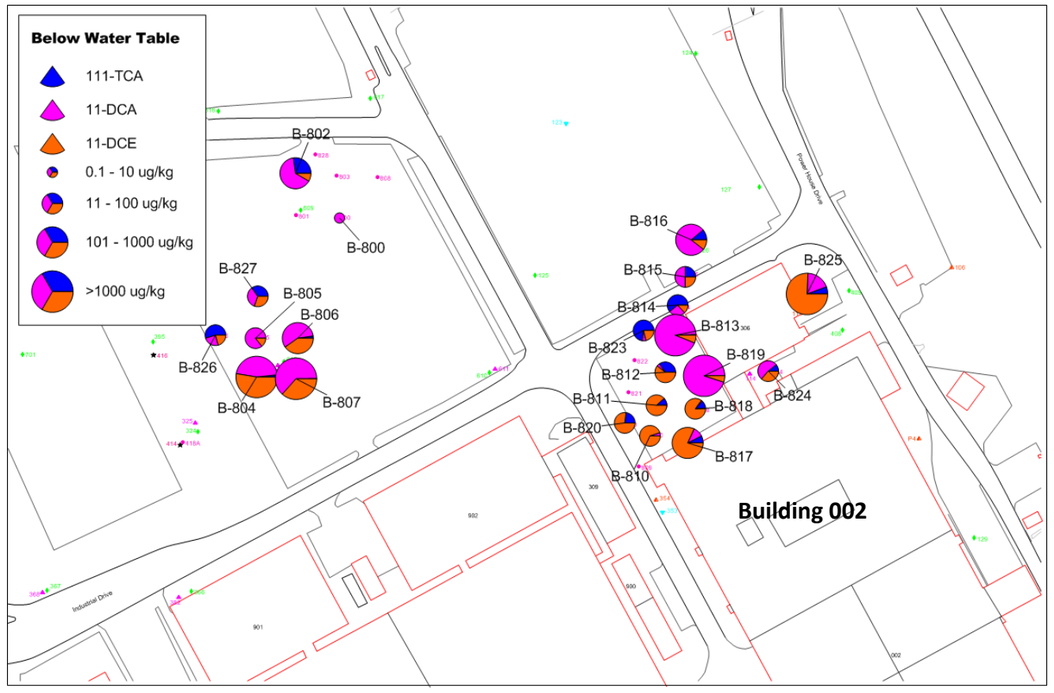
Soil Sample Results from the Vadose Zone



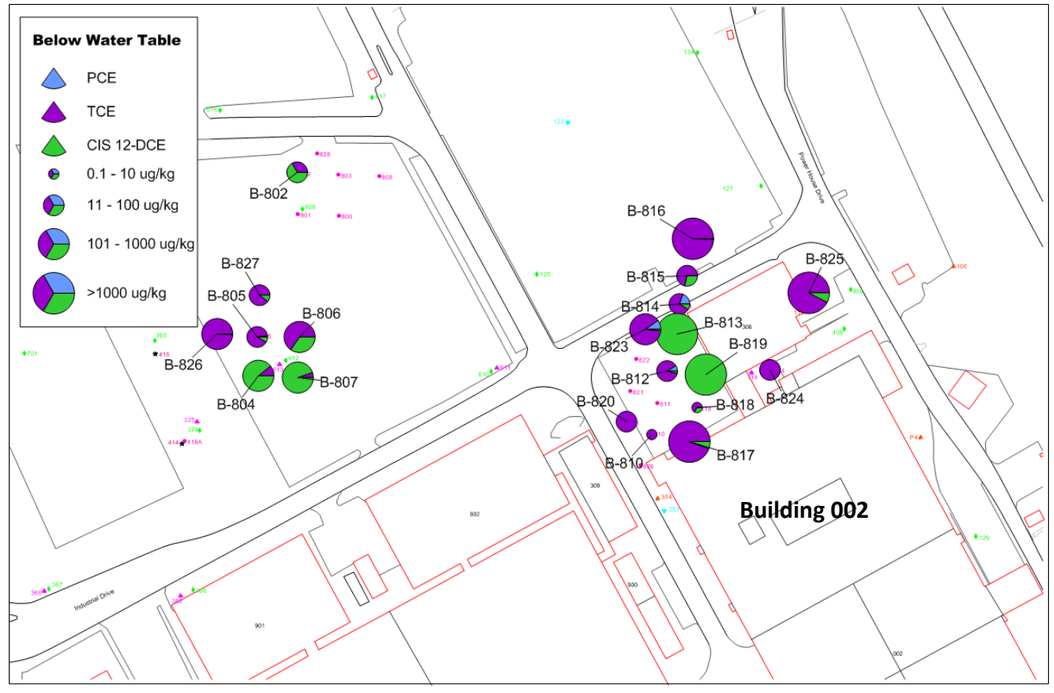
Soil Sample Results from the Vadose Zone



Soil Sample Results from the Saturated Zone



Soil Sample Results from the Saturated Zone



LEGEND: 111-TCA = 1,1,1-Trichloroethane
11-DCA = 1,1-Dichloroethane
11-DCE = 1,1-Dichloroethene
PCE = Tetrachloroethene
TCE = Trichloroethene
cis12-DCE = *cis*-1,2-Dichloroethene

Samples were collected in April and May 2018.
Vinyl chloride was detected in only six soil samples at concentrations ranging from 1 to 8 ug/kg and is not shown on the pie charts.

Figure 3-2: Concentrations of VOCs in Soil Samples from Above and Below the Water Table in the P001 Area Owego, New York

GROUNDWATER SCIENCES CORPORATION

LEGEND

- Till/Bedrock Monitoring Well
- Extraction Well
- Temporary Boring
- 850.11 - Groundwater Elevation (feet amsl)
- 850 - Groundwater Elevation Contour (feet amsl)
- Inferred Groundwater Elevation Contour
- Groundwater Flow Divide
- Direction of Groundwater Flow
- Property Line

Scale

0 50' 100' 150'

Bodle Hill Road

Lake View Pkwy.

Power House Drive

Industrial Drive

Owego Bowl

Victory Plaza

Moore Tire

907 908 909 910 905 906 902 309 306 002 900 901 304 001 004 082

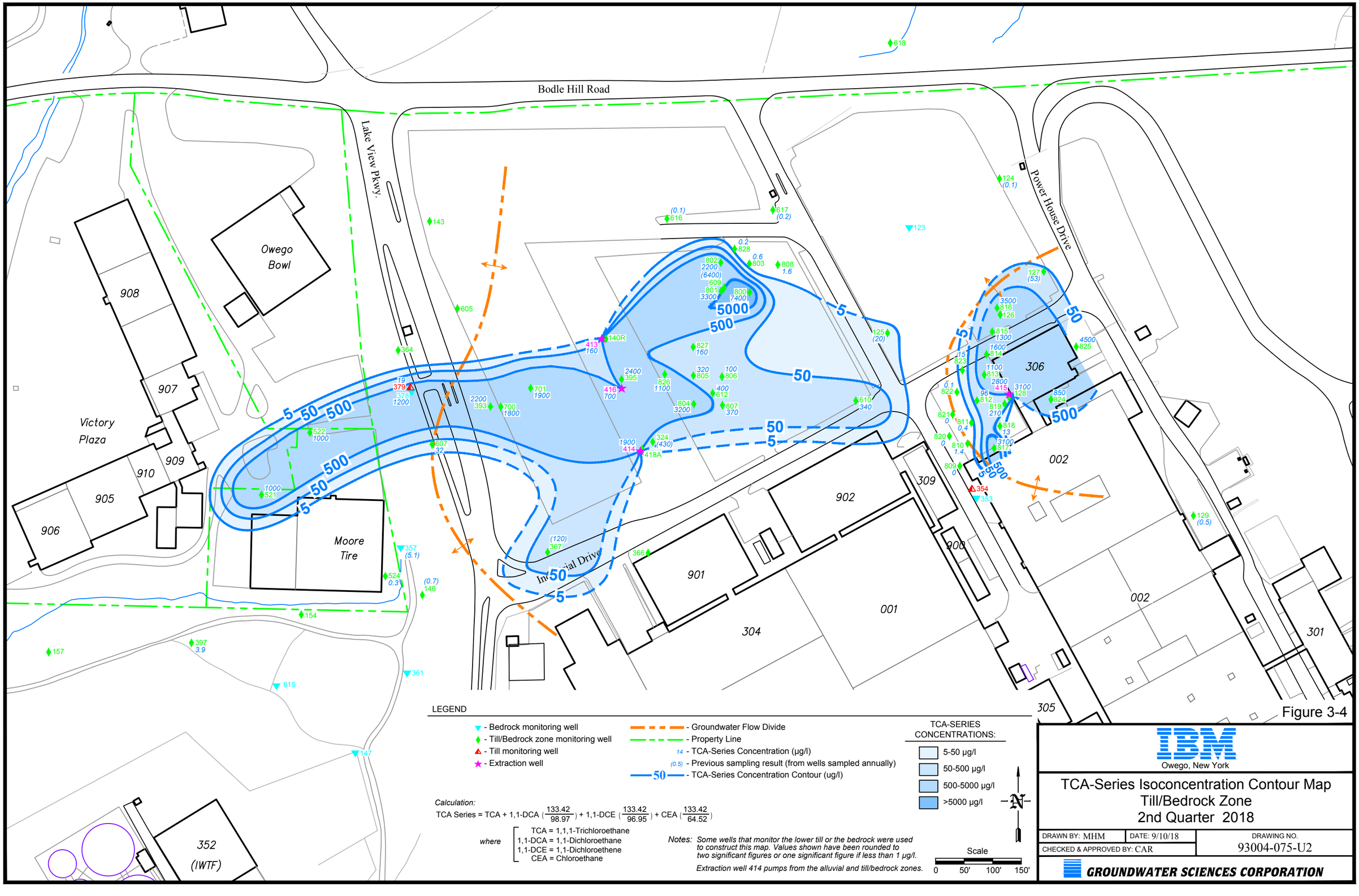
Figure 3-3

IBM
Owego, New York

Groundwater Elevation Contour Map
Till/Bedrock Zone
(June 6, 2018)

DRAWN BY: JPB/MHM	DATE: 6/20/18	DRAWING NO. 93004-112-A1
CHECKED & APPROVED BY: SMF		

GROUNDWATER SCIENCES CORPORATION



LEGEND

- ▼ - Bedrock monitoring well
- ♦ - Till/Bedrock zone monitoring well
- ⚠ - Till monitoring well
- ★ - Extraction well
- Groundwater Flow Divide
- Property Line
- 14 - TCA-Series Concentration (µg/l)
- (0.5) - Previous sampling result (from wells sampled annually)
- 50 - TCA-Series Concentration Contour (ug/l)

TCA-SERIES CONCENTRATIONS:

- 5-50 µg/l
- 50-500 µg/l
- 500-5000 µg/l
- >5000 µg/l

Calculation:

$$\text{TCA Series} = \text{TCA} + \text{1,1-DCA}\left(\frac{133.42}{98.97}\right) + \text{1,1-DCE}\left(\frac{133.42}{96.95}\right) + \text{CEA}\left(\frac{133.42}{64.52}\right)$$

where

- TCA = 1,1,1-Trichloroethane
- 1,1-DCA = 1,1-Dichloroethane
- 1,1-DCE = 1,1-Dichloroethene
- CEA = Chloroethane

Notes: *Some wells that monitor the lower till or the bedrock were used to construct this map. Values shown have been rounded to two significant figures or one significant figure if less than 1 µg/l.*

Extraction well 414 pumps from the alluvial and till/bedrock zones.

Scale: 0 50' 100' 150'

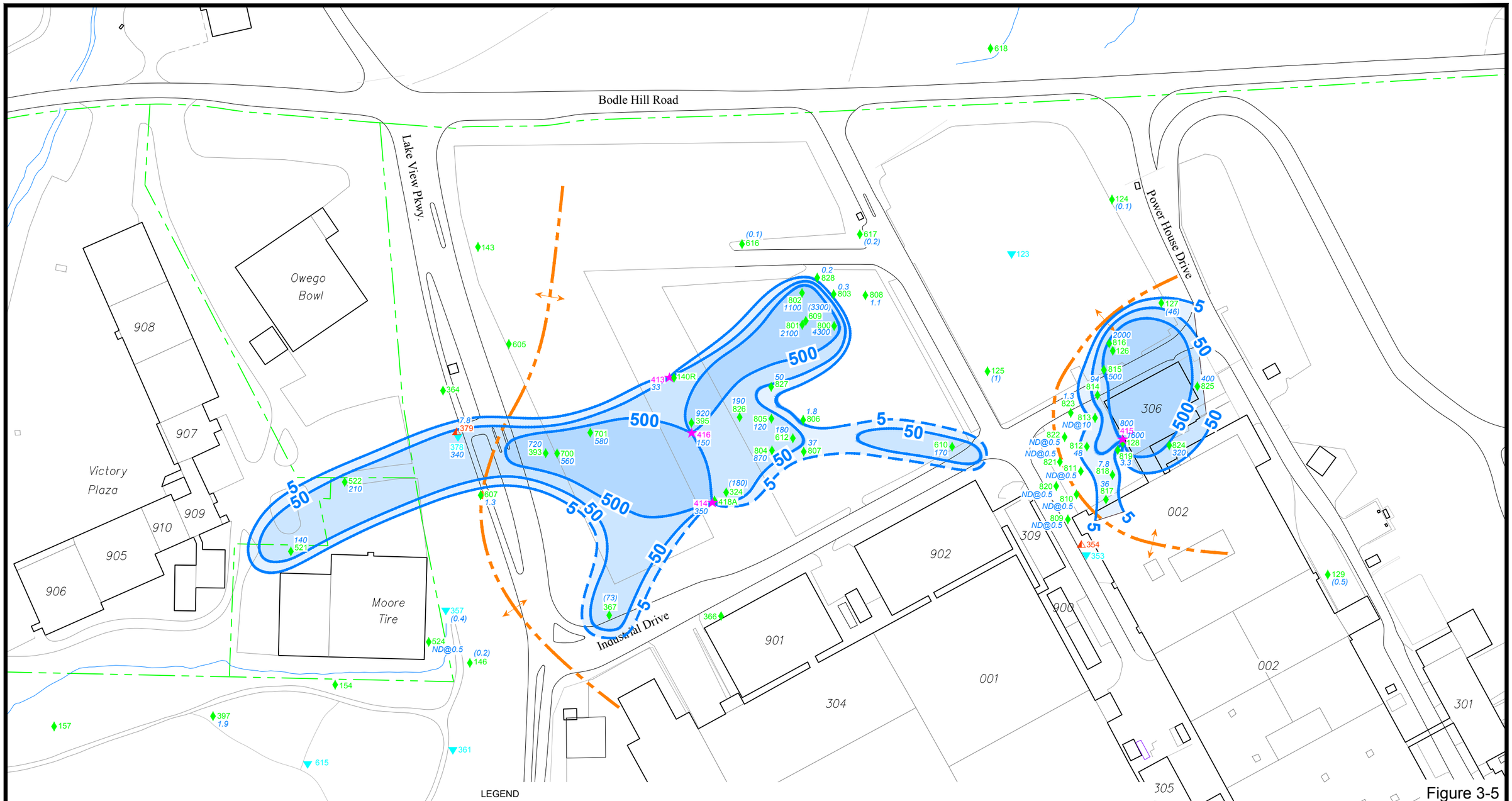
Figure 3-4

IBM
Owego, New York

TCA-Series Isoconcentration Contour Map
Till/Bedrock Zone
2nd Quarter 2018

DRAWN BY: MHM	DATE: 9/10/18	DRAWING NO.
CHECKED & APPROVED BY: CAR		93004-075-U2

GROUNDWATER SCIENCES CORPORATION



LEGEND

- Bedrock monitoring well
- Till/Bedrock zone monitoring well
- Till monitoring well
- Extraction well
- Property Line
- Groundwater Flow Divide
- 111-TCA - 1,1,1-Trichloroethane
- *14* - 111-TCA Concentration (µg/l)
- *(0.5)* - Previous sampling result (from wells sampled annually)
- *ND@"X"* - Not Detected at Laboratory Detection Limit "X"
- 5 - 111-TCA Concentration Contour (ug/l)

111-TCA CONCENTRATIONS:

- 5-50 µg/l
- 50-500 µg/l
- 500-5000 µg/l

Notes: Some wells that monitor the lower till or the bedrock were used to construct this map. Values shown have been rounded to two significant figures or one significant figure if less than 1 µg/l.

Extraction well 414 pumps from the alluvial and till/bedrock zones.

Scale 0 50' 100' 150'

Figure 3-5

IBM
Owego, New York

111-TCA Isoconcentration Contour Map Till/Bedrock Zone 2nd Quarter 2018

DRAWN BY: MHM	DATE: 9/7/18	DRAWING NO. 93004-027-X2
CHECKED & APPROVED BY: CAR		

GROUNDWATER SCIENCES CORPORATION

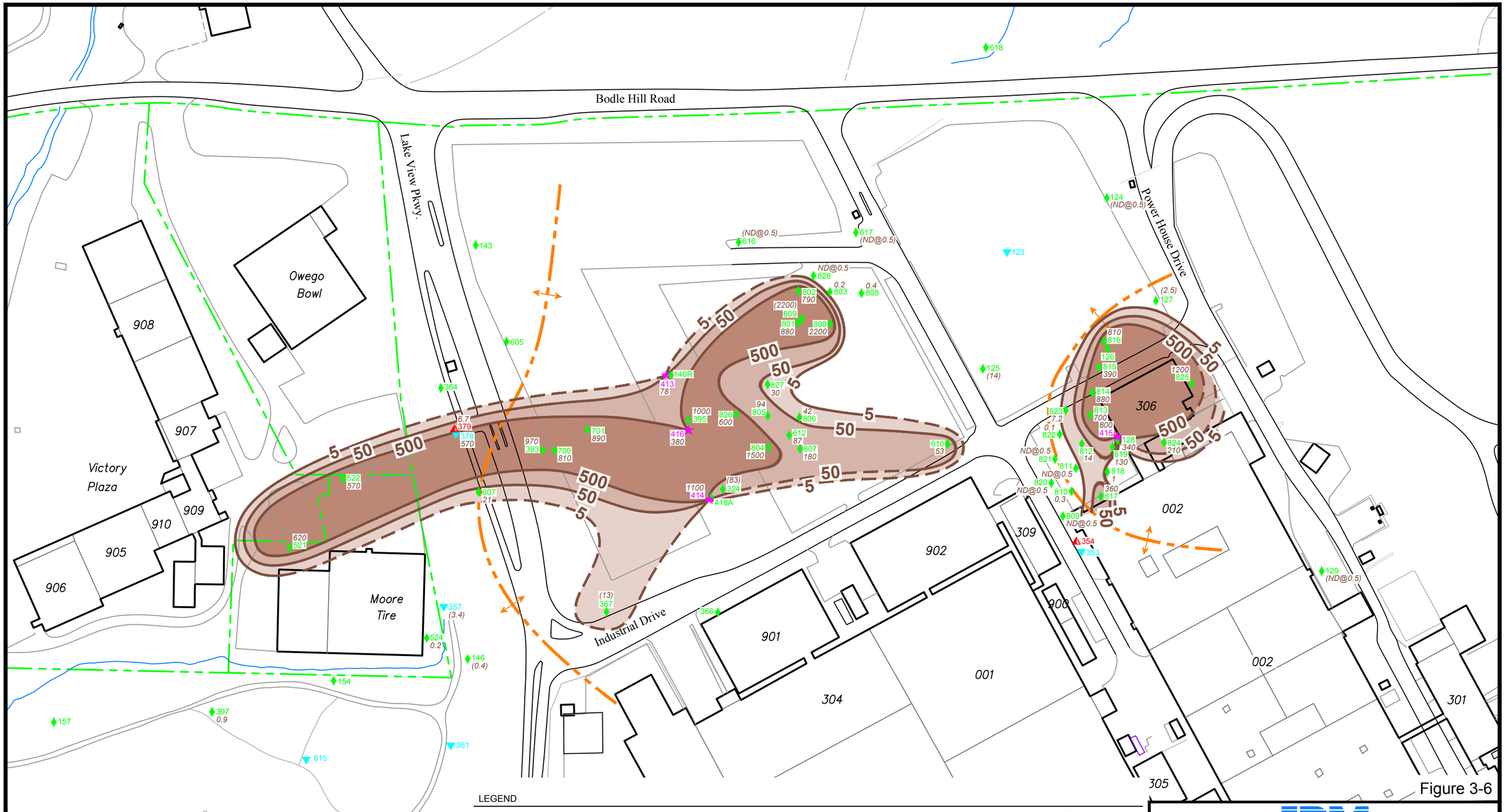


Figure 3-6

IBM
Owego, New York

11-DCA Isoconcentration Contour Map
Till/Bedrock Zone
2nd Quarter 2018

DRAWN BY: MHM	DATE: 9/10/18	DRAWING NO. 93004-115-A2
CHECKED & APPROVED BY: CAR		

GROUNDWATER SCIENCES CORPORATION

Bodle Hill Road

Lake View Pkwy.

Power House Drive

Owego Bowl

Victory Plaza

Moore Tire

Industrial Drive

908 907 910 909 905 906 902 901 904 001 309 306 002 900 305 301 352 (IWTF)

LEGEND

- Bedrock monitoring well
- Till/Bedrock zone monitoring well
- Till monitoring well
- Extraction well
- Property Line
- Groundwater Flow Divide
- 11-DCE - 1,1-Dichlorothene
- *14* - 11-DCE Concentration (µg/l)
- *(0.5)* - Previous sampling result (from wells sampled annually)
- *ND@"X"* - Not Detected at Laboratory Detection Limit "X"
- 5 - 11-DCE Concentration Contour (ug/l)

11-DCE CONCENTRATIONS:

- 5-50 µg/l
- 50-500 µg/l
- 500-5000 µg/l

Notes: *Some wells that monitor the lower till or the bedrock were used to construct this map. Values shown have been rounded to two significant figures or one significant figure if less than 1 µg/l.*

Extraction well 414 pumps from the alluvial and till/bedrock zones.

Scale 0 50' 100' 150'

Figure 3-7

IBM
Owego, New York

11-DCE Isoconcentration Contour Map
Till/Bedrock Zone
2nd Quarter 2018

DRAWN BY: MHM	DATE: 9/7/18	DRAWING NO. 93004-117-A2
CHECKED & APPROVED BY: CAR		

GROUNDWATER SCIENCES CORPORATION

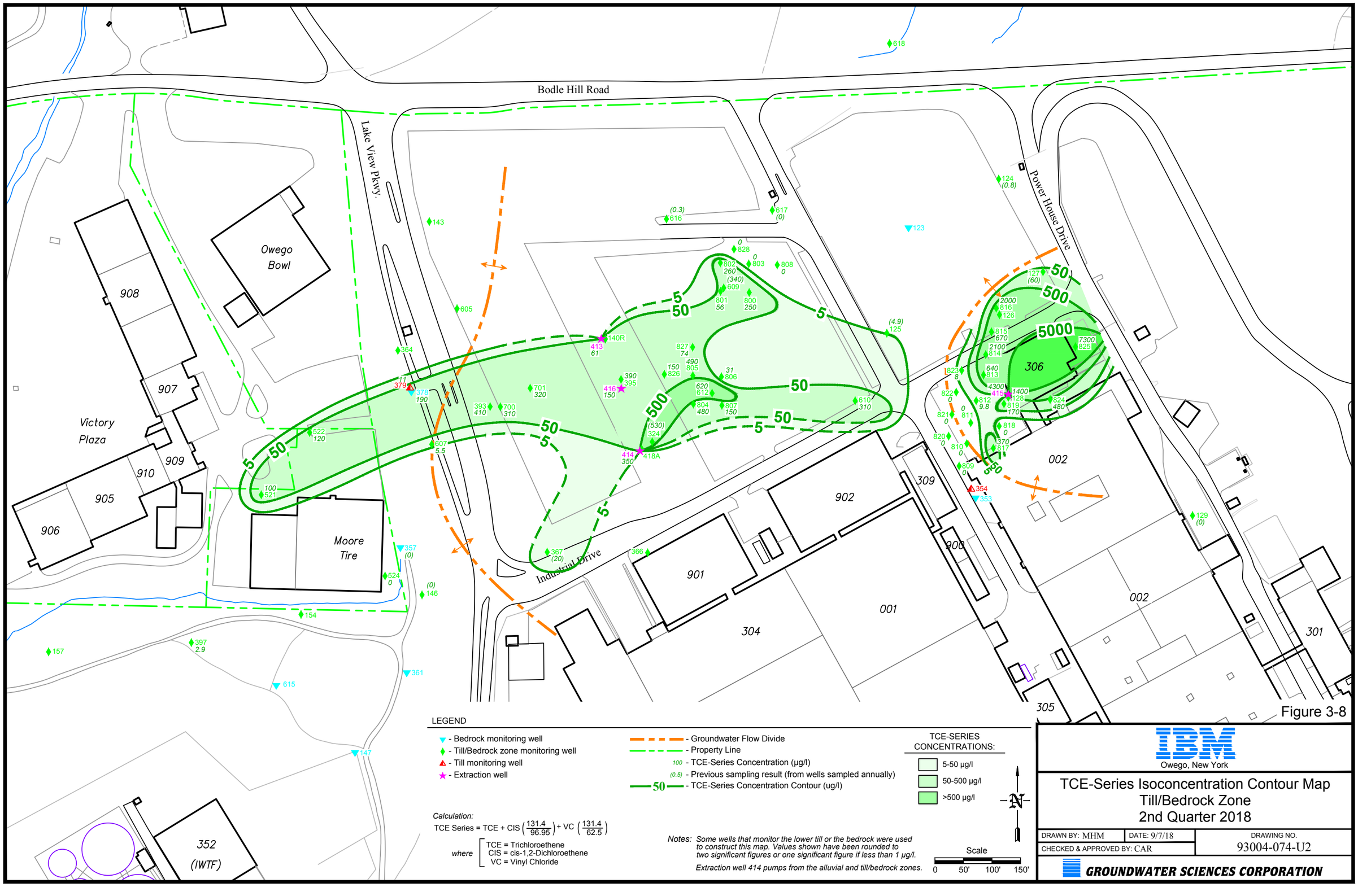


Figure 3-8

IBM
Owego, New York

TCE-Series Isoconcentration Contour Map
Till/Bedrock Zone
2nd Quarter 2018

DRAWN BY: MHM	DATE: 9/7/18	DRAWING NO. 93004-074-U2
CHECKED & APPROVED BY: CAR		

GROUNDWATER SCIENCES CORPORATION

Bodle Hill Road

Lake View Pkwy.

Power House Drive

Industrial Drive

Owego Bowl

Victory Plaza

Moore Tire

908

907

910

909

905

906

306

002

309

902

901

900

304

001

305

301

352 (IWTF)

618

143

605

364

379 9

378 80

522 31

607 1.7

9.4 521

357 (ND@0.5)

524 ND@0.5

146 (ND@0.5)

154

157

397 2.5

615

361

147

(0.3) 616

617 (ND@0.5)

ND@0.5 828

ND@0.5 803

808 ND@0.5

802 140

(150) 609

801 25

800 100

605

413 39

140R

827 44

826 57

805 350

806 6.7

612 470

804 200

807 66

610 240

190 395

190 393

700 140

701 130

416 98

230 414

(460) 324

418A

(11) 367

366

123

124 (0.8)

125 (3.7)

127 (59)

1700 816 126

815 170

19 814

5700 825

2.8 823

813 ND@10

1100 415 440 128

400 824

812 5.9

822 ND@0.5

821 ND@0.5

819 0.7

811 ND@0.5

818 ND@0.5

820 ND@0.5

160 817

810 ND@0.5

809 ND@0.5

354

353

129 (ND@0.5)

5 50 500 5000

50 5

LEGEND

- ▼ - Bedrock monitoring well
- ♦ - Till/Bedrock zone monitoring well
- ▲ - Till monitoring well
- ★ - Extraction well
- Property Line
- Groundwater Flow Divide
- TCE - 1,1-Dichlorothene
- *14* - TCE Concentration (µg/l)
- *(0.5)* - Previous sampling result (from wells sampled annually)
- *ND@"X"* - Not Detected at Laboratory Detection Limit "X"
- 5 - TCE Concentration Contour (ug/l)

TCE CONCENTRATIONS:

- 5-50 µg/l
- 50-500 µg/l
- 500-5000 µg/l
- > 5000 µg/l

N

Scale 0 50' 100' 150'

Notes: Some wells that monitor the lower till or the bedrock were used to construct this map. Values shown have been rounded to two significant figures or one significant figure if less than 1 µg/l.

Extraction well 414 pumps from the alluvial and till/bedrock zones.

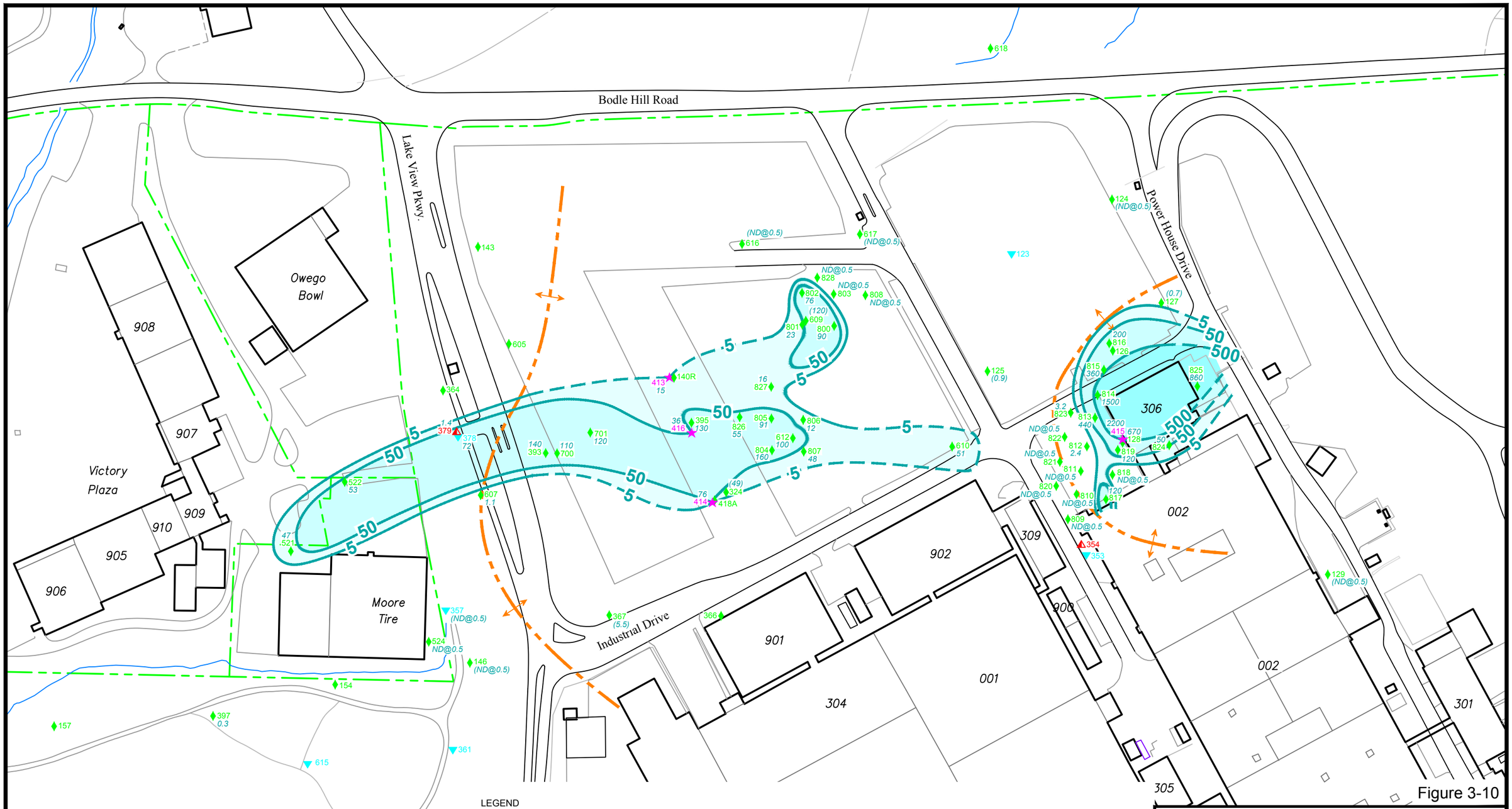
Figure 3-9

IBM
Owego, New York

TCE Isoconcentration Contour Map
Till/Bedrock Zone
2nd Quarter 2018

DRAWN BY: MHM	DATE: 9/7/18	DRAWING NO.
CHECKED & APPROVED BY: CAR		93004-118-A2

GROUNDWATER SCIENCES CORPORATION



LEGEND

- Bedrock monitoring well
- Till/Bedrock zone monitoring well
- Till monitoring well
- Extraction well
- Property Line
- Groundwater Flow Divide

c12-DCE - 1,1-Dichlorothene

14 - cis-12DCE Concentration (µg/l)

(0.5) - Previous sampling result (from wells sampled annually)

ND@"X" - Not Detected at Laboratory Detection Limit "X"

5 - cis-12DCE Concentration Contour (ug/l)

cis-12DCE CONCENTRATIONS:

- 5-50 µg/l
- 50-500 µg/l
- 500-5000 µg/l

Notes: Some wells that monitor the lower till or the bedrock were used to construct this map. Values shown have been rounded to two significant figures or one significant figure if less than 1 µg/l.

Extraction well 414 pumps from the alluvial and till/bedrock zones.

Scale 0 50' 100' 150'

Figure 3-10

IBM
Owego, New York

c12-DCE Isoconcentration Contour Map
Till/Bedrock Zone
2nd Quarter 2018

DRAWN BY: MHM	DATE: 9/7/18	DRAWING NO.
CHECKED & APPROVED BY: CAR		93004-118-A2

GROUNDWATER SCIENCES CORPORATION

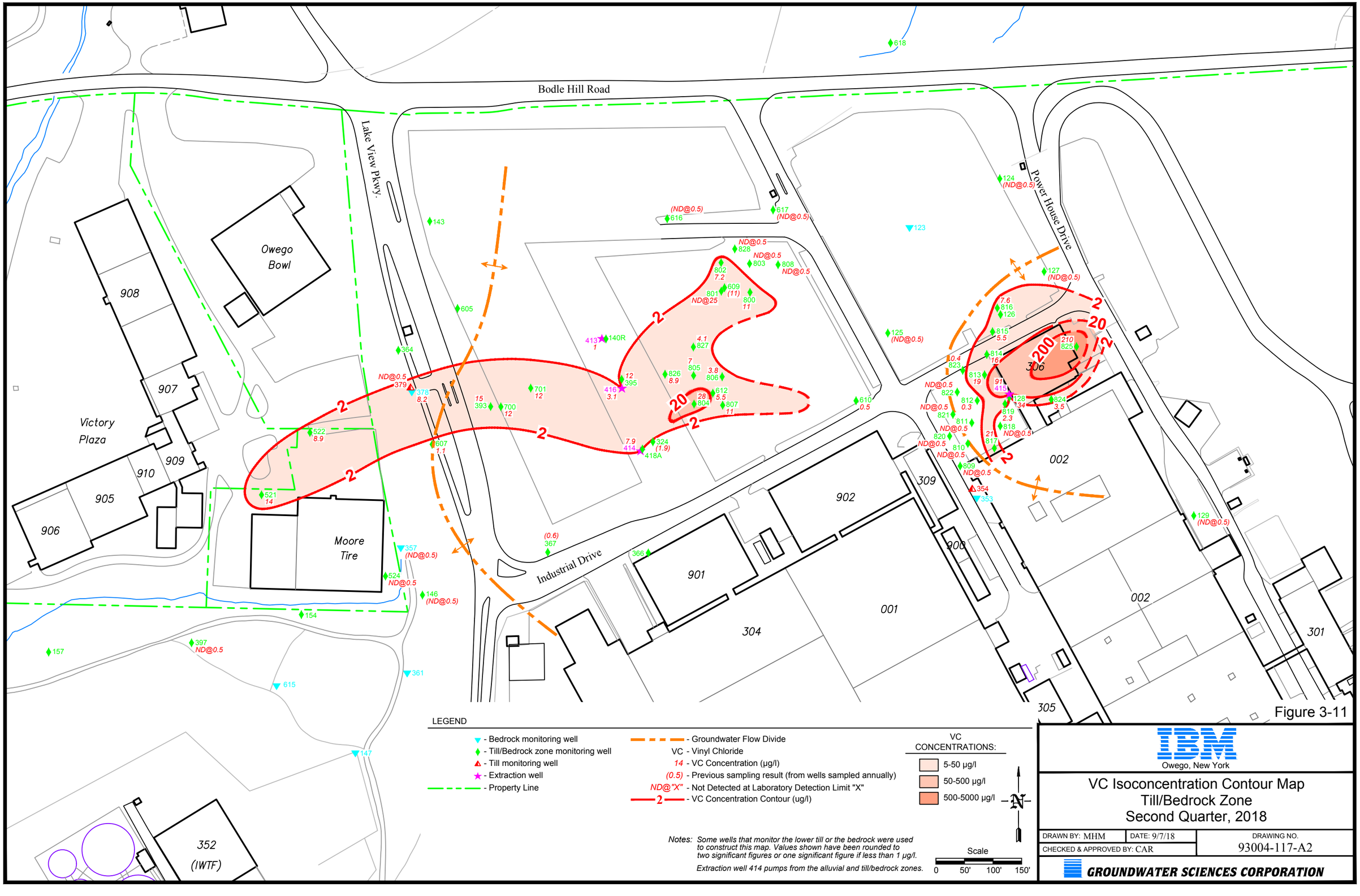


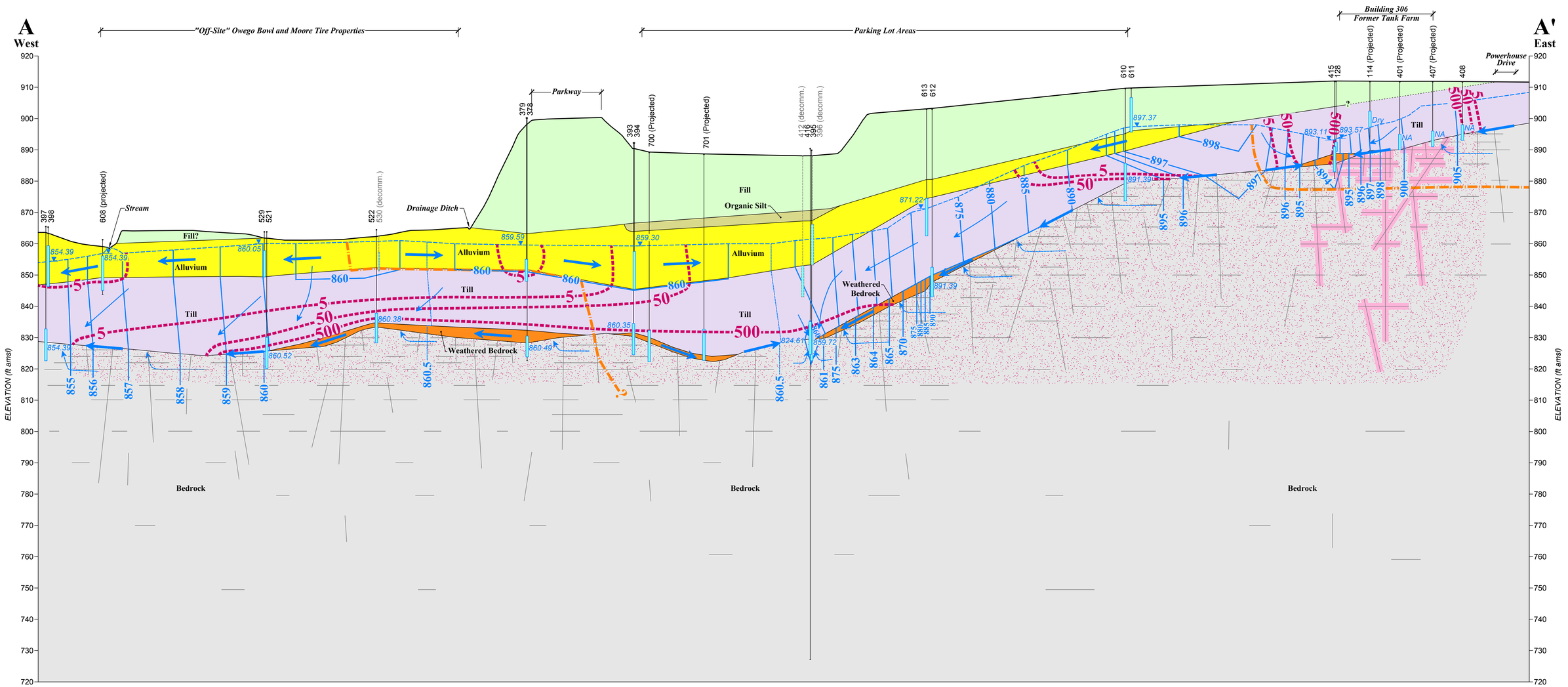
Figure 3-11

IBM
Owego, New York

VC Isoconcentration Contour Map
Till/Bedrock Zone
Second Quarter, 2018

DRAWN BY: MHM	DATE: 9/7/18	DRAWING NO. 93004-117-A2
CHECKED & APPROVED BY: CAR		

GROUNDWATER SCIENCES CORPORATION



BOREHOLES

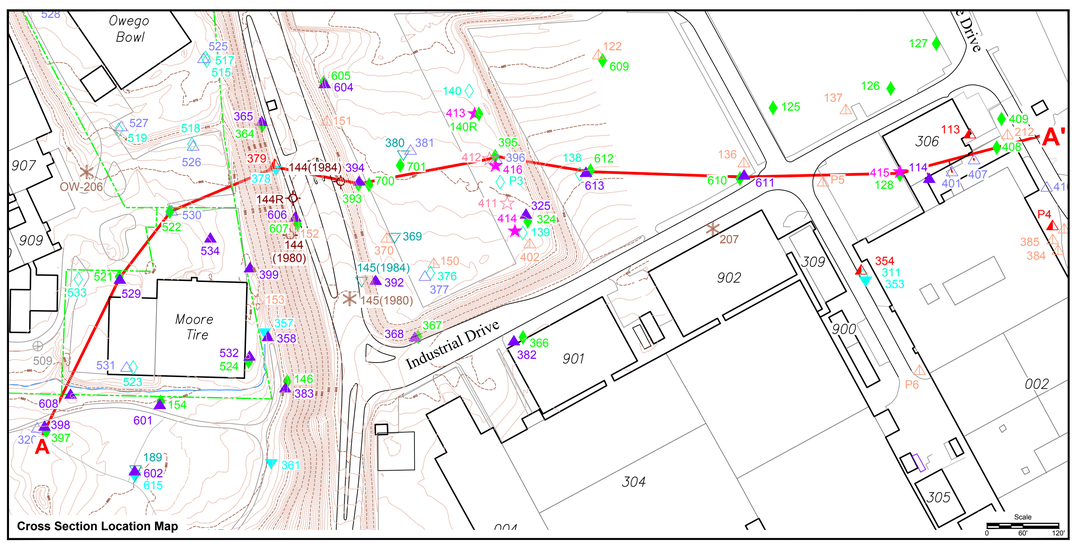
- Monitoring Well or Soil Boring (dashed for decommissioned wells)
- Lithologic contact
- Water Table (feet amsl; July 18, 2016)
- 854.39 - Groundwater Elevation (feet amsl; July 18, 2016)
- Monitoring Interval (includes screen and sand pack)
- Conceptual Depiction of Changes in Joint/Fracture Spacing With Depth into Competent Bedrock
- Conceptual Depiction of Joints/Fractures With Residual Non-Aqueous Phase Liquid or Relatively Greater TCA-Series Mass Diffused and Sorbed Into Bedrock

Horizontal Scale: 1" = 60'
Vertical Scale: 1" = 15'
Vertical Exaggeration = 4X

Scale 0 30' 60'

LEGEND

- 860 - Groundwater Elevation Contour (feet amsl)
- Groundwater Flow Divide
- Inferred Direction of Groundwater Flow (Alluvium, Weathered Bedrock, and Glacial Till/Bedrock Interface)
- Inferred Direction of Groundwater Flow (Glacial Till and Bedrock)
- Fill
- Organic Silt
- Alluvium
- Till
- Weathered Bedrock
- Bedrock
- Assumed Extent of VOCs in Bedrock
- 50 - TCA-Series Isoconcentration Contour (µg/l; July 2016)



LEGEND

- Bedrock Monitoring Well
- Decommissioned Bedrock Monitoring Well
- Alluvial Monitoring Well
- Decommissioned Alluvial Monitoring Well
- Till Monitoring Well
- Decommissioned Till Monitoring Well
- Till/Bedrock Zone Monitoring Well
- Decommissioned Till/Bedrock Zone Monitoring Well
- Extraction Well
- Former Extraction Well (decommissioned)
- Soil Boring
- Decommissioned Monitoring Well (no log available)
- Property Line
- Cross Section Transect

Basemap from "Site Plan", L. Robert Kimball & Associates, Coraopolis, PA (site_5-31.dwg; May 2006). Wetlands survey: CNY Land Surveying; Baldwinsville, NY (06102.dwg, July 2006).

Plate 4-1

IBM
Owego, New York

Conceptual Site Model
Cross Section A-A'

DRAWN BY: MJ/MHM	DATE: 9/20/18
CHECKED & APPROVED BY: CR/SF/RW	DRAWING NO. 93004-CS13-2

GROUNDWATER SCIENCES CORPORATION

APPENDIX A

Geophysical Reports by Advanced Geological Services

ADVANCED GEOLOGICAL SERVICES

3 Mystic Lane
Malvern, PA 19355
(610) 722-5500 (ph.)
(610) 722-0250 (fax)

December 14, 2017
Reference: 17-262-1

Mr. Stephen Fisher, P.G.
Groundwater Sciences Corporation
2601 Market Place Street, Suite 310
Harrisburg, PA 17110

Subject: Geophysical Investigation Results
Former IBM Site (Lockheed Martin)
Owego, New York

Dear Mr. Fisher:

Advanced Geological Services (AGS) presents this letter report to Groundwater Sciences Corporation (GSC)summarizing the geophysical investigation completed by AGS on November 3, 4, 17, and 18, 2017 at the former IBM facility in Owego, New York.

The investigation area was situated in the parking lots located to the north of IBM Parkway East and east of Lakeview Parkway. The survey area is composed of fill, alluvium, till, shale bedrock. Based on information from previously site work conducted by GSC it was believed that a bedrock low may be present beneath parking lot lower parking lot adjacent to Lakeview Parkway. Nearby well information indicates the bedrock in the survey area is likely about ±60 feet below ground surface.

The objectives of the present geophysical investigation were to:

1. Map the bedrock surface within the parking lot to identify the lowest occurrence of the bedrock surface, and
2. Identify potential bedrock fractures that cross through the investigation area.

Methods

A combination of the seismic refraction method and the very low frequency (VLF) electromagnetic (EM) method were used to achieve the objectives of the investigation. The seismic refraction method was used to identify the bedrock surface and map the bedrock topography. The VLF EM method was used identify bedrock fractures that may coincide with topographic bedrock lows or weathered bedrock zones determined from the seismic refraction results.

Seismic Refraction Method

The seismic refraction method uses the propagation of elastic waves (shock waves) to map subsurface features. An energy source, such as the sledge hammer and strike plate used in this investigation, produces an elastic wave that propagates downward and outward from its initiation point at the ground surface. When the wave encounters a material having a different propagation velocity, part of the energy is refracted along the layer surface. The refracted

wave front returns to the surface where it is detected by a sensor (geophone). The velocity at which the seismic wave travels is a function of the density and elastic properties of the material. By geometrical calculations, it is possible to determine the acoustic velocity of, and thickness or depth to individual layers.

A DAQLink II seismograph manufactured by Seismic Source Co. and a Geode seismograph manufactured by Geometrics, Inc. were used to complete the seismic investigation. Both of these engineering seismographs have 24 channels and were configured with 24 10-Hz geophones. A 16-lb. sledge hammer and metal strike plate were used as an energy source to initiate a seismic wave. Each seismic spread consisted of 24 geophones. The spacing between geophones was set at 15 feet for a total spread length of 345 feet. Far offset shots, which are needed to provide bedrock refractor information near the ends of each seismic spread, were located 60 feet from geophone 1 (GP-1) and geophone 24 GP-24).

All seismic refraction data were processed using SeisOpt@2D, a commercially available program by Optim, Inc. SeisOpt@2D uses seismic first arrival times and survey geometry to derive subsurface information by using a non-linear optimization technique called generalized simulated annealing. The technique basically generates a velocity model of the subsurface, calculates travel time curves through forward modeling, then compares the calculated travel times to the observed travel times. The velocity model is then systematically modified through an inversion routine to decrease the statistical error to a predetermined level. Of course the resulting velocity model is reviewed by an AGS geophysicist to verify that the model is realistically compatible with known existing geologic conditions of the site.

The advantage to using this modeling method as opposed to other seismic refraction interpretation methods is that it can effectively image gradational seismic velocity variations laterally and vertically. Lateral and vertical variations in the seismic velocity are commonly observed in areas where a thick saprolite layer may be present above the unweathered bedrock, or where preferential weathering of the bedrock may have occurred within bedrock fracture zones.

Very Low Frequency (VLF) Electromagnetic (EM) Method

The VLF method detects electrical conductors, such as mineralized, or water filled bedrock fractures by utilizing the carrier wave of long distance communication radio signals in the range of 15 to 30 kilohertz (kHz). The transmitted radio signal induces electrical current flow into a linear electrical conductor, such as a water filled bedrock fracture, in the same manner as an antenna, which in turn produces a secondary magnetic field around the conductor. The VLF instrument compares the magnetic field strength of the primary (transmitted) signal to that of the secondary signal (induced current flow). When a conductor is crossed, the secondary magnetic field becomes measurably and predictably distorted relative to the primary field and is displayed on the instrument screen.

The VLF instrument records two components of the measured response known as the real and imaginary components that are related to the phase angle of the radio frequency carrier wave.

The response when crossing a conductive fracture or fault is a peak response slightly before the fracture, an abrupt decrease when crossing the fracture, then a trough after the fracture before returning to the background response level. The fracture is located at the inflection or cross-over point of the response.

During this investigation a VLF radio signal frequency of 24.0 kHz transmitted from Cutler, Maine was used for all traverses. Measurements were made every 10 feet along each VLF traverse.

Results and Discussion

The primary investigation area was located in the lower parking lot situated immediately north of Lakeside Parkway. The geophysical investigation also extended into the parking lot located to the north of the lower parking lot to provide additional subsurface information in that area. The survey area and locations of seismic refraction lines and VLF traverses are shown on Figure 1.

Seismic refraction data were collected along lines SR-1 through SR-5 to determine bedrock topography (Figure 1). Lines SR-1 through SR-4 were located within the primary investigation area in the lower parking lot, and line SR-5 was located in the parking lot to the north of the lower parking lot to provide additional information regarding depth to bedrock in that area.

VLF data were also collected along five southeast to northwest oriented traverses identified as VLF-1 through VLF-5 (Figure 1). The VLF traverses were spaced to provide the ability to correlate potential bedrock fractures across the entire survey area.

Seismic Refraction Results and Bedrock Topography

Seismic refraction lines SR-1 through SR-4 were located in the lower parking lot and were oriented from south-southeast to north-northwest. Line SR-5 angled from southwest to northeast diagonally across the upper parking lot (Figure 1). Overall the quality of the seismic data were good. Despite some noise from road traffic and wind, it was possible to pick the first arrivals of the seismic response in each individual seismic trace (i.e. each geophone location). Modeled refraction results indicated that the velocity of the bedrock varied between 8,000 to greater than 10,000 feet per second (fps) depending on the degree of bedrock weathering. Bedrock elevations were determined using a bedrock velocity of 9,000 fps.

Depth to the top of weathered bedrock beneath the seismic profiles ranged between approximately 32 feet in profile SR-5 and approximately 60 feet in SR-1. Ground surface elevations along each of the seismic refraction profiles was determined from a map provided by GSC (map file: 002E Parking Lot Underground.pdf). The ground surface elevations were used during modeling to calculated bedrock elevations.

Seismically derived contoured bedrock elevations are shown on Figure 2. Generally the bedrock elevation decreases from east to west across the investigation area. The contoured bedrock map indicates that the lowest portion of the bedrock surface within the study area is

located along profiles SR-1 and SR-2, near the middle of the lower parking lot (Figure 2). Furthermore, if bedrock topography controls preferential ground water flow in this area, the ground water could flow into the lower parking lot area from the east and exit the western side of the lower parking lot in the area of well 393 and the northern half of seismic line SR-4 (Figure2).

Individual seismic profile models are provided on Figure 3. Generally, the profiles show a slight weathered bedrock layer estimated to between 8,000 and 9,000 fps. The thickness of the weathered bedrock layer varies across the study area, but is generally approximately 3 to 5 feet thick.

Two potential low velocity zones were identified from the seismic profiles that could indicate areas of increased bedrock weathering. The first low velocity zone noted is located in the central portion of profile SR-4 (Figure 3). This low velocity zone is situated slightly to the southeast of the topographic bedrock low observed in profile SR-4. It is possible that this low velocity zone is related to preferential weathering along a potential fracture zone noted in the VLF results (Figure 4).

The second potential low velocity zone was noted at the northeast end of seismic profile SR-5, near the northeastern corner of the study area. It is possible that this low velocity zone could also be the result of preferential weathering, and does appear to coincide with the deepening of the bedrock surface in that area. However, being situated near the end of the seismic profile does make it a little more suspect that it could simply be a remnant of the modeling process. Drilling would be required to verify and better characterize the low velocity zones note in profiles SR-4 and SR-5.

VLE EM Results

VLF were collected along five traverses within the investigation area to identify potential bedrock fractures. The real component of the VLF Profiles are overlain along the map traces of the VLF traverses on Figure 4 along with potential fractures identified from the VLF data. Individual VLF profiles are presented on Figure 5.

Generally the strongest VLF responses noted in the data were caused by the presence of utilities near the ground surface. The potential anomalies attributed to potential bedrock fractures are of a smaller magnitude than those caused by utilities. The bedrock fracture responses in this area are somewhat muted because of the thick overburden combined with the water table being shallower than the bedrock surface. Slightly stronger bedrock responses would be expected if the water table were situated at or deeper than the bedrock surface.

Attempts were made to correlate the most prominent potential fracture responses across the investigation area. Note that some response variation between adjacent profiles and some of the potential fractures identified may not be readily identifiable in all profiles. Based on the identified responses, it appears that there may be a repeating joint pattern oriented approximately east-northeast to west-southwest, with more prominent joints spaced approximately ±75 feet apart. Of course potential fracture or joint spacing and orientation in

the bedrock may be better determined or verified if a nearby bedrock outcrop is available for analysis. In-situ fracture orientations can also be determined within an un-cased well using either acoustic or optical televiewer sondes.

Summary and Closing

Five seismic refraction lines were completed to identify bedrock topography within the parking lots located to the north of Lakeside Parkway. Seismic result did identify a bedrock low situated in the central portion of the lower parking lot, and also verified that the bedrock generally slopes downward towards the western portion of the investigation area. Five VLF EM traverses were collected to identify potential bedrock fractures. Several potential fractures were identified and a repeating set of parallel joints oriented east-northeast to west-southwest could be present across the study area.

All geophysical data and field notes collected as a part of this investigation will be archived at the AGS office. The data collection and interpretation methods used in this investigation are consistent with standard practices applied to similar geophysical investigations. The correlation of geophysical responses with probable subsurface features is based on the past results of similar surveys although it is possible that some variation could exist at this site. Intrusive field activities, such as soil borings or other appropriate methods, would be needed to further investigate and confirm the presence or absence of identified and interpreted features. Due to the nature of geophysical data, no guarantees can be made or implied regarding the presence or absence of additional objects or targets beyond those identified.

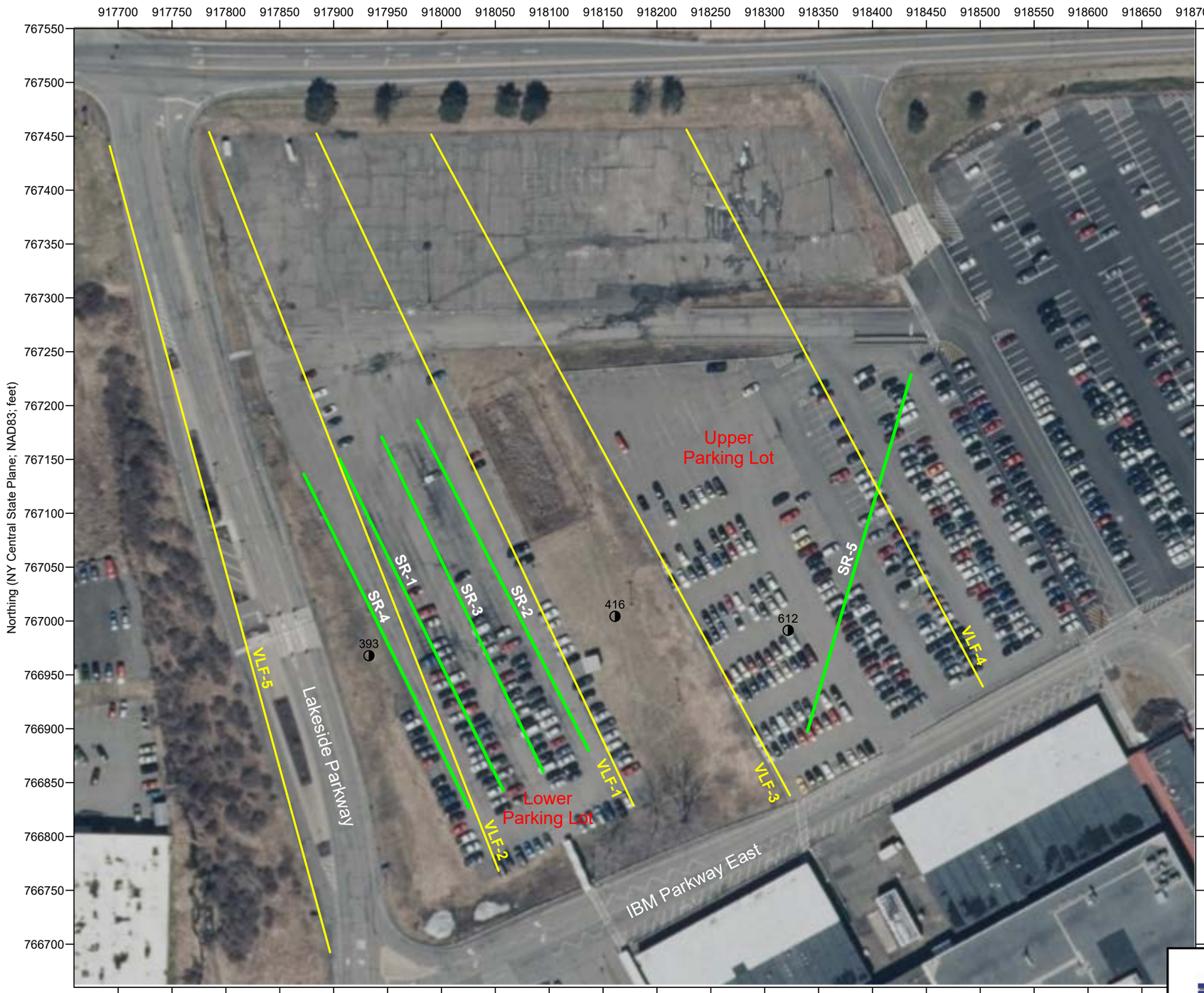
If you have any questions regarding the results of this field investigation, please contact me at 610-722-5500. It was a pleasure working with you on this project and we look forward to being able to provide you with sub-surface imaging services in the future.

Sincerely,

Donald Jagel

Donald Jagel, P.G.
Principal Geophysicist

attachment: Figures 1 through 5



Northing (NY Central State Plane; NAD83; feet)

767550 767500 767450 767400 767350 767300 767250 767200 767150 767100 767050 767000 766950 766900 766850 766800 766750 766700

917700 917750 917800 917850 917900 917950 918000 918050 918100 918150 918200 918250 918300 918350 918400 918450 918500 918550 918600 918650 918700

Easting (NY Central State Plane; NAD83; feet)

0 50 100 150 200
feet

Legend

SR-1 — Seismic Refraction Profile

VLF-1 — Very Low Frequency (VLF) Electromagnetic (EM) Traverse

612 — Bedrock Well

NOTES:

1) Seismic refraction data were collected with a 24-channel engineering seismograph and 24 10-Hz geophones. Geophones were spaced 15 feet apart and far offset shots were 60 feet from the end geophones. A 16-lb sledge hammer and metal strike plate were used as the seismic source.
2) VLF data were collected using an Abem Wadi VLF instrument. VLF data were recorded every 10 feet along each traverse. The VLF instrument was tuned to 24.0 KHz, the Cutler, Maine transmitting station.
3) Base aerial orthophotograph files c_09150766_12_15100_4bd_2014.zip and c_09180766_12_15100_4bd_2014 were downloaded from http://gis.ny.gov/gateway/mg/index.html/.
This work was not completed by a licensed surveyor, and as such should be considered approximate, and is for illustrative purposes only.
4) The items shown on this figure may not be all inclusive. AGS does not warrant the fact that additional buried features/utilities may be present which could not be identified by AGS personnel during this investigation.

ADVANCED GEOLOGICAL SERVICES

Geophysical Survey Area Showing Locations of Seismic Refraction (SR) Lines and VLF Traverses

LOCATION: Former IBM Facility (Lockheed Martin)
Owego, New York

CLIENT: Groundwater Sciences Corp.

PROJECT #: 17-262-1

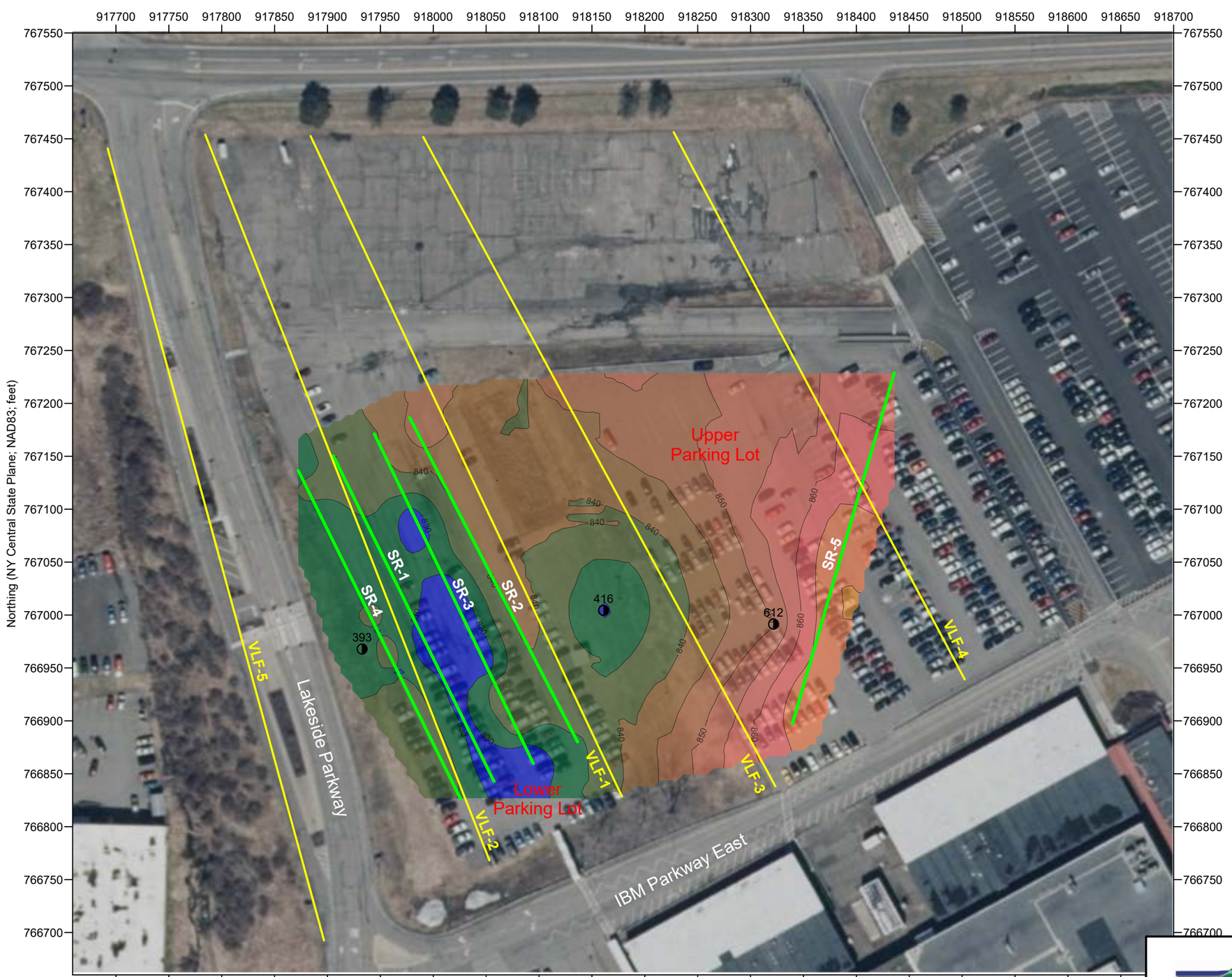
ADVANCED GEOLOGICAL SERVICES, INC.

DATE: December 14, 2017

DRAWN BY: D. JAGEL

APPROVED BY: D. JAGEL

FIGURE 1



917700 917750 917800 917850 917900 917950 918000 918050 918100 918150 918200 918250 918300 918350 918400 918450 918500 918550 918600 918650 918700

Easting (NY Central State Plane; NAD83; feet)

767550 767500 767450 767400 767350 767300 767250 767200 767150 767100 767050 767000 766950 766900 766850 766800 766750 766700

Northing (NY Central State Plane; NAD83; feet)

0 50 100 150 200
feet

870 865 860 855 850 845 840 835 830 825 820
Bedrock Elevation (feet)

Legend

SR-1 — Seismic Refraction Profile

VLF-1 — Very Low Frequency (VLF) Electromagnetic (EM) Traverse

612 — Bedrock Well

NOTES:

1) Seismic refraction data were collected with a 24-channel engineering seismograph and 24 10-Hz geophones. Geophones were spaced 15 feet apart and far offset shots were 60 feet from the end geophones. A 16-lb sledge hammer and metal strike plate were used as the seismic source. Ground surface elevations along the seismic profiles were picked from a map (002E Parking Lot Underground.pdf) provided by GSC, and were used during modeling to determine bedrock elevations.
2) VLF data were collected using an Abem Wadi VLF instrument. VLF data were recorded every 10 feet along each traverse. The VLF instrument was tuned to 24.0 KHz, the Cutler, Maine transmitting station.
3) Base aerial orthophotograph files c_09150766_12_15100_4bd_2014.zip and c_09180766_12_15100_4bd_2014 were downloaded from http://gis.ny.gov/gateway/mg/index.html/.
This work was not completed by a licensed surveyor, and as such should be considered approximate, and is for illustrative purposes only.
4) The items shown on this figure may not be all inclusive. AGS does not warrant the fact that additional buried features/utilities may be present which could not be identified by AGS personnel during this investigation.

N W E S

ADVANCED GEOLOGICAL SERVICES

Geophysical Survey Area Showing Bedrock Topography Derived from Modeled Seismic Refraction Data and Select Bedrock Well Information

LOCATION: Former IBM Facility (Lockheed Martin)
Owego, New York

CLIENT: Groundwater Sciences Corp.

PROJECT #: 17-262-1

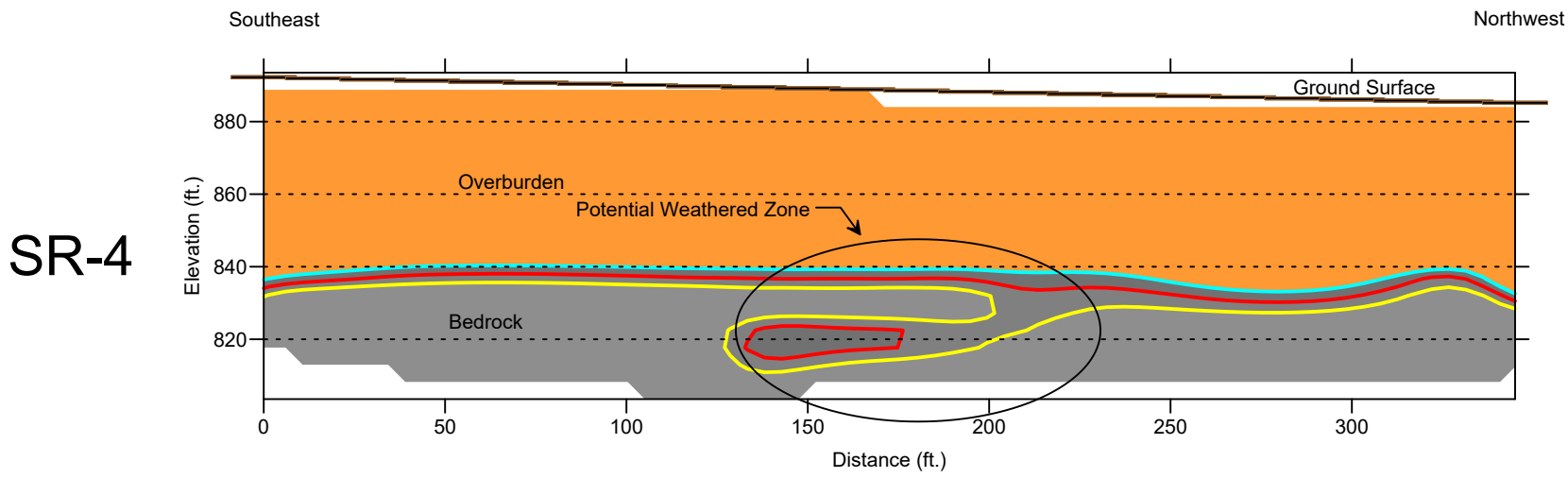
ADVANCED GEOLOGICAL SERVICES, INC.

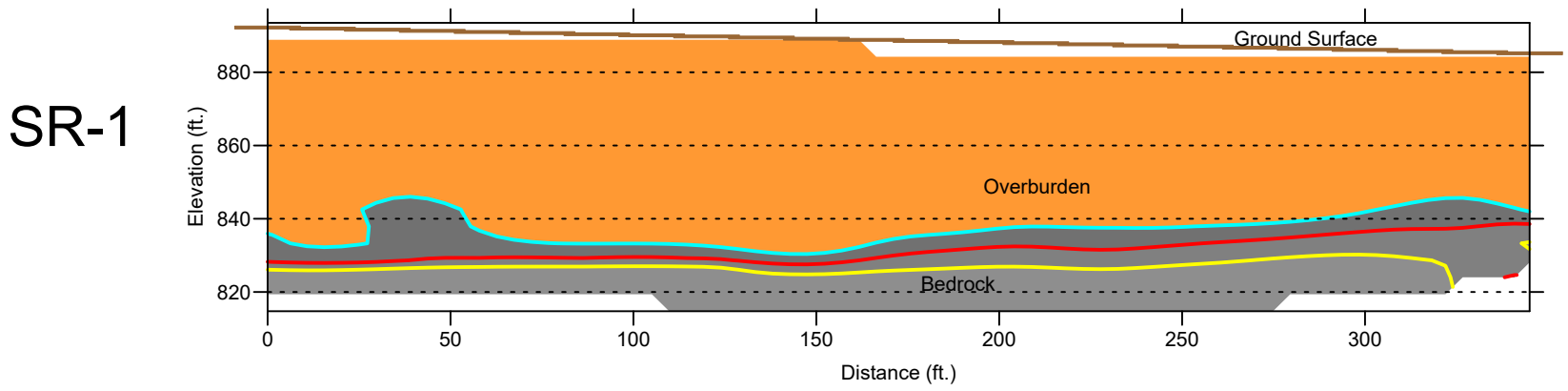
DATE: December 14, 2017

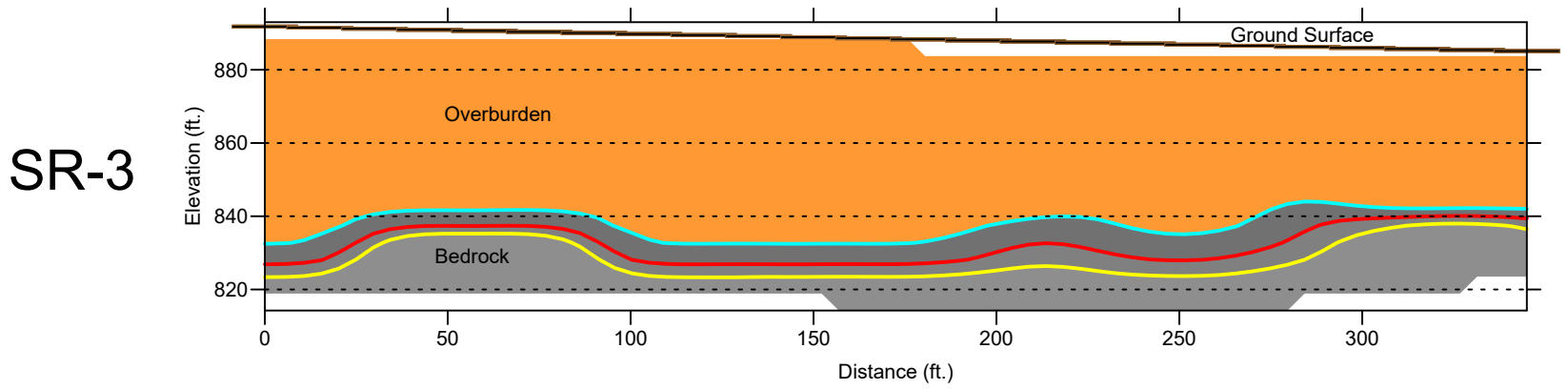
DRAWN BY: D. JAGEL

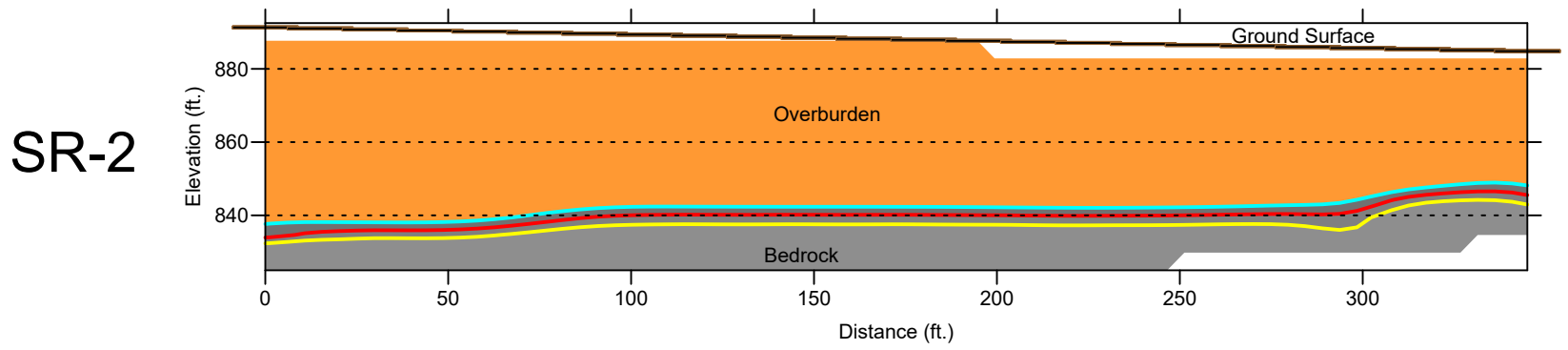
APPROVED BY: D. JAGEL

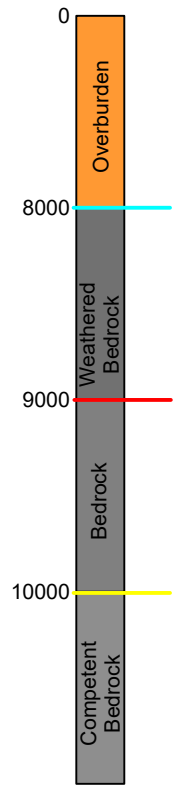
FIGURE 2

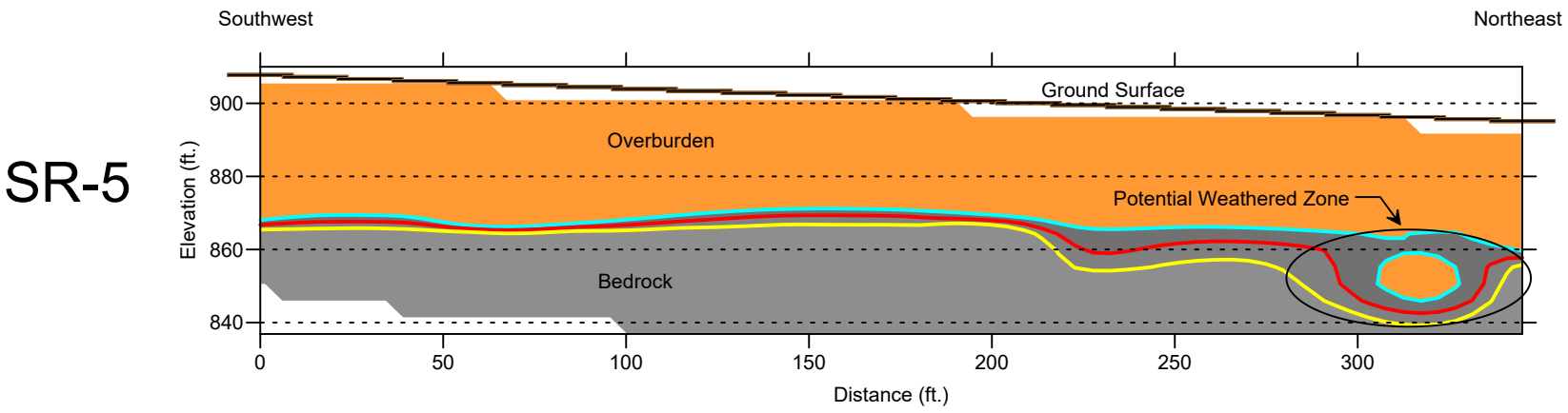












Seismic profiles are ordered from southern most profile
at the top of the page to northern most profile at the bottom of the page

NOTES:

1) Locations of the seismic refraction lines are shown on Figures 1 and 2. Seismic refraction data were collected with a 24-channel engineering seismograph and 24 10-Hz geophones. Geophones were spaced 15 feet apart and far offset shots were 60 feet from the end geophones. A 16-lb sledge hammer and metal strike plate were used as the seismic source. Seismic data were modeled using the program SeisOpt@2d.
2) Ground surface elevations along the seismic profiles were picked from a map (002E Parking Lot Underground.pdf) provided by GSC, and were used during modeling to determine bedrock elevation. Bedrock surface elevations assume the average bedrock velocity of 9,000 fps. Generally, the berock velocity varies between approximately 8,000 fps to greater than 10,000 fps.

ADVANCED GEOLOGICAL SERVICES

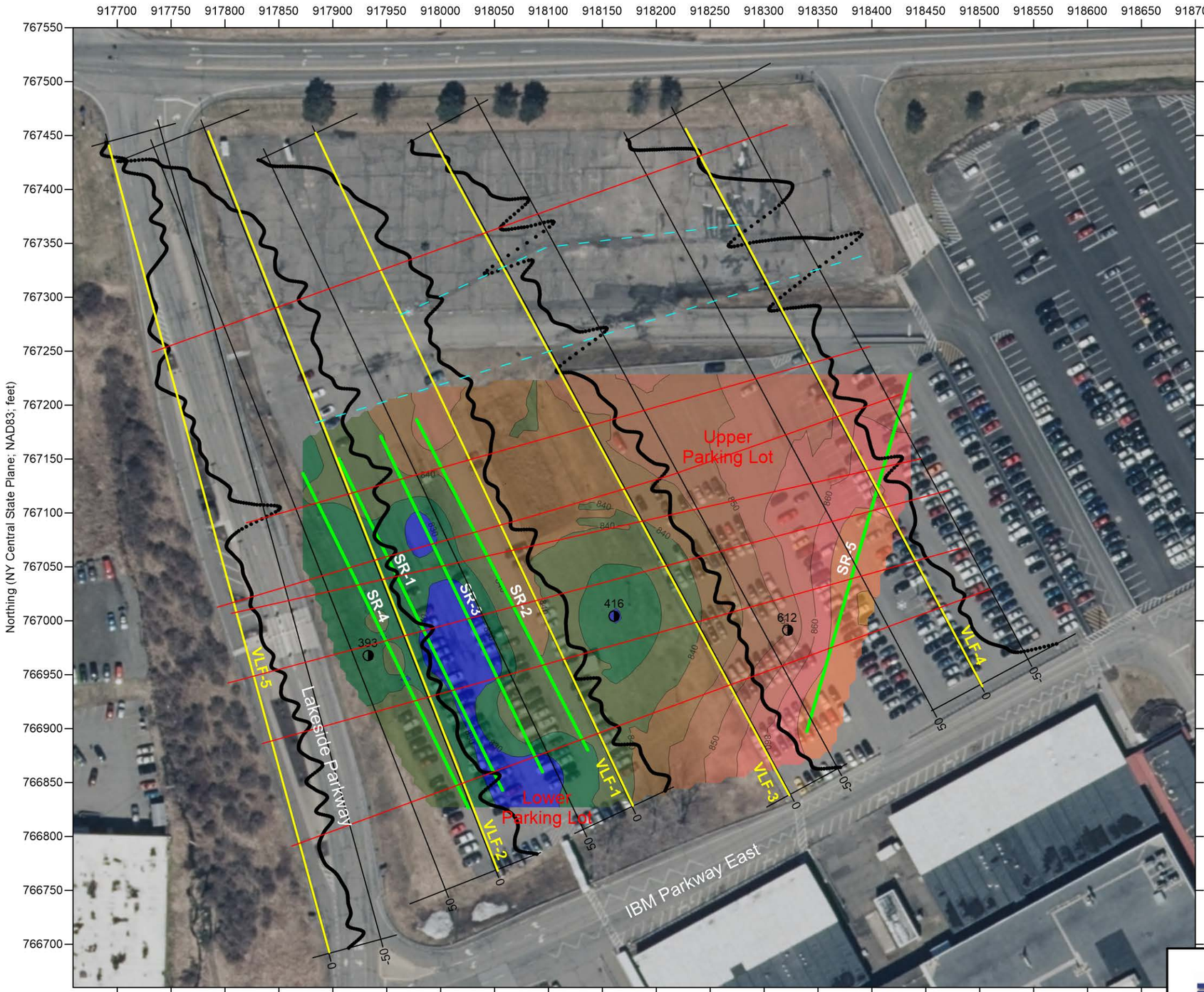
Modeled Seismic Refraction (SR) Profiles

LOCATION: Former IBM Facility (Lockheed Martin)
Owego, New York

CLIENT: Groundwater Sciences Corp.

FIGURE 3

PROJECT #:	17-262-1	ADVANCED GEOLOGICAL SERVICES, INC.	
DATE:	December 14, 2017	DRAWN BY: D. JAGEL	APPROVED BY: D. JAGEL



Northing (NY Central State Plane; NAD83; feet)

917700 917750 917800 917850 917900 917950 918000 918050 918100 918150 918200 918250 918300 918350 918400 918450 918500 918550 918600 918650 918700

767550 767500 767450 767400 767350 767300 767250 767200 767150 767100 767050 767000 766950 766900 766850 766800 766750 766700

Easting (NY Central State Plane; NAD83; feet)

0 50 100 150 200
feet

870 865 860 855 850 845 840 835 830 825 820

Bedrock Elevation (feet)

Legend

SR-1 Seismic Refraction Profile

VLF-1 Very Low Frequency (VLF) Electromagnetic (EM) Traverse

Potential Bedrock Fracture Correlated Between VLF Profiles

Potential Utility

612 Bedrock Well

NOTES:

1) Seismic refraction data were collected with a 24-channel engineering seismograph and 24 10-Hz geophones. Geophones were spaced 15 feet apart and far offset shots were 60 feet from the end geophones. A 16-lb sledge hammer and metal strike plate were used as the seismic source. Ground surface elevations along the seismic profiles were picked from a map (002E Parking Lot Underground.pdf) provided by GSC, and were used during modeling to determine bedrock elevations.
2) VLF data were collected using an Abem Wadi VLF instrument. VLF data were recorded every 10 feet along each traverse. The VLF instrument was tuned to 24.0 KHz, the Cutler, Maine transmitting station. VLF real component shown. VLF anomalies occur at the inflection point between the pike and trough of the anomlies.
3) Base aerial orthophotograph files c_09150766_12_15100_4bd_2014.zip and c_09180766_12_15100_4bd_2014 were downloaded from http://gis.ny.gov/gateway/mg/index.html/.
This work was not completed by a licensed surveyor, and as such should be considered approximate, and is for illustrative purposes only.
4) The items shown on this figure may not be all inclusive. AGS does not warrant the fact that additional buried features/utilities may be present which could not be identified by AGS personnel during this investigation.

N W E S

ADVANCED GEOLOGICAL SERVICES

Geophysical Survey Area Showing Bedrock Topography, VLF Profile Data, and Interpreted Potential Bedrock Fractures

LOCATION: Former IBM Facility (Lockheed Martin)
Owego, New York

CLIENT: Groundwater Sciences Corp.

PROJECT #: 17-262-1

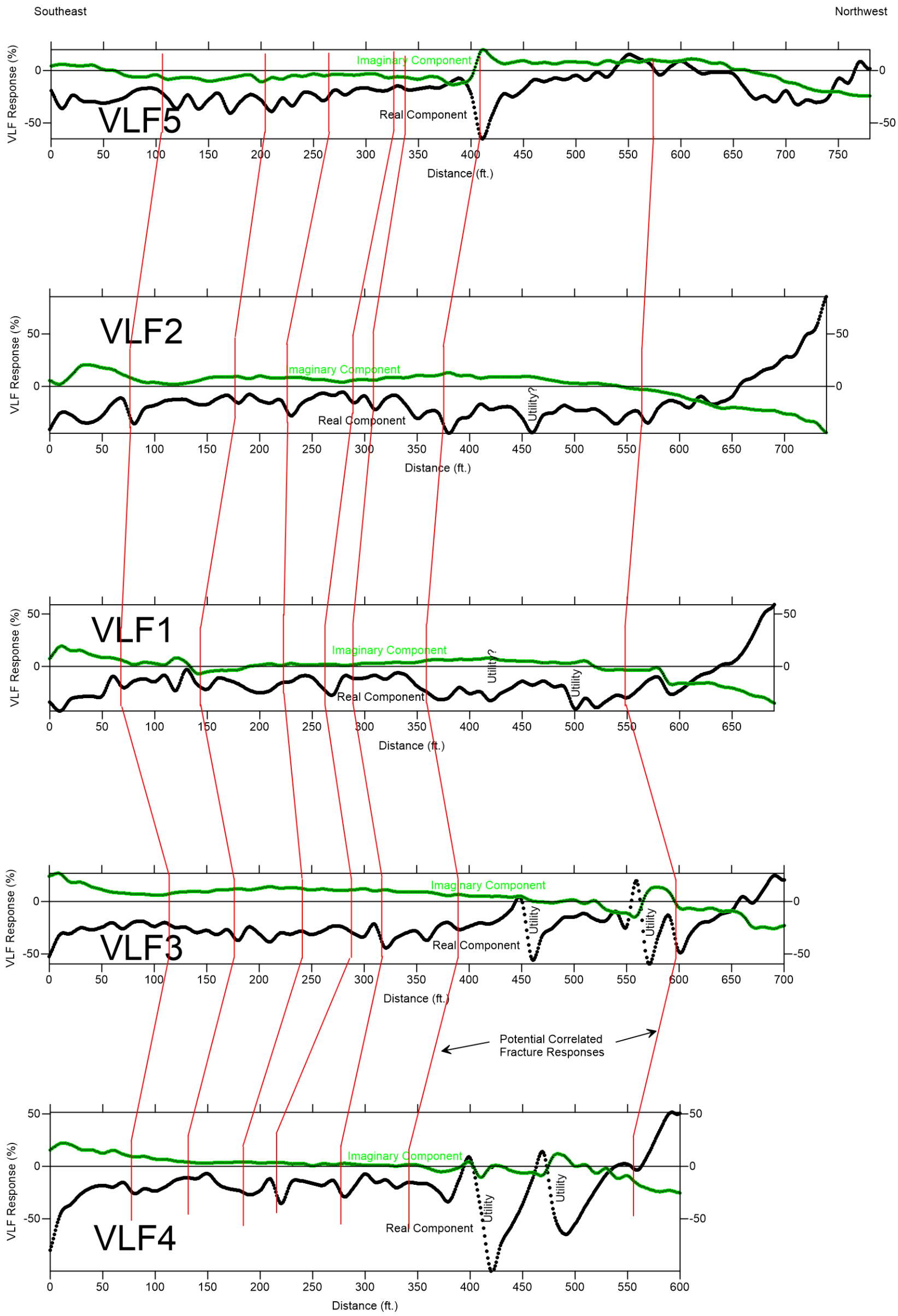
ADVANCED GEOLOGICAL SERVICES, INC.

DATE: December 14, 2017

DRAWN BY: D. JAGEL

APPROVED BY: D. JAGEL

FIGURE 4



VLF profiles are ordered from southern most profile at the top of the page to northern most profile at the bottom of the page

NOTES:

1) Locations of the VLF traverses are shown on Figures 1, 2, and 4. The identified potential fractures (shown in red) correspond to the potential fractures shown on Figure 4. Note that not all anomalies can be correlated directly from one profile to the adjacent profile. Also, ther may be other potential fractures that can be correlated between profiles that have not been identified. Anomaly locations are generally indicated by the inflection point between peak and trough of any given anomaly.

ADVANCED GEOLOGICAL SERVICES

VLF Profiles (Real and Imaginary Components) and Potential Correlated Bedrock Fractures

LOCATION: Former IBM Facility (Lockheed Martin) Owego, New York

CLIENT: Groundwater Sciences Corp.

FIGURE 5

PROJECT #: 17-262-1

ADVANCED GEOLOGICAL SERVICES, INC.

DATE: December 14, 2017

DRAWN BY: D. JAGEL

APPROVED BY: D. JAGEL

ADVANCED GEOLOGICAL SERVICES
Headquarters in Malvern, PA
Offices in Chillicothe, OH and
Moraga, CA

December 19, 2017
Reference: 17-262-1

Mr. Stephen Fisher, P.G.
Groundwater Sciences Corporation
2601 Market Place Street, Suite 310
Harrisburg, PA 17110

Subject: Geophysical Investigation Results
Building 306 Utility Mark-out Area
Former IBM Site (Lockheed Martin)
Owego, New York

Dear Mr. Fisher:

Advanced Geological Services (AGS) presents this letter to roundwater Sciences Corporation (GSC) summarizing the geophysical investigation completed by AGS on November 17, 2017 at the at the former IBM facility in Owego, New York.

The objective of the geophysical investigation was to identify and mark locations of underground utilities on the southwest and northwest sides of Building 306.

To achieve the project objective, AGS utilized a combination of the radio frequency utility locating method, the hand-held electromagnetic (EM) metal detection method, and the ground penetrating radar (GPR) method.

Methods

Radio Frequency (RF) Utility Locating Methods

The investigation area was inspected using a RF utility locating system (also known as a precision utility locator (PUL)) to identify and trace potential electrical, telecommunication, water, and other potential identifiable utilities.

AGS utilized a Radiodetection RD4000 RF utility locating instrument. This instrument consists of a receiver/tracer and a remote transmitter which operates at multiple radio-frequencies (RF) ranging from 8 kHz to 65 kHz. The receiver unit detects the transmitted RF signals as well as standard 60 Hz electrical power lines and broad-band RF signals when operated in passive detection modes. This utility tracing instrument is an analog device which provides visual and audible feedback to the operator when a utility coupled with the transmitted signal is crossed. The transmitter produces a radio-frequency signal in the utility to be traced by either induction coupling or direct hook-up. The receiver output varies an audible pitch and visual feedback depending upon how far the utility is from the receiver. By carefully adjusting the gain of the receiver it is possible to determine the location of the utility and to separate it from adjacent utilities.

The investigation area was scanned using passive 60 Hz and the broad-band RF detection

modes to identify potential utilities that may be present. Inductive and direct hook-up methods were used to trace specific utilities when possible. Identified utilities were marked on the ground surface with spray paint and/or pin flags.

Hand-Held Electromagnetic (EM) Metal Detection Method

The hand-held EM metal detection method was used to search for metallic utilities, and other buried metal objects throughout the investigation area. The EM method uses the principle of electromagnetic induction to detect shallow buried metal objects. This is done by carrying a unit consisting of hand-held radio frequency transmitter and receiver above the ground and continuously scanning the surface. A primary coil broadcasts a radio frequency signal from a transmitter. This primary radio signal induces secondary electrical currents in metal objects. These secondary currents in turn produce a magnetic field which is detected by the receiver.

The EM instrument used for this investigation was a Fisher TW-6 pipe and cable locator. This instrument is expressly designed to detect metallic pipes, cables, USTs, manhole covers, and other buried metallic objects. The instrument produces an audible response and significant meter deflections when near a metal object. The peak instrument response occurs when the unit is directly over the object. The EM instrument is ineffective in areas covered with reinforced concrete because the metal reinforcing material saturates the instrument response. In some instances, this instrument does respond slightly to variations in soil conductivity that can indicate the presence of fill, increased soil moisture, or increased clay content. In areas with very high conductivity soil, the instrument response can become swamped, thereby masking buried metal features.

The TW-6 is operated in scanning mode, and does not allow for recording of the instrument response. For the present investigation, the survey area was scanned in a grid pattern to identify potential utilities or other buried metal objects. Locations of potential utilities were marked on site with spray paint and/or pin flags.

Ground Penetrating Radar (GPR) Method

The ground penetrating radar (GPR) method was used to search for metallic and non-metallic utilities and other targets of interest surrounding proposed drilling locations.

The GPR method is based upon the transmission of repetitive, radio-frequency electromagnetic (EM) pulses into the subsurface. When the transmitted energy of the down-going wave contacts an interface of dissimilar electrical character, part of the energy is returned to the surface in the form of a reflected signal. This reflected signal is detected by a receiving transducer and is displayed on the screen of the GPR unit as well as being recorded on the internal hard-drive. The received GPR response remains constant as long as the electrical contrast between media is present and constant. Lateral or vertical changes in the electrical properties of the subsurface result in equivalent changes in the GPR response. The system records a continuous image of the subsurface by plotting two-way travel time of the reflected EM pulse versus distance traveled along the ground surface. Two-way travel time values are

then converted to depth using known soil velocity functions.

A GSSI SIR-3000 GPR system and a 400 megahertz (MHz) antenna were used with a recording window of 60 nanoseconds (ns) to provide depth of penetration of up to approximately 10 feet under ideal field conditions. High conductivity soil, some conductive ballast gravels, and de-icing salt can strongly attenuate GPR signals, thereby decreasing the effective depth of investigation of the GPR system.

GPR data were collected accessible portion of the site to identify potential utilities. Locations of identified utilities were marked on the ground surface with spray paint and/or pin flags.

Results and Discussion

The investigation included the visitor parking lot on the southwest side of Building 306 and the access road (IBM Parkway East) that runs along the northwest side of Building 306. The investigation are and identified utilities are shown on Figure 1. All identified utilities were marked on site with spray paint and/or pin flags.

A number of utilities and potential utilities were identified in the visitor parking lot and in the roadway on the northwest side of Building 306, including a utility tunnel, water, sewer, electrical, telecommunications, and potential abandoned utilities. Overall, the configuration of identified utilities agreed fairly well with those shown on the utility base map that GSC had while on site. The GSC map did show potential additional utilities in the visitor parking lot that could not be verified by AGS. Although AGS was unable to verify some of the utilities, AGS recommends that the original utility base map that GSC had prior to this investigation be reviewed before starting any drilling and areas where the maps shows potential utilities should be avoided.

There were also potential utilities identified by AGS that had not been previously documented on the original GSC utility map that were marked on site and are shown on Figure 1. Previously undocumented utilities are located near the southern corner of the visitor parking lot and along the strip of grass between Building 306 and the roadway on the northwest side of Building 306.

Upon completion of the utility mark-out, all identified utilities and features were reviewed with the on site CSG representative. Again, it is recommended that the original GSC utility map and enclosed Figure 1 be reviewed prior to drilling. Hand clearing the upper several feet of any borings in the vicinity of potential utilities may be advisable in any questionable areas.

Closing

All geophysical data and field notes collected as a part of this investigation will be archived at the AGS office. The data collection and interpretation methods used in this investigation are consistent with standard practices applied to similar geophysical investigations. The correlation of geophysical responses with probable subsurface features is based on the past results of similar surveys although it is possible that some variation could exist at this site. Due

to the nature of geophysical data, no guarantees can be made or implied regarding the presence or absence of additional objects or targets beyond those identified.

If you have any questions regarding the results of this field investigation, please contact me at 610-722-5500. It was a pleasure working with you on this project and we look forward to being able to provide you with sub-surface imaging services in the future.

Sincerely,

Donald Jagel, P.G.
Geophysicist/Branch Manager
Advanced Geological Services, Inc.
P.O. Box 349
280½ East Main Street
Chillicothe, OH 45601

attachment: Figure 1

LEGEND

E	Electric
T	Telecommunication
W	Water
SS	Sanitary Sewer
ST	Storm Sewer
U	Utility (Misc. Type)
??	Potential Utility (Unknown Type)

0 20 40

Feet

NOTES:

1) Base aerial orthophotograph downloaded from https://orthos.dhses.ny.gov/, and included files c_09150766_12_15100_4bd_2014.zip and c_09180766_12_15100_4bd_2014.zip. Utility locations are based on GPS locations of utilities identified by AGS. This work was not completed by a licensed surveyor, and as such should be considered approximate, and is for illustrative purposes only.
2) The items shown on this figure may not be all inclusive. AGS does not warrant the fact that additional buried features/utilities may be present which could not be identified by AGS personnel during this investigation.

FIGURE 1

Identified Utilities Surrounding the Building 306 Survey Area

PROJECT:
Utility Mark Out
Former IBM Facility
Owego, New York

PREPARED FOR:
Groundwater Science Corp.
2601 Market Place St.
Suite 310
Harrisburg, PA 17110

PREPARED BY:
Advanced Geological Services, Inc.
PO Box 349
280½ E. Main ST.
Chillicothe, OH 45601

AGS# 17-262-1 DJ/12/19/2017

ADVANCED GEOLOGICAL SERVICES

APPENDIX B

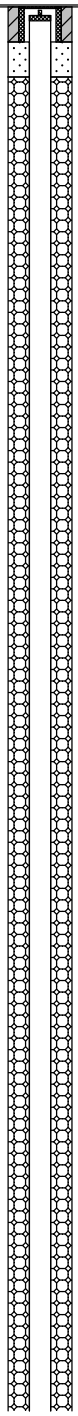
Geologic and Well Construction Logs for Soil Borings B-800 through B-828, Test Boring 418A and Test Monitoring Wells 700 and 701

GROUNDWATER SCIENCES CORPORATION

GEOLOGIC LOG: B-800

PROJECT INFORMATION		DRILLING INFORMATION	
PROJECT:	***Owego P001 Investigation***	DRILLING CO.:	***Cascade Drilling***
SITE LOCATION:	***1801 NY-17C, Owego, NY***	DRILLER:	***Rob Maillet***
JOB NO.:	***93004.46.1701***	RIG TYPE:	***LS 250 MiniSonic***
LOGGED BY:	***Jane Block***	DRILLING METHOD:	***6" Sonic***
DATES DRILLED:	***4/9/18 - 4/10/18***	DEVELOPMENT DATE:	***4/26/18***
		LOCATION:	***Approximately 40 feet southeast of well 609***
NOTES: MP Elevation: 897.44		ELEVATION: 897.8	
		NORTHING: 767167.9498	EASTING: 918386.6162

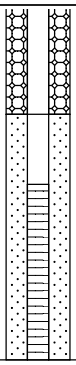
DEPTH FEET	PID Reading	SAMP.	Recovery	LITHOLOGY
0				ASPHALT: Asphalt pavement
	0	1	5'/ 10'	SILT, SAND & GRAVEL: Moderate yellowish brown (10YR 5/4) and dark yellowish brown (10YR 4/2) silt and vf-vc sand, some f-m gravel, trace cobbles, crumbly
10				
	0	2	2.4'/ 5'	SILT, SAND & GRAVEL: Moderate yellowish brown (10YR 5/4) and some medium gray (N5) silt and vf-vc sand, f-m subrounded to angular gravel, trace subrounded to angular cobbles
	0	3	5'/5'	SILT, SAND & GRAVEL: Olive gray (5Y 4/1) silt and vf-vc sand, f-m subrounded to angular gravel, trace subrounded to angular cobbles, trace clay
20				SAND & SILT: Silt and f-c sand, trace organic materials (rootlets and grass remnants), fragments of terra cotta pipe
	0	4	5'/5'	SILT, SAND & GRAVEL: Moderate olive brown (5Y 4/4), silt and vf-c sand, f-m rounded gravel, crumbly
	0	5	4'/5'	SILT, SAND & GRAVEL: as above, increasing coarse sand, crumbly
30				
	0.5 0	6	2.4'/ 5'	SILT, SAND & GRAVEL: As above, increasing cobbles, crumbly, wet at 30 feet
	0.2 0	7	2.9' /5'	SILT, SAND & GRAVEL: Light olive gray (5Y 6/1), silt and vf-vc sand, f-m gravel, some cobbles, crumbly
40				



WELL CONSTRUCTION DETAILS
Flushmounted 4" Manhole (0'-1')
No. 1 sand fill (1'-2')
Bentonite chip annular seal (2'-43')
6" dia. Sonic borehole (0-50')
2" Sch. 40 PVC riser (0-45')

GROUNDWATER SCIENCES CORPORATION

GEOLOGIC LOG: B-800

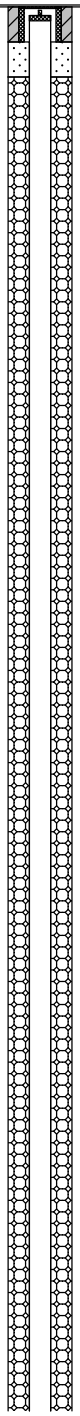
DEPTH FEET	PID Reading	SAMP.	Recovery	LITHOLOGY	GRAPHIC	DEPTH FEET	WELL CONSTRUCTION	WELL CONSTRUCTION DETAILS
40				SILT, SAND & GRAVEL: Medium gray (N5), silt and vf-vc sand, f-m angular gravel, little clay, plastic, moist		40		
	0	8	5'/5'					
				SILT, SAND & GRAVEL: As above				No. 1 sand pack (43'-50')
	0	9	3.5'/5'					
				SHALE: Shale bedrock				2" PVC 20-slot screen (45'-50')
50						50		

GROUNDWATER SCIENCES CORPORATION

GEOLOGIC LOG: B-801

PROJECT INFORMATION		DRILLING INFORMATION	
PROJECT:	***Owego P001 Investigation***	DRILLING CO.:	***Cascade Drilling***
SITE LOCATION:	***1801 NY-17C, Owego, NY***	DRILLER:	***Rob Maillet***
JOB NO.:	***93004.46.1701***	RIG TYPE:	***LS 250 Mini Sonic***
LOGGED BY:	***Jane Block***	DRILLING METHOD:	***6" Sonic***
DATES DRILLED:	***4/10/18***	DEVELOPMENT DATE:	***4/26/18***
		LOCATION:	***Approximately 30 feet south of well 609***
NOTES: MP Elevation: 895.75		ELEVATION: 896.1	
		NORTHING: 767169.9474	EASTING: 918336.4517

DEPTH FEET	PID Reading	SAMP.	Recovery	LITHOLOGY
0				ASPHALT: Asphalt pavement
	0	1	4' /10'	SILT, SAND & GRAVEL: Moderate yellowish brown (10YR 5/4) to dark yellowish brown (10YR 4/2), silt, very fine to very coarse sand, fine to medium rounded to angular gravel, cohesive, slightly moist
10				
	0	2	3.1' /5'	SILT, SAND & GRAVEL: As above, some olive gray (5Y 4/1)
	0	3	3'/5'	SILT, SAND & GRAVEL: As above, occasional brick fragment
20				SAND & SILT: Olive gray (5Y 3/2) silt, vf-c sand, little clay, little organics, moist at 21 feet
	0	4	5'/5'	SILT & CLAY: Light olive gray (5Y 5/2) clay and silt, little gravel, little organics, plastic, moist
	0	5	5'/5'	SILT, SAND & GRAVEL: Moderate yellowish brown (10 YR 5/4) to light olive gray (5Y 5/2), silt, very fine to very coarse sand, fine to medium angular to rounded gravel, trace angular to rounded cobbles, crumbly
30				SILT, SAND & GRAVEL: As above, some cobbles
	0	6	4.8' /5'	SAND & SILT: Olive gray (5Y 5/2), silt, f-c sand, little clay, plastic, moist SILT, SAND & GRAVEL: Moderate yellowish brown (10YR 5/4) to light olive gray (5Y 5/2), very fine to very coarse sand, fine to medium angular to rounded gravel, few angular to rounded cobbles, crumbly
	0	7	NA	SILT, SAND & GRAVEL: Medium light gray (N5) with some light olive gray (5Y 5/2), very fine to very coarse sand, fine to medium gravel, angular, crumbly, very hard spot around 37 feet, dry
40				

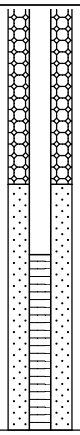


WELL CONSTRUCTION DETAILS
Flushmounted 4" Manhole (0'-1')
No. 1 sand fill (1'-2')
Bentonite chip annular seal (2'-45')
6" dia. Sonic borehole (0-52')
2" Sch. 40 PVC riser (0-47')

GROUNDWATER SCIENCES CORPORATION

GEOLOGIC LOG: B-801

DEPTH FEET	PID Reading	SAMP.	Recovery	LITHOLOGY	GRAPHIC	DEPTH FEET	WELL CONSTRUCTION	WELL CONSTRUCTION DETAILS
40				SILT, SAND & GRAVEL: As above, dark gray (N4)		40		
	0	8	5'/5'	GRAVEL: Boulders and cobbles, little sand, little silt				
				SILT, SAND & GRAVEL: Light olive gray (5Y 5/2), very fine to very coarse sand, fine to medium angular to rounded gravel, some angular to rounded cobbles, crumbly				No. 1 sand pack (45'-52')
	0	9	5'/5'					2" PVC 20-slot screen (47'-52')
50				SHALE: Shale bedrock		50		



GROUNDWATER SCIENCES CORPORATION

GEOLOGIC LOG: B-802

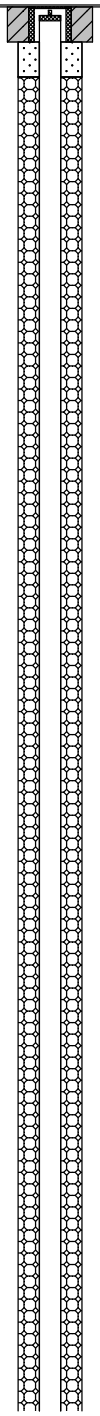
PROJECT INFORMATION		DRILLING INFORMATION	
PROJECT:	***Owego P001 Investigation***	DRILLING CO.:	***Cascade Drilling***
SITE LOCATION:	***1801 NY-17C, Owego, NY***	DRILLER:	***Rob Maillet***
JOB NO.:	***93004.46.1701***	RIG TYPE:	***LS 250 Mini Sonic***
LOGGED BY:	***Jane Block***	DRILLING METHOD:	***6" Sonic***
DATES DRILLED:	***4/11/18***	DEVELOPMENT DATE:	***4/26/18***
		LOCATION:	***Approxmiately 10 feet north of well 609***

NOTES: MP Elevation: 894.13

ELEVATION: 894.5

NORTHING: 767219.8866 EASTING: 918336.0398

DEPTH FEET	PID Reading	SAMP.	Recovery	LITHOLOGY
0	3.0			ASPHALT: Asphalt pavement
	0	1	4' /10'	SILT, SAND & GRAVEL: Moderate olive brown (5Y 4/4) to moderate yellowish brown (10YR 5/4), very fine to very coarse sand, fine to medium angular to rounded gravel, some angular to rounded cobbles, crumbly, dry
	0.4			
10	68.5			SILT, SAND & GRAVEL: As above, some olive gray (5Y 4/1), moist at 11 feet
	0	2	3'/5'	
	0.6			
		3	0'/5'	SILT, SAND & GRAVEL: No recovery
20	5.1			SAND & SILT: Light olive gray (5Y 5/2), silt, very fine to very coarse sand, little fine gravel, rounded, wet.
	0	4	3.5'/5'	SILT, SAND & GRAVEL: Light olive gray (5Y 5/2) to moderate olive brown (5Y 4/4), silt, very fine to very coarse sand, fine to medium angular gravel, trace angular cobbles, cohesive, crumbly, wet at 25 feet
	2.1			SAND & SILT: Moderate olive brown (5Y 4/4), silt, sand, few pebbles
	0	5	4'/5'	SILT, SAND & GRAVEL: Moderate olive brown (5Y 4/4) to light olive gray (5Y 5/2), very fine to very coarse sand, fine to medium angular to rounded gravel, cohesive, tightly packed, dry
30	1.7			
	0	6	5'/5'	SILT, SAND & GRAVEL: Light olive gray (5Y 6/1) to grayish olive (10Y 4/2), silt, very fine to very coarse sand, fine gravel, increasing amount of gravel and cobbles with depth
				SILT, SAND & GRAVEL: Medium light gray (N6), as above, medium to large gravel, some cobbles, boulder from 35'-37', crumbly, dry
	0	7	5'/5'	SILT, SAND & GRAVEL: Light olive gray (5Y 6/1) to light gray (N7), silt, very fine to very coarse sand, fine to medium angular
40				



WELL CONSTRUCTION DETAILS

Flushmounted 4" Manhole (0'-1')

No. 1 sand fill (1'-2')

Bentonite chip (2'-46.5')

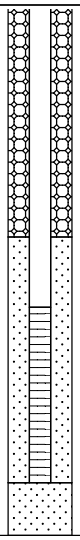
6" dia. Sonic borehole (0-55')

2" Sch. 40 PVC riser (0-48.5')

GROUNDWATER SCIENCES CORPORATION

GEOLOGIC LOG: B-802

DEPTH FEET	PID Reading	SAMP.	Recovery	LITHOLOGY	GRAPHIC	DEPTH FEET	WELL CONSTRUCTION	WELL CONSTRUCTION DETAILS
40				gravel (up to 2")		40		
	0	8	2'/5'	SILT & CLAY: Light olive gray (5Y 6/1), silt, clay, some fine (pebble sized) angular gravel, few angular cobbles, cohesive, plastic, very wet				
		9	2'/5'	GRAVEL: Cobbles and boulders intermixed with silt and clay				No. 1 sand pack (46.5'-55')
50						50		2" PVC 20-slot screen (48.5'-53.5')
	0	10	4'/5'	SHALE: Shale bedrock				



GROUNDWATER SCIENCES CORPORATION

GEOLOGIC LOG: B-803

PROJECT INFORMATION		DRILLING INFORMATION	
PROJECT:	***Owego P001 Investigation***	DRILLING CO.:	***Cascade Drilling***
SITE LOCATION:	***1801 NY-17C, Owego, NY***	DRILLER:	***Rob Maillet***
JOB NO.:	***93004.46.1701***	RIG TYPE:	***LS 250 Mini Sonic***
LOGGED BY:	***Jane Block***	DRILLING METHOD:	***6" Sonic***
DATES DRILLED:	***4/12/18***	DEVELOPMENT DATE:	***4/25/18***
		LOCATION:	***Approximately 50 feet east of well 609***

NOTES: MP Elevation: 895.84

ELEVATION: 896.3

NORTHING: 767218.0893 EASTING: 918385.8729

DEPTH FEET	PID Reading	SAMP.	Recovery	LITHOLOGY
0	1.9			ASPHALT: Asphalt pavement
		1	4' /10'	SILT, SAND & GRAVEL: Light olive gray (5Y 5/2) to moderate olive brown (5Y 4/4) with some moderate yellowish brown (10YR 4/2) silt, very fine to very coarse sand, fine to medium angular to rounded gravel (up to 2"), organic material at 12 and 14 feet, crumbly, dry
	0			
	0.6			
10	2.9			
	0	2	3.5' /5'	
				SILT & CLAY: Light olive gray (5Y 6/1) to olive gray (5Y 4/1), silt and clay, some sand, some organic material (roots and small twigs), stiff, tightly packed
	1.9			
	0	3	5'/5'	SILT, SAND & GRAVEL: Moderate yellowish brown (10YR 5/4) with some light olive brown (5Y 5/6), silt, very fine to very coarse sand, fine angular gravel, crumbly
20	7.0			
		4	4.5' /5'	SILT, SAND & GRAVEL: As above, moderate olive brown (5Y 4/4) to olive gray (5Y 4/1), f-m angular to rounded gravel
	0			
				SILT, SAND & GRAVEL: As above, some large gravel to cobbles (>2"), moist
	0	5	4'/5'	
30	0			SILT, SAND & GRAVEL: As above
	2.1	6	5'/5'	
	0			
	0.7			SILT, SAND & GRAVEL: Light gray (N7) to medium light gray (N6), silt, very fine to very coarse sand, fine to medium gravel, some cobbles, very hard spots in interval, potential boulders or extremely tightly packed sand and silt
	0			
		7	5'/5'	
	0			
40	2.0			

DEPTH FEET	GRAPHIC	WELL CONSTRUCTION	WELL CONSTRUCTION DETAILS
0			Flushmounted 4" Manhole (0'-1')
			No. 1 sand fill (1'-2')
			Bentonite chip annular seal (2'-35.5')
10			6" dia. Sonic borehole (0-50')
20			2" Sch. 40 PVC riser (0-37.5')
30			No. 1 sand pack (35.5'-42.5')
40			2" PVC 20-slot screen (37.5'-42.5')

GROUNDWATER SCIENCES CORPORATION

GEOLOGIC LOG: B-803

DEPTH FEET	PID Reading	SAMP.	Recovery	LITHOLOGY	GRAPHIC	DEPTH FEET	WELL CONSTRUCTION	WELL CONSTRUCTION DETAILS
40		8	5'/5'	SHALE: Shale bedrock		40		
		9	5'/5'	SHALE: Shale bedrock				Bentonite chip backfill
50						50		

GROUNDWATER SCIENCES CORPORATION

GEOLOGIC LOG: B-804

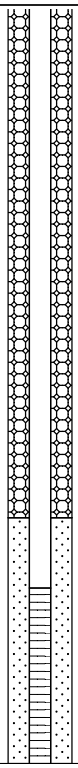
PROJECT INFORMATION		DRILLING INFORMATION	
PROJECT:	***Owego P001 Investigation***	DRILLING CO.:	***Cascade Drilling***
SITE LOCATION:	***1801 NY-17C, Owego, NY***	DRILLER:	***Rob Maillet***
JOB NO.:	***93004.46.1701***	RIG TYPE:	***LS 250 Mini Sonic***
LOGGED BY:	***Jane Block***	DRILLING METHOD:	***6" Sonic***
DATES DRILLED:	***4/13/18 - 4/16/18***	DEVELOPMENT DATE:	***4/30/18***
		LOCATION:	***Approximately 40 feet southwest of well 612***
NOTES: MP Elevation: 904.40		ELEVATION: 904.7	
		NORTHING: 766972.2710	EASTING: 918288.7976

DEPTH FEET	PID Reading	SAMP.	Recovery	LITHOLOGY	GRAPHIC	DEPTH FEET	WELL CONSTRUCTION	WELL CONSTRUCTION DETAILS
0				ASPHALT: Asphalt pavement		0		Flushmounted 4" Manhole (0'-1')
	0			SILT, SAND & GRAVEL: Moderate yellowish brown (10YR 5/4), silt, very fine to very coarse sand, fine to medium angular to rounded gravel, little clay, cohesive, crumbly				No. 1 sand fill (1'-2')
		1	4.5' /10'					Bentonite chip annular seal (2'-54.5')
	0							
	0							
10	0			SILT, SAND & GRAVEL: As above, some light olive gray (5Y 5/2)		10		6" dia. Sonic borehole (0-61.5')
	0	2	4.5' /5'					
	0							
	1.4			SILT, SAND & GRAVEL: As above, some cobbles (>2")				
		3	5'/5'					
	0			SILT, SAND & GRAVEL: As above, grayish brown (5YR 3/2)				
	3.5							
20	2.3			SILT, SAND & GRAVEL: Moderate olive brown (5Y 4/4), silt, very fine to very coarse sand, fine to medium angular to rounded gravel, some angular to rounded cobbles (>2"), crumbly		20		2" Sch. 40 PVC riser (0-56.5')
	0	4	5'/5'					
	0			SILT, SAND & GRAVEL: Light olive gray (5Y 5/2), silt, very fine to very coarse sand, fine to medium angular to rounded gravel, little clay, plastic, wet at 30-31 feet				
	0							
	0	5	3.5' /5'					
30	0					30		
	0			SILT & CLAY: Dark yellowish brown (10YR 4/2), silt, clay, organics				
	1.4	6	5'/5'					
	2.7			SILT, SAND & GRAVEL: Light olive gray (5Y 5/2), silt, very fine to very coarse sand, fine to medium gravel, crumbly, wet at 36 feet				
	1.4							
	1.5							
	0	7	5'/5'	SILT, SAND & GRAVEL: Moderate yellowish brown (10YR 5/4), silt, vf-vc sand, f-c angular to rounded gravel, some angular to rounded cobbles, little clay, cohesive, plastic				
	1.1							
40	0					40		

GROUNDWATER SCIENCES CORPORATION

GEOLOGIC LOG: B-804

DEPTH FEET	PID Reading	SAMP.	Recovery	LITHOLOGY	GRAPHIC	DEPTH FEET	WELL CONSTRUCTION	WELL CONSTRUCTION DETAILS
40	0.3			SILT, SAND & GRAVEL: Moderate olive brown (5Y 4/4), silt, very fine to very coarse sand, fine to medium gravel, rounded, moist		40		
	0	8	5'/5'					
	0			SILT, SAND & GRAVEL: As above, light olive gray (5Y 5/2)				
	0							
	0	9	5'/5'					
50	0			SILT, SAND & GRAVEL: As above, light olive gray (5Y 6/1) to medium light gray (N6), some angular cobbles		50		
	0	10	5'/5'					
	0							
	0							No. 1 sand pack (54.5'-61.5')
	0	11	5'/7'					2" PVC 20-slot screen (56.5'-61.5')
60				SHALE: Shale bedrock		60		



GROUNDWATER SCIENCES CORPORATION

GEOLOGIC LOG: B-805

PROJECT INFORMATION

PROJECT: ***Owego P001 Investigation***

SITE LOCATION: ***1801 NY-17C, Owego, NY***

JOB NO.: ***93004.46.1701***

LOGGED BY: ***Jane Block***

DATES DRILLED: ***4/16/18 - 4/17/18***

NOTES: MP Elevation: 902.12

DRILLING INFORMATION

DRILLING CO.: ***Cascade Drilling***

DRILLER: ***Rob Maillet***

RIG TYPE: ***LS 250 Mini Sonic***

DRILLING METHOD: ***6" Sonic***

DEVELOPMENT DATE: ***4/30/18-5/1/18***

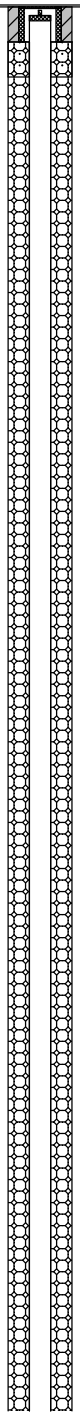
LOCATION: ***Approximately 40 feet northwest of well 612***

ELEVATION: 902.4

NORTHING: 767022.2181 EASTING: 918287.8937

DEPTH FEET	PID Reading	SAMP.	Recovery	LITHOLOGY
0				ASPHALT: Asphalt pavement
	0	1	3' /10'	SILT, SAND & GRAVEL: Moderate yellowish brown (10 YR 5/4) to light olive gray (5Y 5/2), silt, very fine to very coarse sand, fine to medium angular to rounded gravel, little clay, crumbly, cohesive
	0			
10	0	2	5'/5'	SILT, SAND & GRAVEL: As above SILT, SAND & GRAVEL: Light olive gray (5Y 6/1), silt, very fine to very coarse sand, fine to medium gravel, some organics, crumbly
	0	3	2'/5'	SILT, SAND & GRAVEL: Light olive gray (5Y 6/1), silt, very fine to very coarse sand, fine to medium angular to rounded gravel, some angular to rounded cobbles
20	0	4	0.5' /5'	SILT, SAND & GRAVEL: As above
	0	5	4.5' /5'	
30	0	6	5'/5'	SILT & CLAY: Silt and clay, some organics SILT, SAND & GRAVEL: Moderate olive brown to light olive gray, silt, very fine to very coarse sand, fine to medium angular to rounded gravel, some angular to rounded cobbles, coheisve, moist
	0	7	5'/5'	
40				

WELL CONSTRUCTION



WELL CONSTRUCTION DETAILS

Flushmounted 4" Manhole (0'-1')

No. 1 sand fill (1'-2')

Bentonite chip annular seal (2'-49')

6" dia. Sonic borehole (0-56.5')

2" Sch. 40 PVC riser (0-51')

GROUNDWATER SCIENCES CORPORATION

GEOLOGIC LOG: B-805

DEPTH FEET	PID Reading	SAMP.	Recovery	LITHOLOGY	GRAPHIC	DEPTH FEET	WELL CONSTRUCTION	WELL CONSTRUCTION DETAILS
40	0	8	5'/5'	SILT, SAND & GRAVEL: As above, dry		40		
	1.6	9	4.5'/5'	SILT, SAND & GRAVEL: Light olive gray (5Y 5/2) to olive gray (5Y 3/2), silt, very fine to very coarse sand, fine to medium angular gravel, crumbly, wet at 46 feet				
50	0 2.0	10	4'/5'	SILT, SAND & GRAVEL: Light olive gray (5Y 6/1), silt, very fine to very coarse sand, fine to coarse gravel, some cobbles, moist		50		No. 1 sand pack (49'-56.5')
	0			SHALE: Shale bedrock				2" PVC 20-slot screen (51'-56')
		11	1'/1'					

GROUNDWATER SCIENCES CORPORATION

GEOLOGIC LOG: B-806

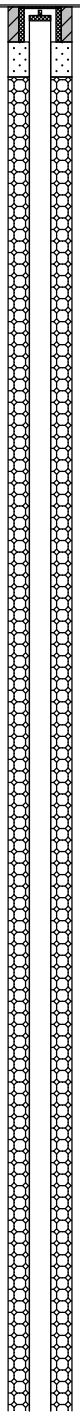
PROJECT INFORMATION		DRILLING INFORMATION	
PROJECT:	***Owego P001 Investigation***	DRILLING CO.:	***Cascade Drilling***
SITE LOCATION:	***1801 NY-17C, Owego, NY***	DRILLER:	***Rob Maillet***
JOB NO.:	***93004.46.1701***	RIG TYPE:	***LS 250 Mini Sonic***
LOGGED BY:	***Jane Block***	DRILLING METHOD:	***6" Sonic***
DATES DRILLED:	***4/17/18***	DEVELOPMENT DATE:	***4/30/18-5/2/18***
		LOCATION:	***Approximately 30 feet northeast of well 612***

NOTES: MP Elevation: 902.79

ELEVATION: 903.2

NORTHING: 767020.1693 EASTING: 918337.9453

DEPTH FEET	PID Reading	SAMP.	Recovery	LITHOLOGY
0				ASPHALT: Asphalt pavement
	0	1	3'/5'	SILT, SAND & GRAVEL: Moderate yellowish brown (10YR 5/4), silt, very fine to coarse sand, fine to medium angular to rounded gravel, crumbly, dry
	0	2	3'/5'	SILT, SAND & GRAVEL: As above, moderate yellowish brown (10YR 5/4) to moderate olive brown (5Y 4/4), some cobbles (>2")
10				
	0	3	4'/5'	SILT, SAND & GRAVEL: As above, very wet from 10-11 feet
				SILT, SAND & GRAVEL: As above
	0	4	4'/5'	SILT, SAND & GRAVEL: Light olive gray (5Y 5/2), silt, very fine to very coarse sand, fine to medium angular to rounded gravel, some angular to rounded cobbles
20				
	0	5	3'/5'	
				SILT & CLAY: Silt and clay, little organics
	0	6	5'/5'	SILT, SAND & GRAVEL: Moderate yellowish brown (10YR 5/4) to light olive gray (5Y 5/2), silt, very fine to very coarse sand, fine to medium angular to rounded gravel, some angular to rounded cobbles, crumbly
30				
	0	7	5'/5'	SILT, SAND & GRAVEL: As above, some cobbles (6"), wet at 32 feet
	0	8	2.5'/5'	SILT, SAND & GRAVEL: As above, moderate olive brown (5Y 4/4), some cobbles (4")
40				



WELL CONSTRUCTION DETAILS

- Flushmounted 4" Manhole (0'-1')
- No. 1 sand fill (1'-2')
- Bentonite chip annular seal (2'-49.5')
- 6" dia. Sonic borehole (0-59')
- 2" Sch. 40 PVC riser (0-51.5')

GROUNDWATER SCIENCES CORPORATION

GEOLOGIC LOG: B-806

DEPTH FEET	PID Reading	SAMP.	Recovery	LITHOLOGY	GRAPHIC	DEPTH FEET	WELL CONSTRUCTION	WELL CONSTRUCTION DETAILS
40	0	9	5'/5'	SILT, SAND & GRAVEL: As above, moderate olive brown (5Y 4/4) to moderate yellowish brown (10YR 5/4), some cobbles (5"), very wet from 43-45 feet		40		
	0 0.7 0 0 0.1	10	4'/5'	SILT, SAND & GRAVEL: Light olive gray (5Y 6/1) to medium light gray (N6), silt, very fine to very coarse sand, fine to medium angular to rounded gravel, cobbles and boulders from 48'-49', crumbly				
50	0	11	5'/5'	SILT, SAND & GRAVEL: Light olive gray (5Y 6/1) to medium light gray (N6), silt, very fine to very coarse sand, fine to medium angular to rounded gravel, crumbly, wet from 50-52 feet		50		No. 1 sand pack (49.5'-59') 2" PVC 20-slot screen (51.5'-56.5')
		12	5'/5'	SHALE: Fossiliferous shale bedrock				

GROUNDWATER SCIENCES CORPORATION

GEOLOGIC LOG: B-807

PROJECT INFORMATION		DRILLING INFORMATION	
PROJECT:	***Owego P001 Investigation***	DRILLING CO.:	***Cascade Drilling***
SITE LOCATION:	***1801 NY-17C, Owego, NY***	DRILLER:	***Rob Maillet***
JOB NO.:	***93004.46.1701***	RIG TYPE:	***LS 250 Mini Sonic***
LOGGED BY:	***Jane Block***	DRILLING METHOD:	***6" Sonic***
DATES DRILLED:	***4/18/18***	DEVELOPMENT DATE:	***4/27/18***
		LOCATION:	***Approximately 30 feet southeast of well 612***
NOTES: MP Elevation: 905.04		ELEVATION: 905.6	
		NORTHING: 766970.2439	EASTING: 918338.7362

DEPTH FEET	PID Reading	SAMP.	Recovery	LITHOLOGY
0				ASPHALT: Asphalt pavement
	0	1	3'/5'	SILT, SAND & GRAVEL: Moderate yellowish brown (10YR 5/4), silt, very fine to very coarse sand, fine to medium angular to rounded gravel, loose, crumbly
	0			
	2.9			SILT, SAND & GRAVEL: As above, some cobbles (6"), top 1.5 feet plastic, moist
	2.8			
	0	2	3.5'/5'	
10				
	0.9			SILT, SAND & GRAVEL: As above, some cobbles (6"), crumbly, moist from 10 to 11 feet
	0	3	4.5'/5'	
	0			
	4.9			SILT, SAND & GRAVEL: As above, some cobbles (6"), crumbly
		4	5'/5'	
20				
	0			SILT, SAND & GRAVEL: As above, trace cobbles
	0	5	5'/5'	SILT, SAND & GRAVEL: Light olive gray (5Y 5/2), silt. very fine to very coarse sand, fine to medium angular to rounded gravel, crumbly, dry
	0			
		6	1'/5'	WOOD: Large piece of wood
	0			SILT, SAND & GRAVEL: Light olive gray (5Y 5/2) to moderate olive brown to light olive brown (5Y 5/6), silt, very fine to very coarse sand, fine to medium gravel, stiff, tightly packed
30	0			
	0	7	5'/5'	
	0			
	0			SILT, SAND & GRAVEL: As above, wet
	0	8	4'/5'	
40				

GRAPHIC	DEPTH FEET	WELL CONSTRUCTION	WELL CONSTRUCTION DETAILS
	0		Flushmounted 4" Manhole (0'-1')
			No. 1 sand fill (1'-2')
			Bentonite chip annular seal (2'-51')
	10		6" dia. Sonic borehole (0-59')
	20		2" Sch. 40 PVC riser (0-53')
	30		
	40		

GROUNDWATER SCIENCES CORPORATION

GEOLOGIC LOG: B-807

DEPTH FEET	PID Reading	SAMP.	Recovery	LITHOLOGY	GRAPHIC	DEPTH FEET	WELL CONSTRUCTION	WELL CONSTRUCTION DETAILS
40	0			SILT, SAND & GRAVEL: As above, some light olive gray (5Y 5/2), some cobbles (4")		40		
	0	9	4'/5'					
	0							
	0			SILT, SAND & GRAVEL: As above, wet				
	0	10	5'/5'					
50	0			SILT, SAND & GRAVEL: Light olive gray (5Y 6/1) to medium light gray (N6), silt, very fine to very coarse sand, fine to coarse gravel, angular to rounded, crumbly		50		
	0	11	5'/5'					No. 1 sand pack (51'-59')
				SILT, SAND & GRAVEL: Boulders intermixed with sand, silt, gravel				
	0							2" PVC 20-slot screen (53'-58')
				SHALE: Shale bedrock				
		12	3'/4'					

GROUNDWATER SCIENCES CORPORATION

GEOLOGIC LOG: B-808

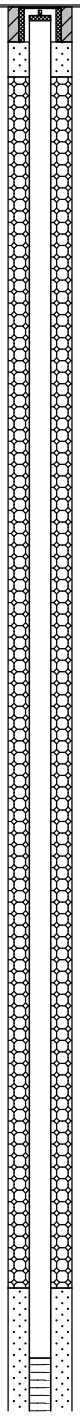
PROJECT INFORMATION		DRILLING INFORMATION	
PROJECT:	***Owego P001 Investigation***	DRILLING CO.:	***Cascade Drilling***
SITE LOCATION:	***1801 NY-17C, Owego, NY***	DRILLER:	***Rob Maillet***
JOB NO.:	***93004.46.1701***	RIG TYPE:	***LS 250 Mini Sonic***
LOGGED BY:	***Jane Block***	DRILLING METHOD:	***6" Sonic***
DATES DRILLED:	***4/19/18***	DEVELOPMENT DATE:	***4/27/18***
		LOCATION:	***Approximately 90 feet northeast of well 609***

NOTES: MP Elevation: 897.72

ELEVATION: 898.1

NORTHING: 767216.2702 EASTING: 918435.8120

DEPTH FEET	PID Reading	SAMP.	Recovery	LITHOLOGY
0				ASPHALT: Asphalt pavement
	0	1	4'/5'	SILT, SAND & GRAVEL: Moderate yellowish brown (10YR 5/4) to light olive gray (5Y 5/2), silt, very fine to very coarse sand, fine to medium angular to rounded gravel, some angular to rounded cobbles (4"), crumbly
	0			
	2.2	2	3'/5'	SILT, SAND & GRAVEL: As above, bottom 1 foot contains little organics (rootlets, plant remnants), moist
	0			
10	0			
	0	3	4.5'/5'	SILT, SAND & GRAVEL: Olive gray (5Y 4/1), silt, very fine to very coarse sand, fine to coarse gravel, little cobbles (>3"), little clay, some organics (twigs, branch fragments) in bottom 1 foot, moderately stiff, moderately tightly packed
	0.7			
	0			
	0	4	5'/5'	SILT, SAND & GRAVEL: Moderate olive brown (5Y 4/4) to moderate yellowish brown (10YR 5/4), silt, very fine to very coarse sand, fine to coarse gravel, some cobbles (4"), angular to rounded, crumbly, wet at 19 feet
	0			
20	0			
	1.0	5	5'/5'	SILT, SAND & GRAVEL: As above, stiff, tightly packed
	0			
	0			
	2.8	6	5'/5'	SILT, SAND & GRAVEL: As above, light olive gray (5Y 5/2) to moderate olive brown (5Y 4/4), some cobbles (6")
	0			
	0			
	0.1			
30	2.0			SILT, SAND & GRAVEL: As above
	0	7	5'/5'	GRAVEL: Boulders and cobbles, very difficult drilling
	0			SILT, SAND & GRAVEL: Light olive gray (5Y 5/2) to moderate olive brown (5Y 4/4), silt, very fine to very coarse sand, fine to coarse gravel, some cobbles (6")
	0			
	0	8	5'/5'	SILT, SAND & GRAVEL: Light olive gray (5Y 6/1) to medium light gray (N6), silt, very fine to very coarse sand, fine to medium
40				



Flushmounted 4" Manhole (0'-1')

No. 1 sand fill (1'-2')

Bentonite chip annular seal (2'-36.5')

6" dia. Sonic borehole (0-41.75')

2" Sch. 40 PVC riser (0-38.5')

No. 1 sand pack (36.5'-44.75')

GROUNDWATER SCIENCES CORPORATION

GEOLOGIC LOG: B-808

DEPTH FEET	PID Reading	SAMP.	Recovery	LITHOLOGY	GRAPHIC	DEPTH FEET	WELL CONSTRUCTION	WELL CONSTRUCTION DETAILS
40	0	9	2'/5'	angular gravel, tightly packed SHALE: Shale bedrock		40		2" PVC 20-slot screen (38.5'-43.5')

GROUNDWATER SCIENCES CORPORATION

GEOLOGIC LOG: B-809

PROJECT INFORMATION

PROJECT: ***Owego P001 Investigation***

SITE LOCATION: ***1801 NY-17C, Owego, NY***

JOB NO.: ***93004.46.1701***

LOGGED BY: ***Jane Block***

DATES DRILLED: ***4/19/18***

DRILLING INFORMATION

DRILLING CO.: ***Cascade Drilling***

DRILLER: ***Rob Maillet***

RIG TYPE: ***LS 250 Mini Sonic***

DRILLING METHOD: ***6" Sonic***

DEVELOPMENT DATE: ***5/1/18-5/2/18***

LOCATION: ***In security/medical parking lot near Bldg 306***

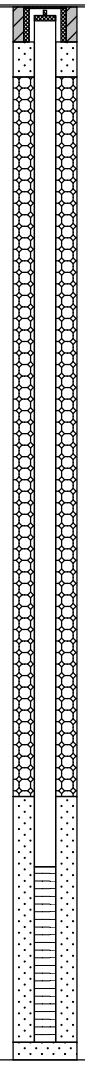
NOTES: MP Elevation: 912.89

ELEVATION: 913.3

NORTHING: 766863.7558 EASTING: 918754.5426

DEPTH FEET	PID Reading	SAMP.	Recovery	LITHOLOGY
0	0	1	NA	ASPHALT: Asphalt pavement Pre-cleared by soft dig
	0	2	4'/4'	SILT, SAND & GRAVEL: Light olive gray (5Y 5/2) to moderate yellowish brown (10YR 5/4), silt and very fine to very coarse sand, fine to coarse angular gravel, trace angular cobbles (4")
10	0	3	5'/5'	
	0	4	5'/5'	SILT, SAND & GRAVEL: Light olive gray (5Y 6/1) to medium light gray (N6), silt and very fine to very coarse sand, fine to medium angular gravel, crumbly, dry
20	0	5	5'/5'	SILT, SAND & GRAVEL: As above, boulders and cobbles at 22 feet, moist from 20 to 21 feet
	0	6	5'/5'	WEATHERED BEDROCK: Weathered bedrock zone SHALE: Shale bedrock
30				

GRAPHIC



WELL CONSTRUCTION DETAILS
Flushmounted 4" Manhole (0'-1')
No. 1 sand fill (1'-2')
Bentonite chip annular seal (2'-22.5')
6" dia. Sonic borehole (0-30')
2" Sch. 40 PVC riser (0-24.5')
No. 1 sand pack (22.5'-30')
2" PVC 20-slot screen (24.5'-29.5')

GROUNDWATER SCIENCES CORPORATION

GEOLOGIC LOG: B-810

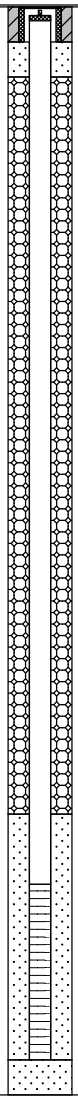
PROJECT INFORMATION		DRILLING INFORMATION	
PROJECT:	***Owego P001 Investigation***	DRILLING CO.:	***Cascade Drilling***
SITE LOCATION:	***1801 NY-17C, Owego, NY***	DRILLER:	***Rob Maillet***
JOB NO.:	***93004.46.1701***	RIG TYPE:	***LS 250 Mini Sonic***
LOGGED BY:	***Jane Block***	DRILLING METHOD:	***6" Sonic***
DATES DRILLED:	***4/23/18***	DEVELOPMENT DATE:	***5/1/18-5/2/18***
		LOCATION:	***In security/medical parking lot near Bldg 306***

NOTES: MP Elevation: 912.10

ELEVATION: 912.5

NORTHING: 766903.1186 EASTING: 918768.0290

DEPTH FEET	PID Reading	SAMP.	Recovery	LITHOLOGY
0	1.7			ASPHALT: Asphalt pavement
	0	1	4'/5'	SILT, SAND & GRAVEL: Moderate olive brown (5Y 4/4) to light olive gray (5Y 5/2), silt and very fine to very coarse sand, some fine to medium angular to rounded gravel, little clay, stiff, crumbly
	0			
	0.7			
	7.1			SILT, SAND & GRAVEL: As above, moist from 6 to 7 feet
	0	2	5'/5'	
	0			
10	0.3			SILT, SAND & GRAVEL: As above, little cobbles (6"), moist at 14 feet
	0	3	5'/5'	
	0			SILT, SAND & GRAVEL: Light olive gray (5Y 5/2) to light olive brown (5Y 5/6), silt and very fine to very coarse sand, fine to coarse angular to rounded gravel, dry
	0			
	0	4	4'/5'	SAND & GRAVEL: Boulders with sand and gravel
20				
		5	4'/5'	
	0			SILT, SAND & GRAVEL: Light olive gray (5Y 6/1) to medium light gray (N6), silt and very fine to very coarse sand, fine to medium angular to rounded gravel, trace angular to rounded cobbles (6"), stiff
	0			
	0	6	1'/6'	SHALE: Shale bedrock
30				



WELL CONSTRUCTION DETAILS
Flushmounted 4" Manhole (0'-1')
No. 1 sand fill (1'-2')
Bentonite chip annular seal (2'-23')
6" dia. Sonic borehole (0-31')
2" Sch. 40 PVC riser (0-25')
No. 1 sand pack (23'-31')
2" PVC 20-slot screen (25'-30')

GROUNDWATER SCIENCES CORPORATION

GEOLOGIC LOG: B-811

PROJECT INFORMATION

PROJECT: ***Owego P001 Investigation***

SITE LOCATION: ***1801 NY-17C, Owego, NY***

JOB NO.: ***93004.46.1701***

LOGGED BY: ***Jane Block***

DATES DRILLED: ***4/24/18***

DRILLING INFORMATION

DRILLING CO.: ***Cascade Drilling***

DRILLER: ***Rob Maillet***

RIG TYPE: ***LS 250 Mini Sonic***

DRILLING METHOD: ***6" Sonic***

DEVELOPMENT DATE: ***5/1/18-5/2/18***

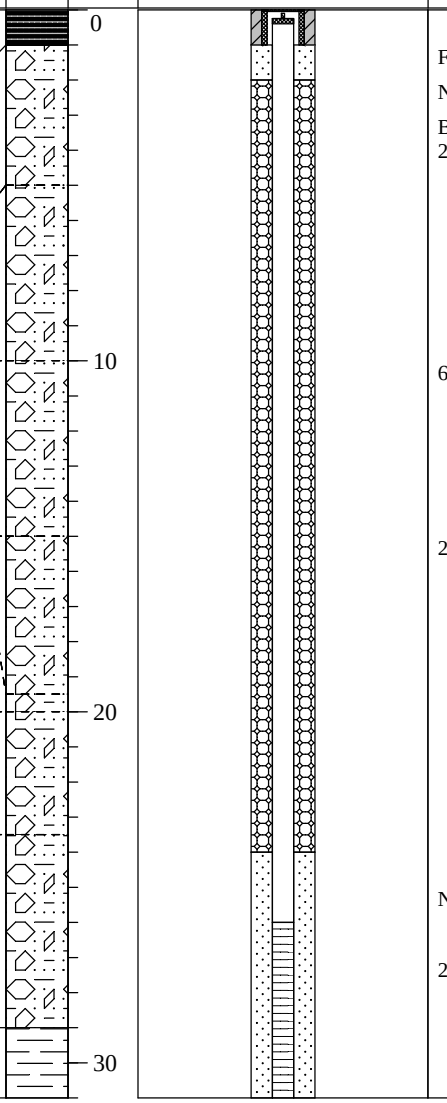
LOCATION: ***In security/medical parking lot near Bldg 306***

NOTES: MP Elevation: 912.06

ELEVATION: 912.4

NORTHING: 766939.4819 EASTING: 918774.9280

DEPTH FEET	PID Reading	SAMP.	Recovery	LITHOLOGY
0				ASPHALT: Asphalt pavement
	0	1	4.5'/5'	SILT, SAND & GRAVEL: Moderate yellowish brown (10YR 5/4) to light olive gray (5Y 5/2), silt and very fine to very coarse sand, fine to medium angular gravel, loosely packed, crumbly
	0	2	5'/5'	SILT, SAND & GRAVEL: As above, trace cobbles (4")
10				
	0	3	5'/5'	SILT, SAND & GRAVEL: As above, trace cobbles (6"), wet from 13 to 14 feet
	0 0 1.6 1.0 1.7	4	4'/5'	SILT, SAND & GRAVEL: As above, 17 to 19 feet tightly packed, cohesive SILT, SAND & GRAVEL: Dusky yellow brown (10YR 2/2), silt and very fine to very coarse sand, fine to medium gravel
20				
	0 0 0.5 1.1 0	5	5'/5'	SILT, SAND & GRAVEL: Light olive brown (5Y 5/6), silt, very fine to very coarse sand, fine to medium gravel, trace cobbles (6")
	0 1.2 0 0	6	5'/5'	SILT, SAND & GRAVEL: Light olive gray (5Y 5/2), silt and very fine to very coarse sand with fine to coarse angular to subrounded gravel
30				SHALE: Shale bedrock



WELL CONSTRUCTION DETAILS
Flushmounted 4" Manhole (0'-1')
No. 1 sand fill (1'-2')
Bentonite chip annular seal (2'-24')
6" dia. Sonic borehole (0-31')
2" Sch. 40 PVC riser (0-26')
No. 1 sand pack (24'-31')
2" PVC 20-slot screen (26'-31')

GROUNDWATER SCIENCES CORPORATION

GEOLOGIC LOG: B-812

PROJECT INFORMATION

PROJECT: ***Owego P001 Investigation***

SITE LOCATION: ***1801 NY-17C, Owego, NY***

JOB NO.: ***93004.46.1701***

LOGGED BY: ***Jane Block***

DATES DRILLED: ***4/25/18***

DRILLING INFORMATION

DRILLING CO.: ***Cascade Drilling***

DRILLER: ***Rob Maillet***

RIG TYPE: ***LS 250 Mini Sonic***

DRILLING METHOD: ***6" Sonic***

DEVELOPMENT DATE: ***5/1/18-5/2/18***

LOCATION: ***In security/medical parking lot near Bldg 306***

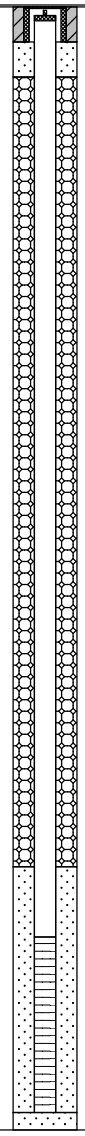
NOTES: MP Elevation: 911.71

ELEVATION: 912.0

NORTHING: 766978.2590 EASTING: 918784.4697

DEPTH FEET	PID Reading	SAMP.	Recovery	LITHOLOGY
0				ASPHALT: Asphalt pavement
	0	1	2.5'/5'	SILT, SAND & GRAVEL: Moderate yellowish brown (10YR 5/4), silt and very fine to very coarse sand, medium to coarse angular gravel, 4 to 5 feet cohesive, moist
	0	2	3.5'/5'	SILT, SAND & GRAVEL: As above, wet from 5 to 7 feet
10				
	0	3	4'/5'	SILT, SAND & GRAVEL: As above, loosely packed, very wet
	0			SILT, SAND & GRAVEL: Silt, very fine to very coarse sand with fine to coarse gravel, trace cobbles
	0			
	0	4	4'/5'	SAND & SILT: Dusky yellowish brown (10YR 2/2) f-c sand and silt
	0			
	0.5			SILT, SAND & GRAVEL: Moderate yellowish brown (10YR 5/4), silt and very fine to very coarse sand, fine to coarse gravel, trace cobbles, loosely packed
20				
	0	5	4'/5'	SILT, SAND & GRAVEL: Light olive gray (5Y 6/1) to medium light gray (N6), silt and very fine to very coarse sand, fine to coarse angular to subrounded gravel, some angular to subrounded cobbles, tightly packed
	0	6	5'/5'	SILT, SAND & GRAVEL: As above, very light gray (N8), some cobbles (>6"), very tightly packed
30				
	0	7	2'/2'	SHALE: Shale bedrock

GRAPHIC



WELL CONSTRUCTION DETAILS

- Flushmounted 4" Manhole (0'-1')
- No. 1 sand fill (1'-2')
- Bentonite chip annular seal (2'-24.5')
- 6" dia. Sonic borehole (0-32')
- 2" Sch. 40 PVC riser (0-26.5')
- No. 1 sand pack (24.5'-32')
- 2" PVC 20-slot screen (26.5'-31.5')

GROUNDWATER SCIENCES CORPORATION

GEOLOGIC LOG: B-813

PROJECT INFORMATION

PROJECT: ***Owego P001 Investigation***

SITE LOCATION: ***1801 NY-17C, Owego, NY***

JOB NO.: ***93004.46.1701***

LOGGED BY: ***Jane Block***

DATES DRILLED: ***4/30/18***

DRILLING INFORMATION

DRILLING CO.: ***Cascade Drilling***

DRILLER: ***Rob Maillet***

RIG TYPE: ***LS 250 Mini Sonic***

DRILLING METHOD: ***6" Sonic***

DEVELOPMENT DATE: ***5/1/18-5/2/18***

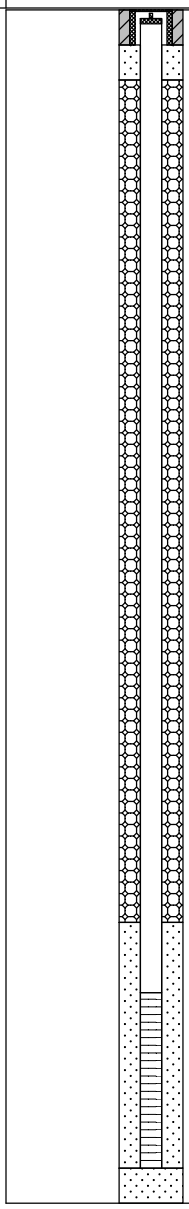
LOCATION: ***In security/medical parking lot near Bldg 306***

NOTES: MP Elevation: 910.95

ELEVATION: 911.3

NORTHING: 767023.4483 EASTING: 918797.2842

DEPTH FEET	PID Reading	SAMP.	Recovery	LITHOLOGY
0				ASPHALT: Asphalt pavement
			NA	Precleared by soft dig
				SAND: Dark yellowish brown (10YR 4/2), Medium well sorted sand, little silt, wet at 6 feet
	0	1	5'/5'	SILT, SAND & GRAVEL: Moderate yellow brown (10YR 5/4), fine to coarse sand, silt, fine to medium gravel, stiff, cohesive
10				
	0	2	5'/5'	SAND & SILT: Dark yellowish brown (10YR 4/2) to Moderate yellowish brown (10YR 5/4), coarse well sorted sand with silt, trace rounded fine gravel wet from 10 to 12 feet
	0	3	5'/5'	SILT, SAND & GRAVEL: Moderate yellowish brown (10YR 5/4), silt and very fine to very coarse sand, fine to coarse angular to subrounded gravel, little angular to subrounded cobbles (>4"), crumbly
				SILT, SAND & GRAVEL: As above, little cobbles (>6")
20	0.9			
	0			SILT, SAND & GRAVEL: Light olive gray (5Y 6/1) to light olive brown (5Y 5/6), very fine to very coarse sand and silt, fine to coarse gravel, trace large cobbles (8"), tightly packed
	0	4	4'/5'	
	0			
	0.4			GRAVEL: Boulder
	0			
	0.8			SILT, SAND & GRAVEL: Light olive gray (5Y 6/1) to light olive brown (5Y 5/6), very fine to very coarse sand and silt, fine to coarse gravel, trace large cobbles (8"), tightly packed
	0			
	0	5	4.5'/5'	
	0			SILT, SAND & GRAVEL: As above, light olive gray (5Y 6/1) to medium light gray (N6)
30	0			
				GRAVEL: Boulder
		6	4'/4'	SILT, SAND & GRAVEL: Light olive gray (5Y 6/1) to medium light gray (N6), silt and very fine to very coarse sand, fine to coarse gravel, trace large cobbles, tightly packed
				SHALE: Shale bedrock



WELL CONSTRUCTION DETAILS

- Flushmounted 4" Manhole (0'-1')
- No. 1 sand fill (1'-2')
- Bentonite chip annular seal (2'-26')
- 6" dia. Sonic borehole (0-34')
- 2" Sch. 40 PVC riser (0-28')
- No. 1 sand pack (26'-34')
- 2" PVC 20-slot screen (28'-33')

GROUNDWATER SCIENCES CORPORATION

GEOLOGIC LOG: B-814

PROJECT INFORMATION

PROJECT: ***Owego P001 Investigation***

SITE LOCATION: ***1801 NY-17C, Owego, NY***

JOB NO.: ***93004.46.1701***

LOGGED BY: ***Jane Block***

DATES DRILLED: ***4/26/18***

DRILLING INFORMATION

DRILLING CO.: ***Cascade Drilling***

DRILLER: ***Rob Maillet***

RIG TYPE: ***LS 250 Mini Sonic***

DRILLING METHOD: ***6" Sonic***

DEVELOPMENT DATE: ***5/1/18-5/2/18***

LOCATION: ***In roadway adjacent to Bldg 306***

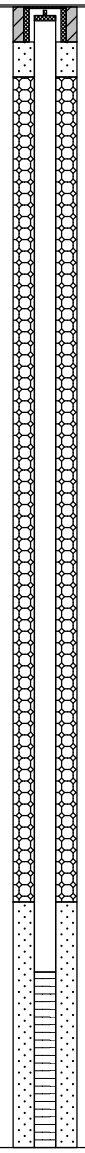
NOTES: MP Elevation: 910.26

ELEVATION: 910.7

NORTHING: 767059.0918 EASTING: 918801.1168

DEPTH FEET	PID Reading	SAMP.	Recovery	LITHOLOGY
0				ASPHALT: Asphalt pavement
			NA	Precleared by soft dig
				SILT, SAND & GRAVEL: Moderate yellowish brown (10YR 5/4), silt and very fine to very coarse sand, fine to coarse angular gravel, wet
	0	1	4'/4'	SAND: Dark yellowish brown (10YR 4/2), well sorted medium sand
10				SILT, SAND & GRAVEL: Moderate yellowish brown (10YR 5/4) to light olive brown (5Y 5/6), silt and very fine to very coarse sand, fine to coarse angular gravel
	0	2	4.5'/5'	SAND: Dark yellowish brown (10YR 4/2) to moderate yellow brown (10YR 5/4), well sorted medium sand, little fine, rounded gravel
				SILT, SAND & GRAVEL: As above, moderate yellowish brown (10YR 5/4)
	0	3	4'/5'	SILT, SAND & GRAVEL: As above, dusky brown (5YR 2/2)
20				SILT, SAND & GRAVEL: Moderate yellowish brown (10YR 5/4)., silt, very fine to very coarse sand, fine to coarse angular gravel, little cobbles
	0 0 0.4 0.5	4	4'/5'	SILT, SAND & GRAVEL: As above, little cobbles (>6")
	0.1 0 0 0 0	5	4'/5'	SILT, SAND & GRAVEL: Light olive brown (5Y 5/6) to light olive gray (5Y 5/2), silt and very fine to very coarse sand, fine to coarse angular gravel, tightly packed
				GRAVEL: Boulders
30	0			SILT, SAND & GRAVEL: Light olive gray (5Y 6/1) to medium light gray (N6), silt and very fine to very coarse sand, fine to coarse angular to rounded gravel, little angular to rounded cobbles (>6")
		6	2.5'/2.5'	SHALE: Shale bedrock

GRAPHIC



WELL CONSTRUCTION	WELL CONSTRUCTION DETAILS
	Flushmounted 4" Manhole (0'-1')
	No. 1 sand fill (1'-2')
	Bentonite chip annular seal (2'-25.5')
	6" dia. Sonic borehole (0-32.5')
	2" Sch. 40 PVC riser (0-25.5')
	No. 1 sand pack (25.5'-32.5')
	2" PVC 20-slot screen (27.5'-32.5')

GROUNDWATER SCIENCES CORPORATION

GEOLOGIC LOG: B-815

PROJECT INFORMATION

PROJECT: ***Owego P001 Investigation***

SITE LOCATION: ***1801 NY-17C, Owego, NY***

JOB NO.: ***93004.46.1701***

LOGGED BY: ***Jane Block***

DATES DRILLED: ***4/30/18***

NOTES: MP Elevation: 910.17

DRILLING INFORMATION

DRILLING CO.: ***Cascade Drilling***

DRILLER: ***Rob Maillet***

RIG TYPE: ***LS 250 Mini Sonic***

DRILLING METHOD: ***6" Sonic***

DEVELOPMENT DATE: ***5/8/18***

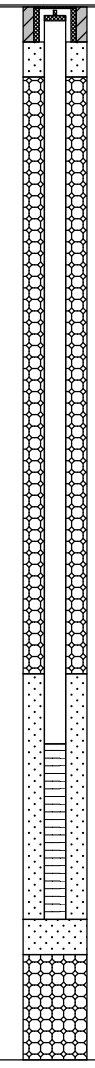
LOCATION: ***In northern parking lot near Bldg 306***

ELEVATION: 910.4

NORTHING: 767098.9439 EASTING: 918811.1081

DEPTH FEET	PID Reading	SAMP.	Recovery	LITHOLOGY
0			NA	ASPHALT: Asphalt pavement
				Precleared by soft dig
				SAND & GRAVEL: Dark brown (10YR 4/2), very coarse rounded sand and rounded gravel
	0	1	5'/5'	SILT, SAND & GRAVEL: Moderate yellowish brown (10YR 5/4), silt and very fine to very coarse sand, fine to coarse rounded gravel (3"), stiff, tightly packed
10				
	0	2	5'/5'	SILT, SAND & GRAVEL: As above, wet at 10 feet
	0	3	5'/5'	GRAVEL: Light olive gray (5Y 5/2) to light olive brown (5Y 5/6), fine to coarse angular to subrounded gravel and cobbles (>6"), little sand and silt
20				SILT, SAND & GRAVEL: Light olive gray (5Y 5/2), silt and very fine to very coarse sand, fine to medium angular gravel
	0	4	4'/5'	WEATHERED BEDROCK: Weathered shale bedrock with intervals of tightly packed sand and silt
	0	5	5'/5'	SHALE: Shale bedrock
30				

GRAPHIC



WELL CONSTRUCTION

WELL CONSTRUCTION DETAILS

Flushmounted 4" Manhole (0'-1')

No. 1 sand fill (1'-2')

Bentonite chip annular seal (2'-19')

6" dia. Sonic borehole (0-30')

2" Sch. 40 PVC riser (0-21')

No. 1 sand pack (19'-27')

2" PVC 20-slot screen (26'-21')

Bentonite chip (27'-30')

GROUNDWATER SCIENCES CORPORATION

GEOLOGIC LOG: B-816

PROJECT INFORMATION

PROJECT: ***Owego P001 Investigation***

SITE LOCATION: ***1801 NY-17C, Owego, NY***

JOB NO.: ***93004.46.1701***

LOGGED BY: ***Jane Block***

DATES DRILLED: ***5/1/18***

DRILLING INFORMATION

DRILLING CO.: ***Cascade Drilling***

DRILLER: ***Rob Maillet***

RIG TYPE: ***LS 250 Mini Sonic***

DRILLING METHOD: ***6" Sonic***

DEVELOPMENT DATE: ***5/7/18***

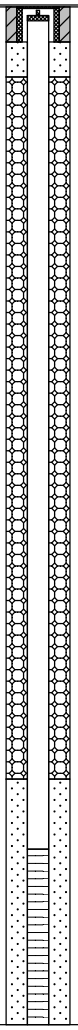
LOCATION: ***In northern parking lot near Bldg 306***

NOTES: MP Elevation: 908.73

ELEVATION: 909.1

NORTHING: 767140.4755 EASTING: 918819.5137

DEPTH FEET	PID Reading	SAMP.	Recovery	LITHOLOGY
0				ASPHALT: Asphalt pavement
	0	1	4'/5'	SILT, SAND & GRAVEL: Moderate yellowish brown (10YR 5/4), silt and very fine to very coarse sand, fine to coarse angular to subrounded gravel, loose, crumbly
	0 0 0 0 1.2	2	5'/5'	SILT, SAND & GRAVEL: As above, little cobbles (6")
10				
	0	3	5'/5'	SILT, SAND & GRAVEL: As above, some light olive gray (5Y 5/2), wet from 10 to 11 feet
	0 0 0 0.6 1.8	4	5'/5'	SILT, SAND & GRAVEL: As above, light olive gray (5Y 5/2), some cobbles up to 6 inches, loose, wet
				SILT, SAND & GRAVEL: Light olive gray (5Y 5/2), silt and very fine to very coarse sand, fine to medium angular gravel, tightly packed, wet
20	10.8			
	1.4	5	3'/5'	SILT, SAND & GRAVEL: As above, light olive brown (5Y 5/6), loosely packed
	0.6			GRAVEL: Boulders
	2.7 4.4	6	4'/4'	SILT, SAND & GRAVEL: Light olive brown (5Y 5/6), silt and very fine to very coarse sand, fine to coarse angular gravel, loosely packed
				WEATHERED BEDROCK: Weathered shale bedrock interbedded with sand and silt
				SHALE: Shale bedrock



WELL CONSTRUCTION DETAILS
Flushmounted 4" Manhole (0'-1')
No. 1 sand fill (1'-2')
Bentonite chip annular seal (2'-22')
6" dia. Sonic borehole (0-29')
2" Sch. 40 PVC riser (0-24')
No. 1 sand pack (22'-29')
2" PVC 20-slot screen (24'-29')

GROUNDWATER SCIENCES CORPORATION

GEOLOGIC LOG: B-817

PROJECT INFORMATION

PROJECT: ***Owego P001 Investigation***

SITE LOCATION: ***1801 NY-17C, Owego, NY***

JOB NO.: ***93004.46.1701***

LOGGED BY: ***Jane Block***

DATES DRILLED: ***4/25/18***

NOTES: MP Elevation: 913.03

DRILLING INFORMATION

DRILLING CO.: ***Cascade Drilling***

DRILLER: ***Rob Maillet***

RIG TYPE: ***LS 250 Mini Sonic***

DRILLING METHOD: ***6" Sonic***

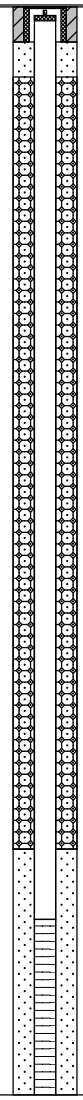
DEVELOPMENT DATE: ***5/1/18-5/2/18***

LOCATION: ***In security/medical parking lot near Bldg 306***

ELEVATION: 913.5

NORTHING: 766895.0268 EASTING: 918814.4659

DEPTH FEET	PID Reading	SAMP.	Recovery	LITHOLOGY
0		NA	NA	ASPHALT: Asphalt pavement Precleared by soft dig
	0	1	4'/4'	SILT, SAND & GRAVEL: Moderate yellowish brown (10YR 5/4), silt and very fine to very coarse sand, fine to coarse angular gravel, wet at 6 feet
10	0			GRAVEL: Cobbles (>6")
	0 0 0 0 0.3	2	5'/5'	SILT, SAND & GRAVEL: Light olive brown (5Y 5/6) to light olive gray (5Y 5/2), silt and very fine to very coarse sand, fine to coarse angular gravel, little angular cobbles
	0 0 0 0.7 7.6	3	5'/5'	SILT, SAND & GRAVEL: As above, very wet
20				
	0	4	3'/5'	SILT, SAND & GRAVEL: As above, dry
	0	5	5'/5'	SILT, SAND & GRAVEL: Light olive gray (5Y 6/1) to medium light gray (N6), silt and very fine to very coarse sand, fine to coarse angular to rounded gravel
30				SHALE: Shale bedrock



WELL CONSTRUCTION DETAILS

- Flushmounted 4" Manhole (0'-1')
- No. 1 sand fill (1'-2')
- Bentonite chip annular seal (2'-24')
- 6" dia. Sonic borehole (0-31')
- 2" Sch. 40 PVC riser (0-26')
- No. 1 sand pack (24'-31')
- 2" PVC 20-slot screen (26'-31')

GROUNDWATER SCIENCES CORPORATION

GEOLOGIC LOG: **B-818**

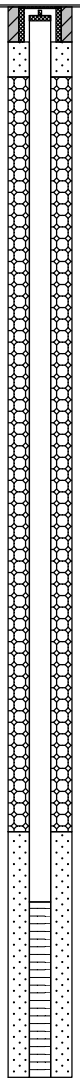
PROJECT INFORMATION		DRILLING INFORMATION	
PROJECT:	***Owego P001 Investigation***	DRILLING CO.:	***Cascade Drilling***
SITE LOCATION:	***1801 NY-17C, Owego, NY***	DRILLER:	***Rob Maillet***
JOB NO.:	***93004.46.1701***	RIG TYPE:	***LS 250 Mini Sonic***
LOGGED BY:	***Jane Block***	DRILLING METHOD:	***6" Sonic***
DATES DRILLED:	***4/26/18***	DEVELOPMENT DATE:	***5/1/18-5/2/18***
		LOCATION:	***In security/medical parking lot near Bldg 306***

NOTES: MP Elevation: 913.02

ELEVATION: 913.3

NORTHING: 766933.7172 EASTING: 918824.6078

DEPTH FEET	PID Reading	SAMP.	Recovery	LITHOLOGY
0		NA	NA	ASPHALT: Asphalt pavement Precleared by soft dig
	0 0 0.3 0	1	4.5' /5'	SILT, SAND & GRAVEL: Moderate yellowish brown (10YR 5/4), silt and very fine to very coarse sand, fine to coarse angular gravel, some angular cobbles (4"), crumbly
10	0.5 0.4 0.7 0.6 0	2	5'/5'	SILT, SAND & GRAVEL: As above, moist at 13 feet
	0.3 0 0 0.5 0.6	3	4'/5'	
20	0 0.3 0 0.3 0.6	4	3.5' /5'	SILT, SAND & GRAVEL: Light olive gray (5Y 6/1), silt and very fine to very coarse sand, fine to coarse angular to subrounded gravel, tightly packed
	0 0 0.7 0	5	5'/6'	SILT, SAND & GRAVEL: As above, trace cobbles (6") WEATHERED BEDROCK: Weathered shale bedrock
30				SHALE: Shale bedrock



WELL CONSTRUCTION DETAILS

- Flushmounted 4" Manhole (0'-1')
- No. 1 sand fill (1'-2')
- Bentonite chip annular seal (2'-23.5')
- 6" dia. Sonic borehole (0-31')
- 2" Sch. 40 PVC riser (0-25.5')
- No. 1 sand pack (23.5'-31')
- 2" PVC 20-slot screen (25.5'-30.5')

GROUNDWATER SCIENCES CORPORATION

GEOLOGIC LOG: B-819

PROJECT INFORMATION

PROJECT: ***Owego P001 Investigation***

SITE LOCATION: ***1801 NY-17C, Owego, NY***

JOB NO.: ***93004.46.1701***

LOGGED BY: ***Jane Block***

DATES DRILLED: ***4/27/18***

DRILLING INFORMATION

DRILLING CO.: ***Cascade Drilling***

DRILLER: ***Rob Maillet***

RIG TYPE: ***LS 250 Mini Sonic***

DRILLING METHOD: ***6" Sonic***

DEVELOPMENT DATE: ***5/1/18-5/2/1***

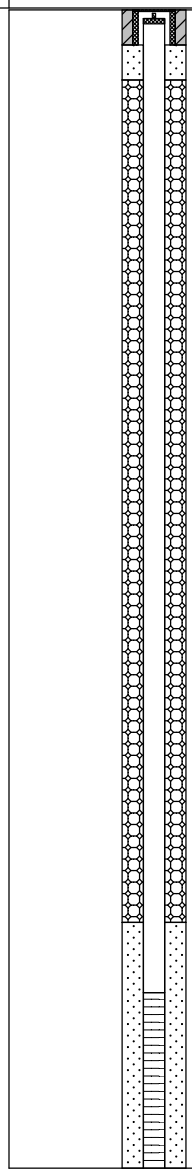
LOCATION: ***In security/medical parking lot near Bldg 306***

NOTES: MP Elevation: 912.06

ELEVATION: 912.5

NORTHING: 766972.7500 EASTING: 918833.0899

DEPTH FEET	PID Reading	SAMP.	Recovery	LITHOLOGY
0		NA	NA	ASPHALT: Asphalt pavement Precleared by soft dig
	0	1	3'/6'	SILT, SAND & GRAVEL: Moderate yellowish brown (10YR 5/4) to light olive brown (5Y 5/6), silt and very fine to very coarse sand, fine to coarse angular gravel, loosely packed, crumbly
10	0.4 0 0 0 0	2	5'/5'	SILT, SAND & GRAVEL: As above, trace cobbles (>4"), moist at 15 feet
	0 0.2 0 1.0 0	3	5'/5'	SILT, SAND & GRAVEL: As above, wet at 17 feet
20	0 0 0 1.4 0	4	4.5'/5'	SILT, SAND & GRAVEL: As above, tightly packed, wet SILT, SAND & GRAVEL: Light olive gray (5Y 6/1), silt and very fine to very coarse sand, fine to coarse angular to subrounded gravel, little angular to subrounded cobbles (>4")
	0	5	2'/5'	SILT, SAND & GRAVEL: As above, light olive gray (5Y 6/1) to medium light gray (N6), some fine to coarse angular gravel
30	5.0	6	3'/4'	SHALE: Shale bedrock



WELL CONSTRUCTION DETAILS
Flushmounted 4" Manhole (0'-1')
No. 1 sand fill (1'-2')
Bentonite chip annular seal (2'-26')
6" dia. Sonic borehole (0-33')
2" Sch. 40 PVC riser (0-28')
2" PVC 20-slot screen (28'-33')

GROUNDWATER SCIENCES CORPORATION

GEOLOGIC LOG: B-820

PROJECT INFORMATION

PROJECT: ***Owego P001 Investigation***

SITE LOCATION: ***1801 NY-17C, Owego, NY***

JOB NO.: ***93004.46.1701***

LOGGED BY: ***Jane Block***

DATES DRILLED: ***4/20/18***

DRILLING INFORMATION

DRILLING CO.: ***Cascade Drilling***

DRILLER: ***Rob Maillet***

RIG TYPE: ***LS 250 Mini Sonic***

DRILLING METHOD: ***6" Sonic***

DEVELOPMENT DATE: ***5/1/18-5/2/18***

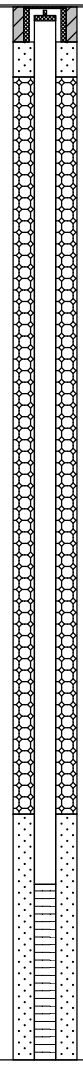
LOCATION: ***In security/medical parking lot near Bldg 306***

NOTES: MP Elevation: 911.73

ELEVATION: 912.0

NORTHING: 766916.1504 EASTING: 918736.1303

DEPTH FEET	PID Reading	SAMP.	Recovery	LITHOLOGY
0				CONCRETE: Concrete
	0	1	2.5'/5'	SILT, SAND & GRAVEL: Moderate olive brown (5Y 4/4) to moderate yellowish brown (10YR 5/4), silt and very fine to very coarse sand, fine to coarse angular gravel, crumbly
	173 7.9 2.1 5.8	2	5'/5'	SILT, SAND & GRAVEL: As above, wet from 5 to 7 feet
10	8.0 0 0 0 0	3	5'/5'	SILT, SAND & GRAVEL: As above, some brick fill at 11 feet, some cobbles (4")
	0 0.1 0 0 0	4	4'/5'	SILT, SAND & GRAVEL: As above, light olive brown (5Y 5/6) to light olive gray (5Y 5/2), some cobbles (4"), dry
20	0	5	5'/5'	SILT, SAND & GRAVEL: Light olive gray (5Y 6/1) to medium light gray (N6), silt and very fine to very coarse sand, fine to coarse angular to rounded gravel, some angular to rounded cobbles (6"), cohesive, stiff
	0	6	5'/5'	WEATHERED BEDROCK: Weathered shale bedrock
30				SHALE: Shale bedrock



WELL CONSTRUCTION DETAILS

Flushmounted 4" Manhole (0'-1')

No. 1 sand fill (1'-2')

Bentonite chip annular seal (2'-23')

6" dia. Sonic borehole (0-30')

2" Sch. 40 PVC riser (0-25')

No. 1 sand pack (23'-30')

2" PVC 20-slot screen (25'-30')

GROUNDWATER SCIENCES CORPORATION

GEOLOGIC LOG: B-821

PROJECT INFORMATION

PROJECT: ***Owego P001 Investigation***

SITE LOCATION: ***1801 NY-17C, Owego, NY***

JOB NO.: ***93004.46.1701***

LOGGED BY: ***Jane Block***

DATES DRILLED: ***4/24/18***

DRILLING INFORMATION

DRILLING CO.: ***Cascade Drilling***

DRILLER: ***Rob Maillet***

RIG TYPE: ***LS 250 Mini Sonic***

DRILLING METHOD: ***6" Sonic***

DEVELOPMENT DATE: ***5/1/18-5/2/18***

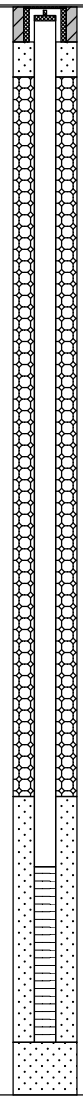
LOCATION: ***In security/medical parking lot near Bldg 306***

NOTES: MP Elevation: 910.97

ELEVATION: 911.3

NORTHING: 766954.1734 EASTING: 918741.9636

DEPTH FEET	PID Reading	SAMP.	Recovery	LITHOLOGY
0				ASPHALT: Asphalt pavement
	0 0.2 0	1	3.75' /5'	SILT, SAND & GRAVEL: Moderate yellowish brown (10YR 5/4) to light olive brown (5Y 5/6), silt and very fine to very coarse sand, fine to medium angular to rounded gravel, bottom 1.3 feet stiff, moist
	0 0 0 0 2.4	2	5'/5'	SILT, SAND & GRAVEL: As above, 5-7 feet moist
10	2.8 0 0 0 0	3	5'/5'	SILT, SAND & GRAVEL: As above, some light olive gray (5Y 5/2), wet at 14 feet
	1.2 1.5 0 0.6	4	5'/5'	SILT, SAND & GRAVEL: As above, some gravel (>2"), 15-17 feet stiff, cohesive
20	1.5 0 0 0 0.4	5	5'/5'	SILT, SAND & GRAVEL: Light olive gray (5Y 5/2), silt and very fine to very coarse sand, fine to coarse angular to rounded gravel, some angular to rounded cobbles (4")
	0.6 0.9			
		6	5'/6'	SHALE: Shale bedrock
30				



WELL CONSTRUCTION DETAILS

- Flushmounted 4" Manhole (0'-1')
- No. 1 sand fill (1'-2')
- Bentonite chip annular seal (2'-22.5')
- 6" dia. Sonic borehole (0-31')
- 2" Sch. 40 PVC riser (0-24.5')
- No. 1 sand pack (22.5'-31')
- 2" PVC 20-slot screen (24.5'-29.5')

GROUNDWATER SCIENCES CORPORATION

GEOLOGIC LOG: B-822

PROJECT INFORMATION

PROJECT: ***Owego P001 Investigation***

SITE LOCATION: ***1801 NY-17C, Owego, NY***

JOB NO.: ***93004.46.1701***

LOGGED BY: ***Jane Block***

DATES DRILLED: ***4/24/18***

DRILLING INFORMATION

DRILLING CO.: ***Cascade Drilling***

DRILLER: ***Rob Maillet***

RIG TYPE: ***LS 250 Mini Sonic***

DRILLING METHOD: ***6" Sonic***

DEVELOPMENT DATE: ***5/1/18-5/2/18***

LOCATION: ***In security/medical parking lot near Bldg 306***

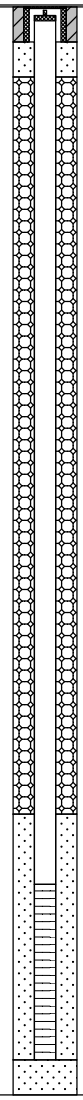
NOTES: MP Elevation: 910.37

ELEVATION: 910.8

NORTHING: 766993.2777 EASTING: 918749.3595

DEPTH FEET	PID Reading	SAMP.	Recovery	LITHOLOGY
0				ASPHALT: Asphalt pavement
	0	1	3.5' /5'	SILT, SAND & GRAVEL: Moderate yellowish brown (10YR 5/4) to dark yellowish brown (10YR 4/2), silt and very fine to very coarse sand, fine to medium angular gravel, crumbly
	0	2	3.5' /5'	SILT, SAND & GRAVEL: As above, moist from 7 to 8 feet
10				
	0	3	5'/5'	SILT, SAND & GRAVEL: As above, wet from 12 to 13 feet
	0	4	4.5' /5'	SILT, SAND & GRAVEL: As above, wet from 17 to 18 feet
20				
	0	5	4.5' /5'	SILT, SAND & GRAVEL: Light olive gray (5Y 6/1) to medium light gray (N6), silt and very fine to very coarse sand, fine to coarse angular to rounded gravel, tightly packed, crumbly
	0	6	5'/5'	SAND & SILT: Light gray (N7), silt and very fine to very coarse sand, little fine to coarse gravel, very tightly packed
				WEATHERED BEDROCK: Weathered shale bedrock
30				SHALE: Shale bedrock

GRAPHIC



WELL CONSTRUCTION

WELL CONSTRUCTION DETAILS

Flushmounted 4" Manhole (0'-1')

No. 1 sand fill (1'-2')

Bentonite chip annular seal (2'-23')

6" dia. Sonic borehole (0-31')

2" Sch. 40 PVC riser (0-25')

No. 1 sand pack (23'-31')

2" PVC 20-slot screen (25'-30')

GROUNDWATER SCIENCES CORPORATION

GEOLOGIC LOG: B-823

PROJECT INFORMATION

PROJECT: ***Owego P001 Investigation***

SITE LOCATION: ***1801 NY-17C, Owego, NY***

JOB NO.: ***93004.46.1701***

LOGGED BY: ***Jane Block***

DATES DRILLED: ***4/26/18***

DRILLING INFORMATION

DRILLING CO.: ***Cascade Drilling***

DRILLER: ***Rob Maillet***

RIG TYPE: ***LS 250 Mini Sonic***

DRILLING METHOD: ***6" Sonic***

DEVELOPMENT DATE: ***5/1/18-5/2/18***

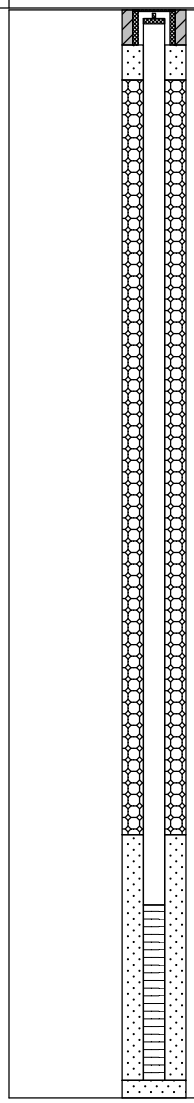
LOCATION: ***In security/medical parking lot near Bldg 306***

NOTES: MP Elevation: 910.16

ELEVATION: 910.5

NORTHING: 767031.3202 EASTING: 918759.0558

DEPTH FEET	PID Reading	SAMP.	Recovery	LITHOLOGY
0				ASPHALT: Asphalt pavement
			NA	Precleared by soft dig
	0	1	4.5' /5'	SILT, SAND & GRAVEL: Moderate yellowish brown (10YR 5/4) to light olive brown (5Y 5/6), silt and very fine to very coarse sand, fine to coarse angular gravel, wet
10				SILT, SAND & GRAVEL: As above, wet from 11 to 12 feet
	0	2	3.5' /5'	SAND: Dark yellowish brown (10YR 4/2), well sorted medium sand
	0			SILT, SAND & GRAVEL: Moderate yellowish brown to light olive brown, silt and very fine to very coarse sand, fine to coarse angular gravel, little angular cobbles
	0			
	0	3	5'/5'	SILT, SAND & GRAVEL: As above, some light olive gray (5Y 5/2)
	0			
	1.6			
20	0.6			SILT, SAND & GRAVEL: As above, some dark yellow brown (10YR 4/2)
	0.3			
	0	4	5'/5'	
	0			
	0			
				SILT, SAND & GRAVEL: Light olive gray (5Y 6/1), silt and very fine to very coarse sand, fine to coarse angular to subrounded gravel, tightly packed
	0	5	5'/6'	
				SHALE: Shale bedrock
30				



WELL CONSTRUCTION DETAILS

- Flushmounted 4" Manhole (0'-1')
- No. 1 sand fill (1'-2')
- Bentonite chip annular seal (2'-23.5')
- 6" dia. Sonic borehole (0-31')
- 2" Sch. 40 PVC riser (0-25.5')
- No. 1 sand pack (23.5'-31')
- 2" PVC 20-slot screen (25.5'-30.5')

GROUNDWATER SCIENCES CORPORATION

GEOLOGIC LOG: B-824

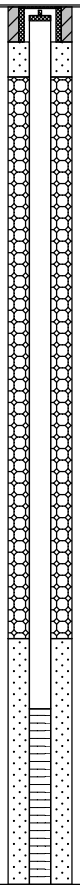
PROJECT INFORMATION		DRILLING INFORMATION	
PROJECT:	***Owego P001 Investigation***	DRILLING CO.:	***Cascade Drilling***
SITE LOCATION:	***1801 NY-17C, Owego, NY***	DRILLER:	***Rob Maillet***
JOB NO.:	***93004.46.1701***	RIG TYPE:	***LS 250 Mini Sonic***
LOGGED BY:	***Jane Block***	DRILLING METHOD:	***6" Sonic***
DATES DRILLED:	***5/1/18***	DEVELOPMENT DATE:	***5/8/18***
		LOCATION:	***In old tank farm area near chemical loading dock***

NOTES: MP Elevation: 912.04

ELEVATION: 912.5

NORTHING: 766980.3132 EASTING: 918914.0485

DEPTH FEET	PID Reading	SAMP.	Recovery	LITHOLOGY
0			NA	TOPSOIL: Topsoil Precleared by soft dig
	0 0 0 1.2	1	4'/5'	SILT, SAND & GRAVEL: Moderate olive brown (5Y 4/4) to moderate yellow brown (10YR 5/4), silt and very fine to very coarse sand, fine to coarse angular to subrounded gravel, crumbly
10	0.8 0.3 0.6 0 3.2	2	4'/5'	SILT, SAND & GRAVEL: As above, moist at 12 feet
	0 0 0 0 0.3	3	4'/5'	SILT, SAND & GRAVEL: Light olive gray (5Y 6/1) to light gray (N7), silt and very fine to very coarse sand, fine to medium angular gravel, tightly packed GRAVEL: Boulders
20	0	4	4'/5'	SILT, SAND & GRAVEL: Yellowish gray (5Y 7/2) to light olive gray (5Y 6/1), silt and very fine to very coarse sand, fine to medium gravel SHALE: Shale bedrock



WELL CONSTRUCTION DETAILS

- Flushmounted 4" Manhole (0'-1')
- No. 1 sand fill (1'-2')
- Bentonite chip annular seal (2'-18')
- 6" dia. Sonic borehole (0-25')
- 2" Sch. 40 PVC riser (0-20')
- No. 1 sand pack (18'-25')
- 2" PVC 20-slot screen (20'-25')

GROUNDWATER SCIENCES CORPORATION

GEOLOGIC LOG: B-825

PROJECT INFORMATION

PROJECT: ***Owego P001 Investigation***

SITE LOCATION: ***1801 NY-17C, Owego, NY***

JOB NO.: ***93004.46.1701***

LOGGED BY: ***Jane Block***

DATES DRILLED: ***5/1/18***

DRILLING INFORMATION

DRILLING CO.: ***Cascade Drilling***

DRILLER: ***Rob Maillet***

RIG TYPE: ***LS 250 Mini Sonic***

DRILLING METHOD: ***6" Sonic***

DEVELOPMENT DATE: ***5/8/18***

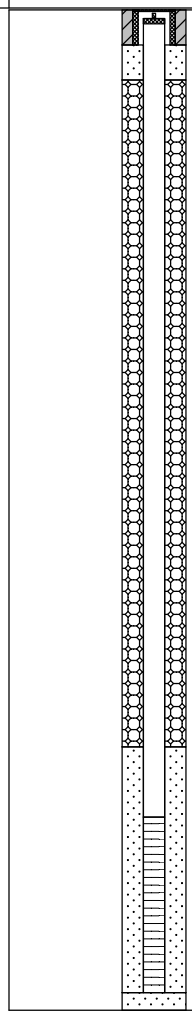
LOCATION: ***In old tank farm area near chemical loading dock***

NOTES: MP Elevation: 913.25

ELEVATION: 913.7

NORTHING: 767072.8057 EASTING: 918958.2820

DEPTH FEET	PID Reading	SAMP.	Recovery	LITHOLOGY
0			NA	TOPSOIL: Topsoil Soft dig material
	0	1	4'/5'	SILT, SAND & GRAVEL: Moderate yellowish brown (10YR 5/4) to moderate olive brown (5Y 4/4), silt and very fine to very coarse sand, fine to coarse rounded gravel, tightly packed at top, loose from 10-12.5 feet, wet
10	0 0 0 1.4 1.6	2	5'/5'	SILT, SAND & GRAVEL: Light olive gray (5Y 5/2) to light olive brown (5Y 5/6), silt and very fine to very coarse sand, fine to coarse angular gravel, tightly packed
	0 0 1.4 1.3 1.1	3	5'/5'	SILT, SAND & GRAVEL: As above, some light olive gray (5Y 5/2), bottom 3 feet tightly packed
20	2.2 1.0 0 0 0	4	5'/5'	SILT, SAND & GRAVEL: Light olive gray (5Y 6/1) to medium light gray (N6), silt and very fine to very coarse sand, fine to coarse angular gravel, some angular cobbles (>6") Cobbles and gravel are angular, tightly packed
	0 0.6			WEATHERED BEDROCK: Weathered shale bedrock, interbedded with thin sand and silt layers
		5	3'/3'	SHALE: Shale bedrock



Flushmounted 4" Manhole (0'-1')

No. 1 sand fill (1'-2')

Bentonite chip annular seal (2'-23')

6" dia. Sonic borehole (0-28.5')

2" Sch. 40 PVC riser (0-23')

No. 1 sand pack (21'-28.5')

2" PVC 20-slot screen (23'-28')

GROUNDWATER SCIENCES CORPORATION

GEOLOGIC LOG: B-826

PROJECT INFORMATION

PROJECT: ***Owego P001 Investigation***

SITE LOCATION: ***1801 NY-17C, Owego, NY***

JOB NO.: ***93004.46.1701***

LOGGED BY: ***Jane Block***

DATES DRILLED: ***5/2/18***

DRILLING INFORMATION

DRILLING CO.: ***Cascade Drilling***

DRILLER: ***Rob Maillet***

RIG TYPE: ***LS 250 Mini Sonic***

DRILLING METHOD: ***6" Sonic***

DEVELOPMENT DATE: ***5/9/18***

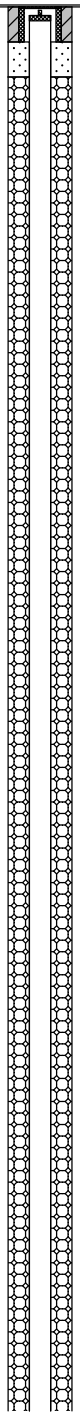
LOCATION: ***Approximately 80 feet northwest of well 612***

NOTES: MP Elevation: 901.36

ELEVATION: 901.7

NORTHING: 767024.4192 EASTING: 918237.9538

DEPTH FEET	PID Reading	SAMP.	Recovery	LITHOLOGY
0				ASPHALT: Asphalt pavement
	2.9	1	2'/5'	SILT, SAND & GRAVEL: Dark yellowish brown (10YR 4/2), silt and very fine to very coarse sand, some fine to coarse gravel, trace cobbles (4"), loose, crumbly
	3.0	2	1'/5'	
10				
	2.4	3	1'/5'	SILT, SAND & GRAVEL: Light olive gray (5Y 5/2) to light olive brown (5Y 5/6), silt and very fine to very coarse sand, some fine to medium angular to subrounded gravel, cohesive, moist
	0	4	2'/5'	SILT, SAND & GRAVEL: As above, little cobbles (>6")
20				
	0 0 0 1.1 1.9	5	3'/5'	SAND & SILT: Sand and silt, some organics (sticks and bark)
				SILT, SAND & GRAVEL: Light olive brown (5Y 5/6), silt and very fine to very coarse sand, fine to coarse angular to subrounded gravel, cohesive
	0	6	5'/5'	
30				SILT, SAND & GRAVEL: Light olive gray (5Y 5/2), silt and very fine to very coarse sand, some fine to coarse angular gravel, little angular cobbles. wet at 28 feet
	0	7	5'/5'	SAND & SILT: Sand and silt, some organics (sticks and rootlets)
				SILT, SAND & GRAVEL: Light olive brown (5Y 5/6) to light olive gray (5Y 5/2), silt and very fine to very coarse sand, fine to coarse angular to subrounded gravel, dry
	0	8	5'/5'	
40				



WELL CONSTRUCTION DETAILS

Flushmounted 4" Manhole (0'-1')

No. 1 sand fill (1'-2')

Bentonite chip annular seal (2'-64.5')

6" dia. Sonic borehole (0-71.5')

2" Sch. 40 PVC riser (0-66.5')

GROUNDWATER SCIENCES CORPORATION

***GEOLOGIC LOG:* B-826**

DEPTH FEET	PID Reading	SAMP.	Recovery	LITHOLOGY	GRAPHIC	DEPTH FEET	WELL CONSTRUCTION	WELL CONSTRUCTION DETAILS
40				SILT, SAND & GRAVEL: As above, tightly packed		40		
	0	9	5'/5'					
	0	10	5'/5'	SILT, SAND & GRAVEL: Light olive gray (5Y 6/1) to medium light gray (N6), silt and very fine to very coarse sand, fine to coarse gravel, little cobbles (>6"), cohesive				
50	0					50		
	0							
	0	11	5'/5'					
	0							
	0.9							
	0	12	5'/5'					
60	0			SILT, SAND & GRAVEL: As above, tightly packed		60		
	0							
	0.7	13	4.5'/5'					
	0							
	0							
				No recovery				No. 1 sand pack (64.5'-71.5')
		14	0'/5'					2" PVC 20-slot screen (66.5'-71.5')
70				SHALE: Shale bedrock		70		
			1.5'					

GROUNDWATER SCIENCES CORPORATION

GEOLOGIC LOG: B-827

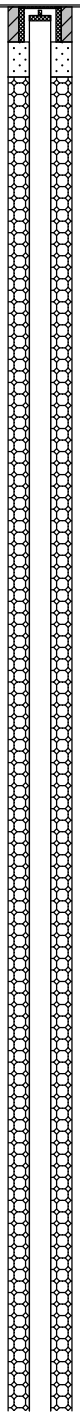
PROJECT INFORMATION		DRILLING INFORMATION	
PROJECT:	***Owego P001 Investigation***	DRILLING CO.:	***Cascade Drilling***
SITE LOCATION:	***1801 NY-17C, Owego, NY***	DRILLER:	***Rob Maillet***
JOB NO.:	***93004.46.1701***	RIG TYPE:	***LS 250 Mini Sonic***
LOGGED BY:	***Jane Block***	DRILLING METHOD:	***6" Sonic***
DATES DRILLED:	***5/2/18 - 5/3/18***	DEVELOPMENT DATE:	***5/9/18***
		LOCATION:	***Approximately 70 feet northwest of well 612***

NOTES: MP Elevation: 899.53

ELEVATION: 900.0

NORTHING: 767072.1395 EASTING: 918287.5378

DEPTH FEET	PID Reading	SAMP.	Recovery	LITHOLOGY
0				ASPHALT: Asphalt pavement
	0	1	4'/5'	SILT, SAND & GRAVEL: Moderate yellowish brown (10YR 5/4), silt and very fine to very coarse sand, fine to coarse angular to subrounded gravel, loose
	0	2	4'/5'	SILT, SAND & GRAVEL: As above, moist from 5 to 9 feet
10				
	0	3	2.5'/5'	SILT, SAND & GRAVEL: As above, some light olive gray (5Y 5/2), occasional cobbles (>6")
	0	4	5'/5'	SILT, SAND & GRAVEL: As above, some organics at 17 feet
20				
	0	5	4'/5'	SILT, SAND & GRAVEL: As above, some grayish olive (10YR 4/2) to light olive gray (5Y 5/2), tightly packed, cohesive
				SAND & SILT: Silt and sand, some organic material (sticks and rootlets)
	0	6	3'/5'	SILT, SAND & GRAVEL: Grayish olive (10YR 4/2) to light olive gray (5Y 5/2), silt and very fine to very coarse sand, fine to medium angular to subrounded gravel, tightly packed
30				
	0	7	5'/5'	SILT, SAND & GRAVEL: Moderate yellowish brown (10YR 5/4), silt and very fine to very coarse sand, fine to medium subrounded gravel, loosely packed
	0	8	4'/5'	SILT, SAND & GRAVEL: Light olive gray (5Y 5/2), silt and very fine to very coarse sand, fine to coarse subrounded gravel, tightly packed
40				



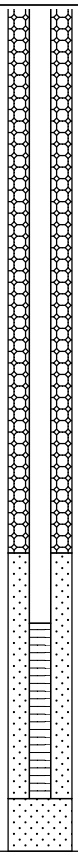
WELL CONSTRUCTION DETAILS

- Flushmounted 4" Manhole (0'-1')
- No. 1 sand fill (1'-2')
- Bentonite chip annular seal (2'-55.5')
- 6" dia. Sonic borehole (0-64')
- 2" Sch. 40 PVC riser (0-57.5')

GROUNDWATER SCIENCES CORPORATION

GEOLOGIC LOG: B-827

DEPTH FEET	PID Reading	SAMP.	Recovery	LITHOLOGY	GRAPHIC	DEPTH FEET	WELL CONSTRUCTION	WELL CONSTRUCTION DETAILS
40				SILT, SAND & GRAVEL: As above		40		
	0	9	5'/5'					
	0							
	0							
	0.6	10	5'/5'					
	0							
	0.7							
50	0					50		
	0							
	0.6	11	5'/5'					
	0							
	1.3							
	0			SILT, SAND & GRAVEL: Light olive gray (5Y 6/1) to medium gray (N6), silt and very fine to very coarse sand, fine to coarse angular gravel, trace angular cobbles, bottom one inch very tightly packed				
	0							
	0							
	0	12	3'/5'					No. 1 sand pack (55.5'-64')
	0.4							
	0							
60						60		
				SHALE: Shale bedrock				2" PVC 20-slot screen (57.5'-62.5')
		13	3'/5'					



GROUNDWATER SCIENCES CORPORATION

GEOLOGIC LOG: B-828

PROJECT INFORMATION

PROJECT: ***Owego P001 Investigation***

SITE LOCATION: ***1801 NY-17C, Owego, NY***

JOB NO.: ***93004.46.1701***

LOGGED BY: ***Jane Block***

DATES DRILLED: ***5/3/18***

DRILLING INFORMATION

DRILLING CO.: ***Cascade Drilling***

DRILLER: ***Rob Maillet***

RIG TYPE: ***LS 250 Mini Sonic***

DRILLING METHOD: ***6" Sonic***

DEVELOPMENT DATE: ***5/8/18***

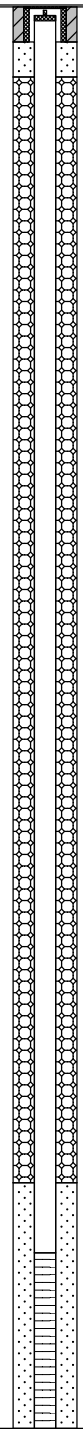
LOCATION: ***Approximately 60 feet northeast of well 609***

NOTES: MP Elevation: 894.23

ELEVATION: 894.5

NORTHING: 767243.9164 EASTING: 918360.0269

DEPTH FEET	PID Reading	SAMP.	Recovery	LITHOLOGY
0				ASPHALT: Asphalt pavement
	0	1	3.5'/5'	SILT, SAND & GRAVEL: Moderate yellowish brown (10YR 5/4) to dark yellowish brown (10YR 4/2), silt and very fine to very coarse sand, fine to coarse gravel, loose
	0	2	2'/5'	SILT, SAND & GRAVEL: As above, dark yellowish brown (10YR 4/2) to olive gray (5Y 3/2), moist
10		3	0'/5'	No recovery
	0	4	3'/5'	SILT, SAND & GRAVEL: Light olive brown (5Y 5/6) to moderate olive brown (5Y 4/4), silt and very fine to very coarse sand, fine to medium gravel, moist at top of run, wet at bottom of run
20	0 0 0 0 0.7	5	4.5'/5'	SILT, SAND & GRAVEL: As above, occasional cobbles (>6"), tightly packed at top of run, loose at bottom of run
	0.6 1.3 0 0 0	6	5'/5'	SILT, SAND & GRAVEL: As above, some cobbles
30	0 0 0 0 0.2	7	5'/5'	SILT, SAND & GRAVEL: Light olive gray (5Y 6/1), silt and very fine to very coarse sand, fine to medium gravel, crumbly SILT, SAND & GRAVEL: Light olive gray (5Y 6/1) to medium gray (N5), Boulders interspersed with very fine to very coarse sand, silt and fine to coarse angular gravel
	0	8	3'/5'	SHALE: Shale bedrock
40				



WELL CONSTRUCTION DETAILS

- Flushmounted 4" Manhole (0'-1')
- No. 1 sand fill (1'-2')
- Bentonite chip annular seal (2'-33.5')
- 6" dia. Sonic borehole (0-40.5')
- 2" Sch. 40 PVC riser (0-35.5')
- No. 1 sand pack (33.5'-40.5')
- 2" PVC 20-slot screen (35.5'-40.5')

GROUNDWATER SCIENCES CORPORATION

GEOLOGIC LOG: 700

PROJECT INFORMATION		DRILLING INFORMATION	
PROJECT:	***Lockheed Martin Facility***	DRILLING CO.:	***Parratt Wolff Inc.***
SITE LOCATION:	***Owego, New York***	DRILLER:	***W. Rice***
JOB NO.:	***94004.46.1701***	RIG TYPE:	***CME 55***
LOGGED BY:	***S. Fisher***	DRILLING METHOD:	***Hollow Stem Auger***
DATES DRILLED:	***4/16/18 - 4/18/18***	DEVELOPMENT DATE:	***4/25/18***
		LOCATION:	***P001 Area, approx. 10 ft E of well 393***
NOTES: SWL= 26.52 ft below TOC, 4/26/18 TOC elevation: 889.06 ft amsl		SURFACE ELEVATION	889.3 ft amsl
		EASTING	917950.4813
		NORTHING	766967.5284

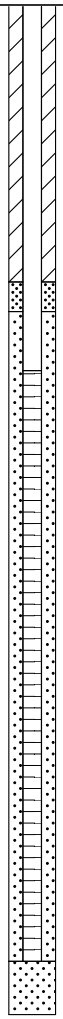
DEPTH FEET	BLOW COUNTS	PID (ppm)	RECOV.	SAMP.	SOIL DESCRIPTION	GRAPHIC	DEPTH FEET	WELL CONSTRUCTION	WELL CONSTRUCTION DETAILS
0							0		
	Augered to 20 ft	---	---	---	SILT, SAND & GRAVEL: dusky yellow to dk yellowish brown (10 YR 4/2) silt and vf-m, lit c-vc with f-m A-SR gravel, dense, crumbly, moist to dry				Flushmounted manhole with concrete surface apron (0'-1.0')
2							2		Sand annular fill (0.5'-3')
4							4		
6							6		8" dia. HSA borehole (0'-49')
8							8		
10							10		
12							12		Bentonite slurry annular seal (3'-55.5')
14							14		
16							16		
18							18		2" dia. Sch. 40 PVC riser (0.5'-57')
20	3 4 7 7	0	12"	1	SILT, SAND & GRAVEL: mod. yellowish brown (10 YR 5/4) to dusky yellow (5 Y 6/4) pred silt, tr clay, some vf-c sand, w/ A-SR gravel, tr. orgnics, dense, stiff, moist		20		
22	5				SILT, SAND & GRAVEL: as above,		22		

DEPTH FEET	BLOW COUNTS	PID (ppm)	RECOV.	SAMP.	SOIL DESCRIPTION	GRAPHIC	DEPTH FEET	WELL CONSTRUCTION	WELL CONSTRUCTION DETAILS
	9 8 9	0	16"	2	turning more olive gray (5 Y 4/1) in lower 4", increasing silt and clay, more plastic, moist				
24	6 7 9 11	0	11"	3	SILT & CLAY: olive gray to lt brownish gray (5 YR 6/1) pred silt w/ clay, dense, plastic, with olive black (5 Y 2/1) peat masses and rootlets, large 3" SA rock frag, moist		24		
26	8 11 12 12	0	20"	4	SILT & CLAY: as above SILT & CLAY: as above, less peat and rootlets, pred greenish gray (5 GY 6/1) to med gray (N5) silt, tr clay, w/ dk yellow orange (10 YR 6/6) mottling, tr f sand, stiff, moist		26		
28	12 13 13 12	0	24"	5			28		8" dia. HSA borehole (0'-49')
30	6 15 14 14	0	24"	6	SILT, SAND & GRAVEL: pred silt w/ vf-f sand, tr m-vc, w/ A-SA wthrd siltstone gravel, mottled, dense, moist SILT, SAND & GRAVEL: as above, less mottled below 14"		30		
32	9 11 18 20	0	16"	7	SILT & GRAVEL: brownish gray (5 YR 4/1) silt, SA-SR fine gravel, tr vf-f sand, dense stiff, moist to wet		32		
34	9 10 11 16	0	23"	8	SILT, SAND & GRAVEL: pred. silt , w/ vf-f sand, w/ more SA siltstone frags, some m gravel, pred silt, tr clay lower 3", more homogeneous, dense, stiff, wet		34		
36	5 15 16 15	0	21"	9	SILT, SAND & GRAVEL: as above, pred. silt 15-21", dense, stiff, wet		36		Bentonite slurry annular seal (3'-55.5')
38	7 11 21 21	0	21"	10	SILT, SAND & GRAVEL: as above, silty 10-14", pred. granules 14-16", v. gravelly elsewhere, some vf-c sand, dense, sl crumbly, wet		38		
40	12 17 38 35	0	20"	11	SILT, SAND & GRAVEL: as above, pred f-m SA-SR clasts of shale and siltstone, v gravelly below 15", dense, stiff, wet		40		
42	37 45 40 40	0	19"	12	SILT, SAND & GRAVEL: as above w/ more f-m A-SA gravel, dense, wet, turning mod yell brown (10 YR 5/4) lower 8", w/ wthrd clasts, wet		42		
44	15 24 26 28	0	22"	13	SILT, SAND & GRAVEL: dk yell brown to olive gray, sl less silt, w/ vf-vc sand, f-m SA-SR gravel, loose, crumbly, wet		44		2" dia. Sch. 40 PVC riser (0.5'-57')
46	33 22 42 37	0	14"	14	SILT, SAND & GRAVEL: as above top 6", then olive gray silt, w/ vf-f sand, tr m-vc, w/ f-m SA-SR gravel, v. dense, stiff, moist to wet		46		
48	14 88	0	12"	15	SILT, SAND & GRAVEL: olive gray, silt, some vf-f sand, f-m gravel, v. dense, stiff, moist		48		
	Spin casing	---	---	---					
50					SHALE: (boulder) med. dark gray (N4) horizontally bedded, some fracturing, irregular top and bottom contacts		50		5" dia. PQ Core corehole (49'-67.9')

GROUNDWATER SCIENCES CORPORATION

***GEOLOGIC LOG:* 700**

DEPTH FEET	BLOW COUNTS	PID (ppm)	RECOV.	SAMP.	SOIL DESCRIPTION	GRAPHIC	DEPTH FEET	WELL CONSTRUCTION	WELL CONSTRUCTION DETAILS
52	PQ Core	0	39"/41"	RUN 1	SILT, SAND & GRAVEL: olive gray silt with vf-f sand, some m-vc sand, w/ f-m A-SA shale fragments, dense, wet		52		Bentonite slurry annular seal (3'-55.5')
54	PQ Core	0	32"/36"	RUN 2	SILT, SAND & GRAVEL: olive gray silt with vf-f sand, some m-vc sand, w/ f-m A-SA shale fragments, dense, wet		54		2" dia. Sch. 40 PVC riser (0.5'-57')
56	PQ Core	0	20"/24"	RUN 3	SHALE: (boulder) med. dark gray (N4) horizontally bedded, some fracturing, irregular top and bottom contacts		56		Fine choke sand (55.5'-56')
58	PQ Core	0	60"/60"	RUN 4	SILT, SAND & GRAVEL: olive gray silt w/ vf-f sand, some m-vc, w/ A-SA grvl, dense, wet		58		#00N Sand pack (56'-67.9')
60					SHALE: deeply wthrd boulder 60.2' to 61 ft		60		
62					SILT, SAND & GRAVEL: olive gray silt w/ vf-f sand, some m-vc, w/ A-SA grvl, dense, wet		62		
64	PQ Core	0	60"/60"	RUN 5	SHALE: fractured shale boulder 61.5 ft to 62.2 ft		64		2" dia. 20-slot PVC screen (57'-67')
66					SILT, SAND & GRAVEL: olive gray silt w/ vf-f sand, some m-vc, w/ A-SA grvl, dense, wet		66		
68					SHALE: med. dk gray (N4), competent , thin horizontal bedding, occ calcite fossil masses 6"-33", calcitic fossil layer 48.5"-49.5", possible clean natural fracture at 8"		68		



GROUNDWATER SCIENCES CORPORATION

GEOLOGIC LOG: 701

PROJECT INFORMATION

PROJECT:	***Lockheed Martin Facility***
SITE LOCATION:	***Owego, New York***
JOB NO.:	***94004.46.1701***
LOGGED BY:	***S. Fisher***
DATES DRILLED:	***4/19/18 - 4/23/18***

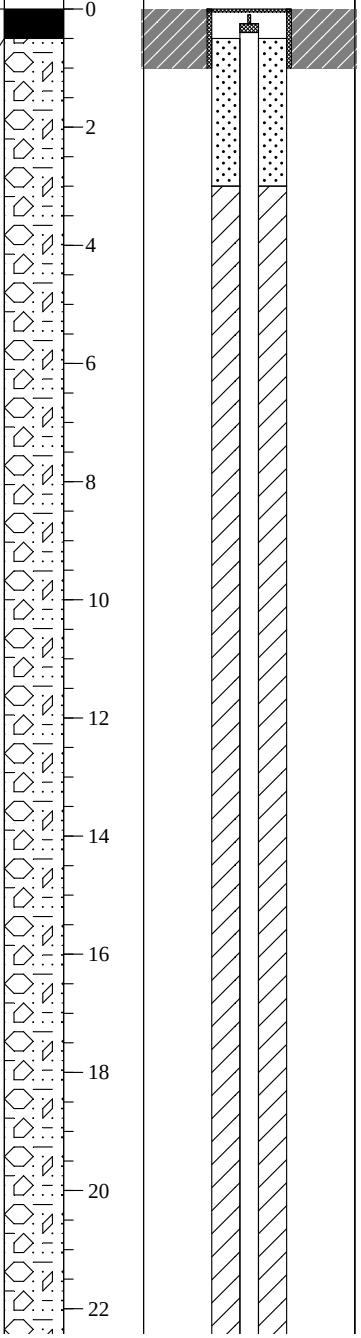
NOTES: SWL= 25.18 ft below TOC, 4/26/18
TOC elevation: 888.24 ft amsl

DRILLING INFORMATION

DRILLING CO.:	***Parratt Wolff Inc.***
DRILLER:	***W. Rice***
RIG TYPE:	***CME 55***
DRILLING METHOD:	***Hollow Stem Auger/Core***
DEVELOPMENT DATE:	***4/25/18***
LOCATION:	***P001 Area, approx. 10 ft E of well 393***
SURFACE ELEVATION	888.7 ft amsl
EASTING	918002.7785
NORTHING	767000.2126

DEPTH FEET	BLOW COUNTS	PID (ppm)	RECOV.	SAMP.	SOIL DESCRIPTION
0					Asphalt: asphalt pavement with gravel base
2	Augered to 24 ft	---	---	---	SILT, SAND & GRAVEL: moderate yellowish brown (10 YR 5/4) to dusky yellow (5 Y 6/4) silt with vf-vc sand, and f-m A-SR gravel, crumbly, moist to dry
4					
6					
8					
10					
12					
14					
16					
18					
20					
22					

GRAPHIC



WELL CONSTRUCTION DETAILS

- Flushmounted manhole with concrete surface apron (0'-1')
- Sand annular fill (0.5'-3')
- 8" dia. HSA borehole (0'-59.5')
- Bentonite slurry annular seal (3'-57')
- 2" dia. Sch. 40 PVC riser (0.5'-60')

DEPTH FEET	BLOW COUNTS	PID (ppm)	RECOV.	SAMP.	SOIL DESCRIPTION	GRAPHIC	DEPTH FEET	WELL CONSTRUCTION	WELL CONSTRUCTION DETAILS
	Augered to 24 ft				SILT & CLAY: olive gray (5 Y 4/1) organic, silt with tr vf sand, tr clay, with peat masses and wood frags, color grading to greenish gray (5 GY 6/1) with dk yellow orange (10 YR 6/6) mottling, tr, roots, dense, stiff, moist				
24	4 8 11 13	0	24"	1			24		
26	9 12 19 15	0	24"	2	SILT, SAND & GRAVEL: mod. brown (5 YR 4/4) pred silt, tr vf-vc sand, w/ A-SA wthrd shale frags, dense, sl crumbly, moist		26		
28	3 9 12 9	0	23"	3	SILT, SAND & GRAVEL: as above, color grading to brownish gray (5 YR 4/1) at 15.5", dense, stiff, f gravel more SR, moist		28		8" dia. HSA borehole (0'-59.5')
30	9 10 13 13	0	24"	4	SILT, SAND & GRAVEL: as above with more A-SA f-m shale frags w/ SR f shale clasts, occ wthrd rock frag, tr clay, sl plastic, dense, moist		30		
32	11 12 16 12	0	17"	5	SILT, SAND & GRAVEL: as above, more gravelly 11-15", pred. shale frags, tr wthrd siltstone frags, dense, stiff, moist		32		
34	5 5 7 8	0	20"	6	SILT, SAND & GRAVEL: as above w/ less gravel, gravelly zone 13-18", dense, stiff, moist		34		
36	6 8 10 10	0	21"	7	SILT & CLAY: olive gray to pale yellowish brown (10 YR 6/2), homogeneous, some clay, some color banding w/ pale red lams, pred vc sand near bottom with tr. vf-c sand, dense plastic, moist		36		Bentonite slurry annular seal (3'-57')
38	6 9 12 11	0	15"	8	SILT & GRAVEL: olive gray (5 Y 4/1) silt w/ f-m SR shale gravel, 2" m-vc sand layer at top, large shale frags at bottom, less dense and stiff, wet		38		
40	7 11 12 20	0	18"	9	SILT & GRAVEL: as above top 7", color changing to grayish orange (10 YR 7/4) silt w/ SA-SR f-m gravel, dense stiff, wet		40		
42	12 27 30 18	0	16"	10	SILT, SAND & GRAVEL: dusky yellow (5 Y 6/4) to grayish orange silt w/ vf-vc sand, and f-m SA-SR gravel, occ. wthrd shale frags, less dense, sl crumbly, wet		42		
44	10 20 24 37	0	14"	11	SILT, SAND & GRAVEL: as above, large SR m gravel 4-7", pred c-vc sand matrix, lit silt binder, all silt lower inch, cohesive, crumbly , wet		44		2" dia. Sch. 40 PVC riser (0.5'-60')
46	14 22 25 42	0	22"	12	SILT, SAND & GRAVEL: olive gray silt, some vf-vc sand w/ f-m SA-SR shale gravel, v. dense, stiff, moist		46		
48	13 30 60/0.5' augered	0	18"	13	SILT, SAND & GRAVEL: olive gray as above, dense, stiff, sl porous 12-14", moist to wet		48		
50	28 62				SILT, SAND & GRAVEL: olive gray as above, w/ abundant m SA-SR shale frags,		50		

GROUNDWATER SCIENCES CORPORATION

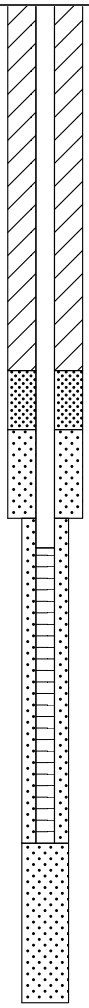
***GEOLOGIC LOG:* 701**

DEPTH FEET	BLOW COUNTS	PID (ppm)	RECOV.	SAMP.	SOIL DESCRIPTION
52	45 48	0	20"	14	dense, stiff, moist
	35 72 31 33	0	19"	15	SILT, SAND & GRAVEL: as above, dense, very gravelly w/ A-SA shale frags, dense, stiff, wet
54	30 47 41 44	0	18"	16	SILT, SAND & GRAVEL: as above, large 3.5" shale frag in tip of spoon, moist
56	32 28 30 38	0	19"	17	SILT, SAND & GRAVEL: as above, sl more vf-vc sand, dense, less stiff, wet
58	37 49 84/0.5'	0	18"	18	SILT, SAND & GRAVEL: as above, oxidized dusky yellow (5 Y 6/4) color 4-10", texturally continuous, dense, wet
60	PQ Core	0	36"/ 38.4"	RUN 1	SILT, SAND & GRAVEL: olive gray pred silt with vf-m sand, w/ f-m SA-SR gravel, cobble at 19-24", dense, wet WEATHERED SHALE: olive gray to dark gray, pred wthrd shale frags, some silt and vf sand, broken, loose, wet
62					
64	PQ Core	0	60"/60"	RUN 2	SHALE: dk gray (N3) horizontally bedded, occ. calcitic fossil frag, occ bedding plane fracture, moist to wet
66					
68					

GRAPHIC

DEPTH FEET: 52, 54, 56, 58, 60, 62, 64, 66, 68

WELL CONSTRUCTION



WELL CONSTRUCTION DETAILS

- Bentonite slurry annular seal (3'-57')
- 2" dia. Sch. 40 PVC riser (0.5'-60')
- Fine choke sand (57'-58')
- #00N Sand pack (58'-67.7')
- 2" dia. 20-slot PVC screen (60'-65')
- 5" dia. PQ Core corehole (59.5'-67.7')

GROUNDWATER SCIENCES CORPORATION

GEOLOGIC LOG: 418A

PROJECT INFORMATION		DRILLING INFORMATION	
PROJECT:	***Lockheed Martin Facility***	DRILLING CO.:	***Parratt Wolff Inc.***
SITE LOCATION:	***Owego, New York***	DRILLER:	***W. Rice***
JOB NO.:	***94004.46.1701***	RIG TYPE:	***CME 55***
LOGGED BY:	***S. Fisher***	DRILLING METHOD:	***Hollow Stem Auger***
DATES DRILLED:	***4/24/18***	DEVELOPMENT DATE:	***NA***
		LOCATION:	***P001 Area, approx. 5 ft NE of well 414***
NOTES: Water encountered at approx. 28 feet below g.s. Pilot boring for extraction well 418		SURFACE ELEVATION	891.1 ft amsl
		EASTING	918197.3152
		NORTHING	766895.6085

DEPTH FEET	BLOW COUNTS	PID (ppm)	RECOV.	SAMP.	SOIL DESCRIPTION	GRAPHIC	DEPTH FEET	WELL CONSTRUCTION	WELL CONSTRUCTION DETAILS
0							0		
					TOPSOIL: sod and organic silt and sand, moist				Top soil backfill, (0 to 0.5')
2					SILT, SAND & GRAVEL: dark yellowish brown (10 YR 4/2) silt with vf-vc sand, and f-m gravel, crumbly, moist		2		
4	Augered to 10 ft	---	---	---			4		
6							6		
8							8		
10	13 8 7 6	0	0"	1	SILT, SAND & GRAVEL: pushed large rock fragment (no recovery)		10		8" dia. HSA borehole (0'-41.3')
12	6 6 8 11	0	6"	2	SILT, SAND & GRAVEL: dk yell brown, pred. silt with vf-vc sand matrix, f-m A-SA gravel throughout, crumbly, moist		12		
14	4 3 2 2	0	23"	3	SILT & SAND: olive gray (5 Y 4/1) pred organic silt w/ vf-f sand, tr m-vc, tr. f SR gravel, w/ rootlets and organic masses, cohesive, moist		14		
16	3 4 3 4	0	21"	4	SILT & SAND: as above, w/ occ large 0.5 "dia. roots, occ wthrd A-SA shale frags, cohesive, moist		16		
18	4 6 10 9	0	5"	5	SILT & SAND: as above, large SA siltstone frag jammed in tip of spoon		18		Sand backfill, (0.5' to 42')
20	3 3 5 18	0	23"	6	SILT & SAND: as above, sl more fine SR gravel in lower 9", w/ rootlets, cohesive, moist		20		
22	24				SILT, SAND & GRAVEL: olive gray silt		22		

GROUNDWATER SCIENCES CORPORATION

***GEOLOGIC LOG:* 418A**

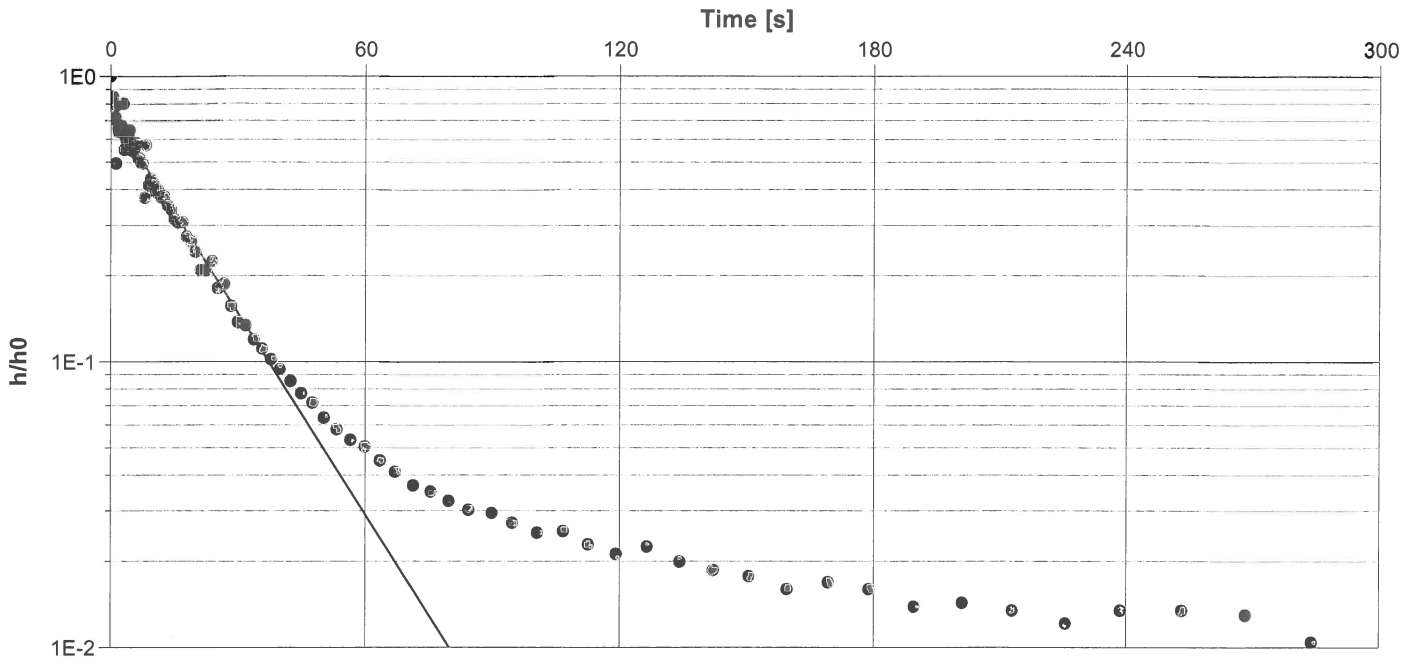
DEPTH FEET	BLOW COUNTS	PID (ppm)	RECOV.	SAMP.	SOIL DESCRIPTION	GRAPHIC	DEPTH FEET	WELL CONSTRUCTION	WELL CONSTRUCTION DETAILS
	21 23 24	0	24"	7	w/ vf-f sand matrix, some m-vc, w/ f-m SA-SR gravel, occ A shale/siltstone frag, crumbly to sl. cohesive, moist				
24	10 15 15 13	0	18"	8	SAND & GRAVEL: dk yell brown, to olive gray, pred m-c, tr silt, lit vf-f, some vc and f SR-R gravel, loose, moist		24		
26	14 21 22 17	0	13"	9	SILT, SAND & GRAVEL: dk yell brown, silt with vf-f, tr m-vc, SA-SR f gravel, dense, cohesive, moist		26		
28	6 7 12 13	0	22"	10	SILT, SAND & GRAVEL: olive gray pred. SR f gravel, tr. A-SA rock wthrd rock frags, dense, sl. crumbly, wet		28		8" dia. HSA borehole (0'-41.3')
30	13 22 29 25	0	23"	11	SILT, SAND & GRAVEL: as above, wet top 8" then more A-SA wthrd shale and siltstone frags, more moderate brown (5 YR 4/4) and moist		30		
32	39 33 34 29	0	22"	12	SILT, SAND & GRAVEL: as above, with thin vc and f SR gravel laminations, pred SA shale and siltstone clasts, some SR clasts, cohesive to crumbly, wet		32		
34	20 24 30 23	0	24"	13	SILT, SAND & GRAVEL: as above, v. gravelly, some layering, freq. SR gravel w/ silty zones, wet		34		Sand backfill, (0.5' to 42')
36	Augered	---	---	---	SILT & SAND: mod yellowish brown (10 YR 5/4), layered vf-f sand with silt, wet		36		
38	23 40 46 46	0	24"	14	SAND: c-vc sand, lit f-m, tr f SR-R gravel, loose, wet SILT, SAND & GRAVEL: mod yell brown, silt with vf-f sans, lit m-vc, w/ f SA-SR gravel throughout, pred dusky brown (5 Y 2/2) wthrd siltstone frags 8"-14", v. dense, stiff, wet		38		
40	13 26 35 69	0	18"	15	SILT, SAND & GRAVEL: as above top 6", then pred silt w/ vf sand, some color banding, cohesive, wet		40		3" dia. split spoon borhole (40' to 42')
42					SILT, SAND & GRAVEL: lt. olive gray (5 Y 5/2) pred silt w/ vf sand matrix, some f-vc, w/ SA-SR f gravel, v. dense, stiff, cohesive, moist		42		
44							44		

APPENDIX C

Hydraulic Testing Results

Groundwater Sciences Corp. ***2601 Market Place Street, Ste 310*** ***Harrisburg, PA 17110***	**Slug Test Analysis Report** Project: Lockheed Martin Owego Number: 93004.46.1701 Client: IBM

Location: Owego, NY	Slug Test: 700 Slug In	Test Well: 700
Test Conducted by: S. Fisher		Test Date: 7/5/2018
Analysis Performed by: S. Fisher	Bouwer & Rice	Analysis Date: 7/6/2018
Aquifer Thickness: 40.71 ft		



Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [ft/d]	
700	6.03×10^{0}	

Groundwater Sciences Corp.
2601 Market Place Street, Ste 310
Harrisburg, PA 17110

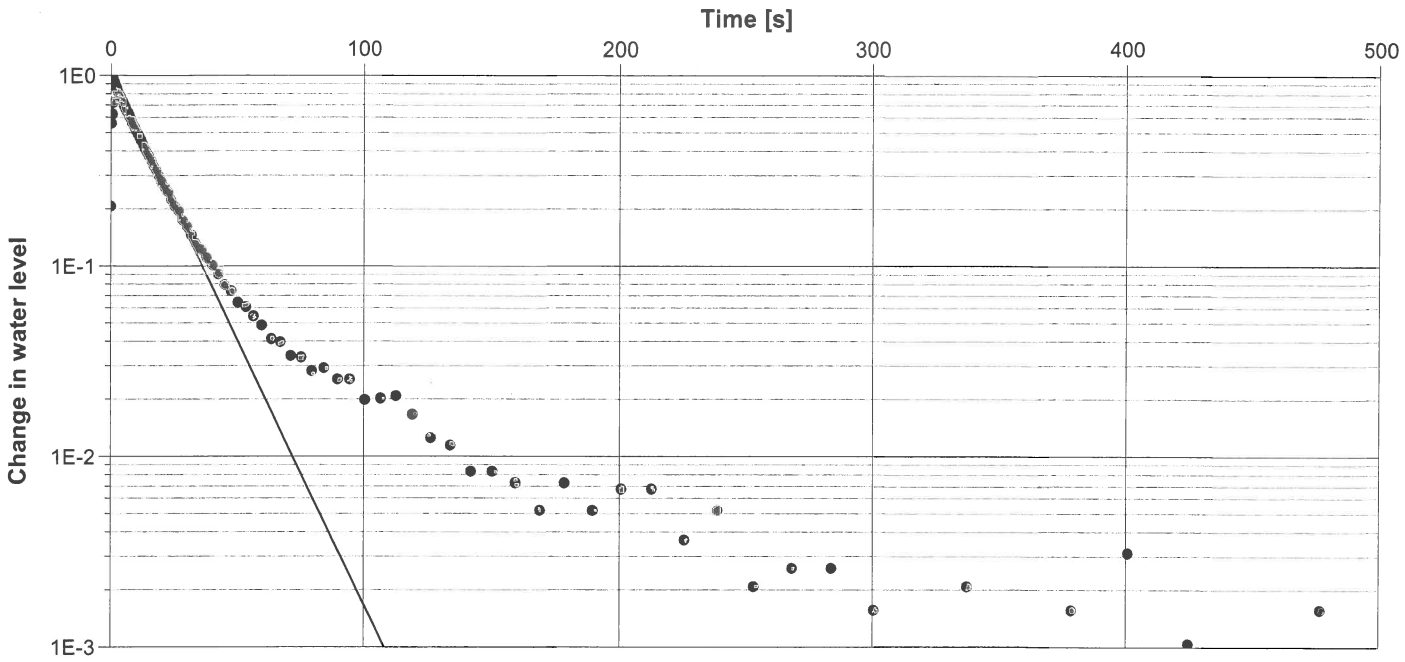
Slug Test Analysis Report

Project: Lockheed Martin Owego

Number: 93004.46.1701

Client: IBM

Location: Owego, NY	Slug Test: 700 Slug Out	Test Well: 700
Test Conducted by: S. Fisher		Test Date: 7/5/2018
Analysis Performed by: S Fisher	Bouwer & Rice	Analysis Date: 7/6/2018
Aquifer Thickness: 40.71 ft		

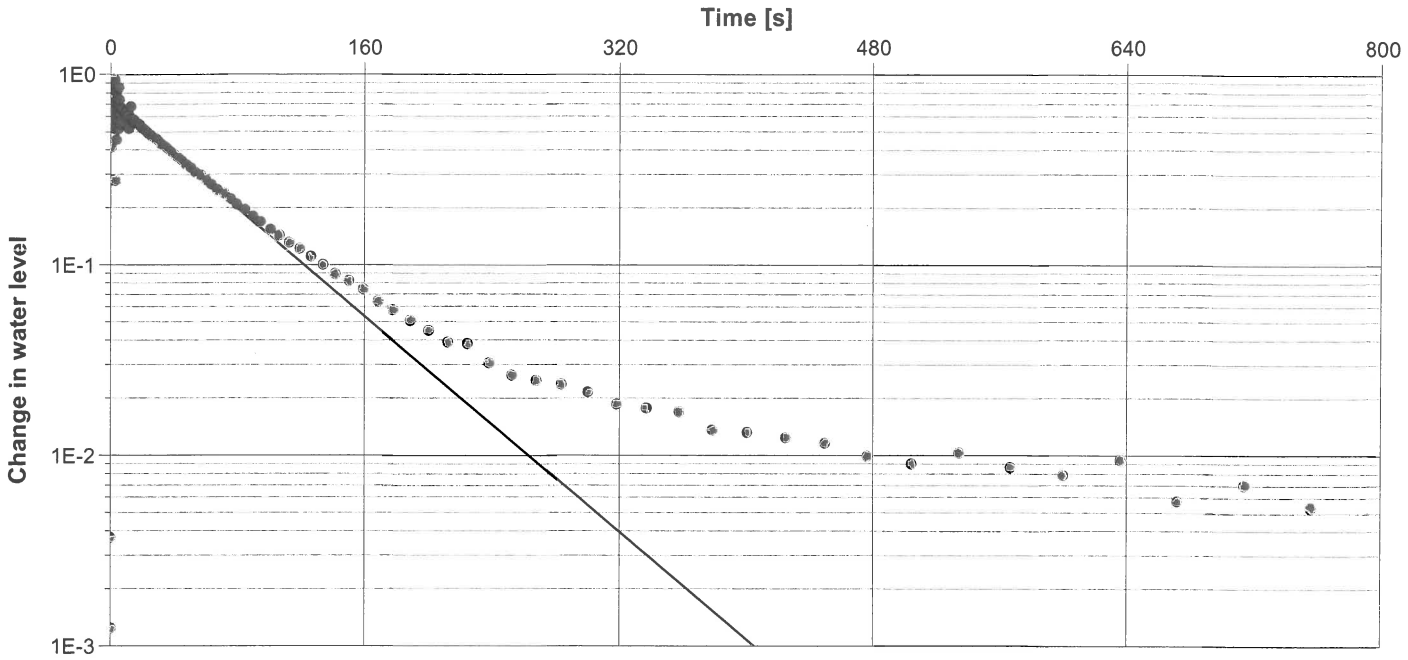


Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [ft/d]	
700	7.12×10^{0}	

Groundwater Sciences Corp. *2601 Market Place Street, Ste 310* *Harrisburg, PA 17110*	**Slug Test Analysis Report** Project: Lockheed Martin Owego Number: 93004.46.1701 Client: IBM

Location: Owego, NY	Slug Test: 701 Slug In	Test Well: 701
Test Conducted by: S. Fisher		Test Date: 7/5/2018
Analysis Performed by: S. Fisher	Bouwer & Rice	Analysis Date: 7/6/2018
Aquifer Thickness: 39.74 ft		



Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [ft/d]	
701	3.08×10^{0}	

Groundwater Sciences Corp.
2601 Market Place Street, Ste 310
Harrisburg, PA 17110

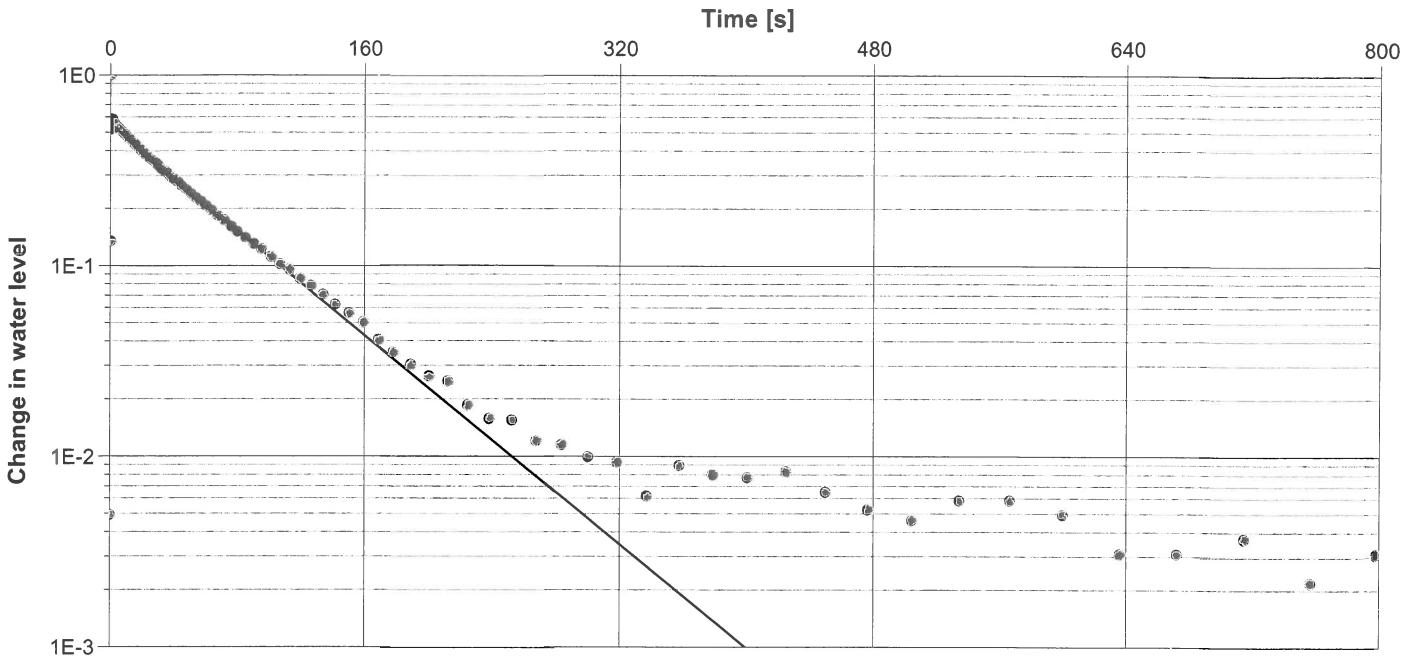
Slug Test Analysis Report

Project: Lockheed Martin Owego

Number: 93004.46.1701

Client: IBM

Location: Owego, NY	Slug Test: 701 Slug Out	Test Well: 701
Test Conducted by: S. Fisher		Test Date: 7/5/2018
Analysis Performed by:	Bouwer & Rice	Analysis Date: 7/6/2018
Aquifer Thickness: 39.74 ft		



Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [ft/d]	
701	2.99×10^{0}	

APPENDIX D

Soil Analytical Chemistry Data

Soil Analytical Chemistry Data

P001 Remedial Alternatives Investigation, Owego, New York

April-May 2018

Sample Location		800	800	801	801
Sample Depth		18-19'	47-48'	19-20'	48-49'
Sample Date		04/09/2018	04/10/2018	04/10/2018	04/10/2018
Laboratory Sample I.D.		9551928	9551929	9551930	9551931
Parameter	**Units**				
1,1,1-TRICHLOROETHANE	ug/kg	ND@6	ND@4	ND@7	ND@4
1,1,2,2-TETRACHLOROETHANE	ug/kg	ND@6	ND@4	ND@7	ND@4
1,1,2-TRICHLOROETHANE	ug/kg	ND@6	ND@4	ND@7	ND@4
1,1-DICHLOROETHANE	ug/kg	ND@6	4 J	ND@7	ND@4
1,1-DICHLOROETHENE	ug/kg	ND@6	ND@4	ND@7	ND@4
1,2-DICHLOROETHANE (EDC)	ug/kg	ND@6	ND@4	ND@7	ND@4
1,2-DICHLOROPROPANE	ug/kg	ND@6	ND@4	ND@7	ND@4
ACETONE	ug/kg	ND@55	ND@17	25 J	13 J
BENZENE	ug/kg	ND@6	ND@4	ND@7	ND@4
BROMODICHLOROMETHANE	ug/kg	ND@6	ND@4	ND@7	ND@4
BROMOFORM (TRIBROMOMETHANE)	ug/kg	ND@6	ND@4	ND@7	ND@4
BROMOMETHANE	ug/kg	ND@6	ND@4	ND@7	ND@4
CARBON DISULFIDE	ug/kg	ND@6	ND@4	ND@7	1 J
CARBON TETRACHLORIDE	ug/kg	ND@6	ND@4	ND@7	ND@4
CHLOROBENZENE	ug/kg	ND@6	ND@4	ND@7	ND@4
CHLORODIBROMOMETHANE	ug/kg	ND@6	ND@4	ND@7	ND@4
CHLOROETHANE	ug/kg	ND@6	ND@4	ND@7	ND@4
CHLOROFORM (TRICHLOROMETHANE)	ug/kg	ND@6	ND@4	ND@7	ND@4
CHLOROMETHANE	ug/kg	ND@6	ND@4	ND@7	ND@4
CIS-1,2-DICHLOROETHENE	ug/kg	ND@6	ND@4	ND@7	ND@4
CIS-1,3-DICHLOROPROPENE	ug/kg	ND@6	ND@4	ND@7	ND@4
ETHYLBENZENE	ug/kg	ND@6	ND@4	ND@7	ND@4
METHYL BUTYL KETONE (2-HEXANONE)	ug/kg	ND@12	ND@8	ND@14	ND@9
METHYL ETHYL KETONE (MEK, 2-BUTANONE)	ug/kg	15	ND@8	8 J	ND@9
METHYLENE CHLORIDE (DICHLOROMETHANE)	ug/kg	ND@6	ND@4	ND@7	ND@4
MIBK (4-METHYL-2-PENTANONE)	ug/kg	ND@12	ND@8	ND@14	ND@9
STYRENE	ug/kg	ND@6	ND@4	ND@7	ND@4
TETRACHLOROETHENE	ug/kg	ND@6	ND@4	ND@7	ND@4
TOLUENE	ug/kg	ND@6	ND@4	ND@7	4 J
TRANS-1,2-DICHLOROETHENE	ug/kg	ND@6	ND@4	ND@7	ND@4
TRANS-1,3-DICHLOROPROPENE	ug/kg	ND@6	ND@4	ND@7	ND@4
TRICHLOROETHENE	ug/kg	ND@6	ND@4	ND@7	ND@4
VINYL CHLORIDE	ug/kg	ND@6	ND@4	ND@7	ND@4
XYLENES, TOTAL	ug/kg	13	ND@4	ND@7	ND@4
MOISTURE	%	16.5	9.1	32	4.8

Soil Analytical Chemistry Data

P001 Remedial Alternatives Investigation, Owego, New York

April-May 2018

Sample Location		802	802	803	803
Sample Depth		11-12'	52-53'	20-21'	39-40'
Sample Date		04/11/2018	04/11/2018	04/12/2018	04/12/2018
Laboratory Sample I.D.		9554433	9554434	9556833	9556834
Parameter	**Units**				
1,1,1-TRICHLOROETHANE	ug/kg	ND@4	110 J	ND@5	ND@5
1,1,2,2-TETRACHLOROETHANE	ug/kg	ND@4	ND@5	ND@5	ND@5
1,1,2-TRICHLOROETHANE	ug/kg	ND@4	ND@5	ND@5	ND@5
1,1-DICHLOROETHANE	ug/kg	ND@4	260 J	ND@5	ND@5
1,1-DICHLOROETHENE	ug/kg	ND@4	34 J	ND@5	ND@5
1,2-DICHLOROETHANE (EDC)	ug/kg	ND@4	ND@5	ND@5	ND@5
1,2-DICHLOROPROPANE	ug/kg	ND@4	ND@5	ND@5	ND@5
ACETONE	ug/kg	26	8 J	37	14 J
BENZENE	ug/kg	ND@4	13 J	ND@5	ND@5
BROMODICHLOROMETHANE	ug/kg	ND@4	ND@5	ND@5	ND@5
BROMOFORM (TRIBROMOMETHANE)	ug/kg	ND@4	ND@5	ND@5	ND@5
BROMOMETHANE	ug/kg	ND@4	ND@5	ND@5	ND@5
CARBON DISULFIDE	ug/kg	ND@4	5 J	ND@5	ND@5
CARBON TETRACHLORIDE	ug/kg	ND@4	ND@5	ND@5	ND@5
CHLOROBENZENE	ug/kg	ND@4	ND@5	ND@5	ND@5
CHLORODIBROMOMETHANE	ug/kg	ND@4	ND@5	ND@5	ND@5
CHLOROETHANE	ug/kg	ND@4	ND@5	ND@5	ND@5
CHLOROFORM (TRICHLOROMETHANE)	ug/kg	ND@4	ND@5	ND@5	ND@5
CHLOROMETHANE	ug/kg	ND@4	ND@5	ND@5	ND@5
CIS-1,2-DICHLOROETHENE	ug/kg	ND@4	12 J	ND@5	ND@5
CIS-1,3-DICHLOROPROPENE	ug/kg	ND@4	ND@5	ND@5	ND@5
ETHYLBENZENE	ug/kg	ND@4	ND@5	ND@5	ND@5
METHYL BUTYL KETONE (2-HEXANONE)	ug/kg	ND@8	ND@10	ND@10	ND@11
METHYL ETHYL KETONE (MEK, 2-BUTANONE)	ug/kg	ND@8	ND@10	11	ND@11
METHYLENE CHLORIDE (DICHLOROMETHANE)	ug/kg	ND@4	ND@5	ND@5	ND@5
MIBK (4-METHYL-2-PENTANONE)	ug/kg	ND@8	ND@10	ND@10	ND@11
STYRENE	ug/kg	ND@4	ND@5	ND@5	ND@5
TETRACHLOROETHENE	ug/kg	ND@4	ND@5	ND@5	ND@5
TOLUENE	ug/kg	ND@4	18 J	1 J	4 J
TRANS-1,2-DICHLOROETHENE	ug/kg	ND@4	ND@5	ND@5	ND@5
TRANS-1,3-DICHLOROPROPENE	ug/kg	ND@4	ND@5	ND@5	ND@5
TRICHLOROETHENE	ug/kg	ND@4	6 J	ND@5	ND@5
VINYL CHLORIDE	ug/kg	ND@4	ND@5	ND@5	ND@5
XYLENES, TOTAL	ug/kg	ND@4	ND@5	ND@5	ND@5
MOISTURE	%	10.9	16	13.5	12.8

Soil Analytical Chemistry Data

P001 Remedial Alternatives Investigation, Owego, New York

April-May 2018

Sample Location		804	804	805	805
Sample Depth		19-20'	58-59'	29-30'	46-47'
Sample Date		04/13/2018	04/16/2018	04/16/2018	04/17/2018
Laboratory Sample I.D.		9558491	9561425	9564252	9564253
Parameter	**Units**				
1,1,1-TRICHLOROETHANE	ug/kg	ND@4	50 J	ND@6	ND@4
1,1,2,2-TETRACHLOROETHANE	ug/kg	ND@4	ND@4 J	ND@6	ND@4
1,1,2-TRICHLOROETHANE	ug/kg	ND@4	ND@4 J	ND@6	ND@4
1,1-DICHLOROETHANE	ug/kg	ND@4	1300 J	ND@6	6
1,1-DICHLOROETHENE	ug/kg	ND@4	1500 J	ND@6	1 J
1,2-DICHLOROETHANE (EDC)	ug/kg	ND@4	1 J	ND@6	ND@4
1,2-DICHLOROPROPANE	ug/kg	ND@4	ND@4 J	ND@6	ND@4
ACETONE	ug/kg	ND@18	ND@17 J	ND@75	ND@28
BENZENE	ug/kg	ND@4	ND@4 J	ND@6	0.7 J
BROMODICHLOROMETHANE	ug/kg	ND@4	ND@4 J	ND@6	ND@4
BROMOFORM (TRIBROMOMETHANE)	ug/kg	ND@4	ND@4 J	ND@6	ND@4
BROMOMETHANE	ug/kg	ND@4	ND@4 J	ND@6	ND@4
CARBON DISULFIDE	ug/kg	ND@4	ND@4 J	ND@6	ND@4
CARBON TETRACHLORIDE	ug/kg	ND@4	ND@4 J	ND@6	ND@4
CHLOROBENZENE	ug/kg	ND@4	ND@4 J	ND@6	ND@4
CHLORODIBROMOMETHANE	ug/kg	ND@4	ND@4 J	ND@6	ND@4
CHLOROETHANE	ug/kg	ND@4	ND@4 J	ND@6	ND@4
CHLOROFORM (TRICHLOROMETHANE)	ug/kg	ND@4	ND@4 J	ND@6	ND@4
CHLOROMETHANE	ug/kg	ND@4	ND@4 J	ND@6	ND@4
CIS-1,2-DICHLOROETHENE	ug/kg	ND@4	140 J	ND@6	4 J
CIS-1,3-DICHLOROPROPENE	ug/kg	ND@4	ND@4 J	ND@6	ND@4
ETHYLBENZENE	ug/kg	ND@4	ND@4 J	ND@6	ND@4
METHYL BUTYL KETONE (2-HEXANONE)	ug/kg	ND@9	ND@9 J	ND@11	ND@9
METHYL ETHYL KETONE (MEK, 2-BUTANONE)	ug/kg	ND@9	ND@9 J	31	9 J
METHYLENE CHLORIDE (DICHLOROMETHANE)	ug/kg	ND@4	ND@4 J	ND@6	ND@4
MIBK (4-METHYL-2-PENTANONE)	ug/kg	ND@9	ND@9 J	ND@11	ND@9
STYRENE	ug/kg	ND@4	ND@4 J	ND@6	ND@4
TETRACHLOROETHENE	ug/kg	ND@4	ND@4 J	ND@6	0.9 J
TOLUENE	ug/kg	ND@4	ND@4 J	ND@6	ND@4
TRANS-1,2-DICHLOROETHENE	ug/kg	ND@4	2 J	ND@6	ND@4
TRANS-1,3-DICHLOROPROPENE	ug/kg	ND@4	ND@4 J	ND@6	ND@4
TRICHLOROETHENE	ug/kg	ND@4	17 J	ND@6	44
VINYL CHLORIDE	ug/kg	ND@4	4 J	ND@6	ND@4
XYLENES, TOTAL	ug/kg	ND@4	ND@4 J	ND@6	ND@4
MOISTURE	%	9.6	10.5	16.5	10.5

Soil Analytical Chemistry Data

P001 Remedial Alternatives Investigation, Owego, New York

April-May 2018

Sample Location		806	806	807	807
Sample Depth		26-27'	47-48'	15-16'	54-55'
Sample Date		04/17/2018	04/17/2018	04/18/2018	04/18/2018
Laboratory Sample I.D.		9564254	9564255	9566524	9566525
Parameter	**Units**				
1,1,1-TRICHLOROETHANE	ug/kg	ND@6	8	ND@5	6
1,1,2,2-TETRACHLOROETHANE	ug/kg	ND@6	ND@4	ND@5	ND@5
1,1,2-TRICHLOROETHANE	ug/kg	ND@6	ND@4	ND@5	ND@5
1,1-DICHLOROETHANE	ug/kg	ND@6	200	ND@5	1900
1,1-DICHLOROETHENE	ug/kg	ND@6	140	ND@5	1100
1,2-DICHLOROETHANE (EDC)	ug/kg	ND@6	1 J	ND@5	2 J
1,2-DICHLOROPROPANE	ug/kg	ND@6	ND@4	ND@5	ND@5
ACETONE	ug/kg	ND@49	ND@18	28	10 J
BENZENE	ug/kg	ND@6	ND@4	ND@5	ND@5
BROMODICHLOROMETHANE	ug/kg	ND@6	ND@4	ND@5	ND@5
BROMOFORM (TRIBROMOMETHANE)	ug/kg	ND@6	ND@4	ND@5	ND@5
BROMOMETHANE	ug/kg	ND@6	ND@4	ND@5	ND@5
CARBON DISULFIDE	ug/kg	ND@6	ND@4	ND@5	ND@5
CARBON TETRACHLORIDE	ug/kg	ND@6	ND@4	ND@5	ND@5
CHLOROBENZENE	ug/kg	ND@6	ND@4	ND@5	ND@5
CHLORODIBROMOMETHANE	ug/kg	ND@6	ND@4	ND@5	ND@5
CHLOROETHANE	ug/kg	ND@6	9	ND@5	5
CHLOROFORM (TRICHLOROMETHANE)	ug/kg	ND@6	ND@4	ND@5	ND@5
CHLOROMETHANE	ug/kg	ND@6	ND@4	ND@5	ND@5
CIS-1,2-DICHLOROETHENE	ug/kg	ND@6	79	ND@5	250
CIS-1,3-DICHLOROPROPENE	ug/kg	ND@6	ND@4	ND@5	ND@5
ETHYLBENZENE	ug/kg	ND@6	ND@4	ND@5	ND@5
METHYL BUTYL KETONE (2-HEXANONE)	ug/kg	ND@13	ND@9	ND@9	ND@9
METHYL ETHYL KETONE (MEK, 2-BUTANONE)	ug/kg	16	ND@9	11	ND@9
METHYLENE CHLORIDE (DICHLOROMETHANE)	ug/kg	ND@6	ND@4	ND@5	ND@5
MIBK (4-METHYL-2-PENTANONE)	ug/kg	ND@13	ND@9	ND@9	ND@9
STYRENE	ug/kg	ND@6	ND@4	ND@5	ND@5
TETRACHLOROETHENE	ug/kg	ND@6	ND@4	ND@5	ND@5
TOLUENE	ug/kg	3 J	ND@4	ND@5	ND@5
TRANS-1,2-DICHLOROETHENE	ug/kg	ND@6	1 J	ND@5	2 J
TRANS-1,3-DICHLOROPROPENE	ug/kg	ND@6	ND@4	ND@5	ND@5
TRICHLOROETHENE	ug/kg	2 J	150	ND@5	14
VINYL CHLORIDE	ug/kg	ND@6	5	ND@5	8
XYLENES, TOTAL	ug/kg	ND@6	ND@4	ND@5	ND@5
MOISTURE	%	24.2	10	8.4	13.3

Soil Analytical Chemistry Data

P001 Remedial Alternatives Investigation, Owego, New York

April-May 2018

Sample Location		808	808	809	809
Sample Depth		06-07'	25-26'	10-11'	24-25'
Sample Date		04/19/2018	04/19/2018	04/19/2018	04/19/2018
Laboratory Sample I.D.		9568881	9568882	9568883	9570917
Parameter	**Units**				
1,1,1-TRICHLOROETHANE	ug/kg	ND@6	ND@5	ND@5	ND@5
1,1,2,2-TETRACHLOROETHANE	ug/kg	ND@6	ND@5	ND@5	ND@5
1,1,2-TRICHLOROETHANE	ug/kg	ND@6	ND@5	ND@5	ND@5
1,1-DICHLOROETHANE	ug/kg	ND@6	ND@5	ND@5	ND@5
1,1-DICHLOROETHENE	ug/kg	ND@6	ND@5	ND@5	ND@5
1,2-DICHLOROETHANE (EDC)	ug/kg	ND@6	ND@5	ND@5	ND@5
1,2-DICHLOROPROPANE	ug/kg	ND@6	ND@5	ND@5	ND@5
ACETONE	ug/kg	27	34	ND@21	13 J
BENZENE	ug/kg	ND@6	ND@5	ND@5	ND@5
BROMODICHLOROMETHANE	ug/kg	ND@6	ND@5	ND@5	ND@5
BROMOFORM (TRIBROMOMETHANE)	ug/kg	ND@6	ND@5	ND@5	ND@5
BROMOMETHANE	ug/kg	ND@6	ND@5	ND@5	ND@5
CARBON DISULFIDE	ug/kg	ND@6	ND@5	ND@5	2 J
CARBON TETRACHLORIDE	ug/kg	ND@6	ND@5	ND@5	ND@5
CHLOROBENZENE	ug/kg	ND@6	ND@5	ND@5	ND@5
CHLORODIBROMOMETHANE	ug/kg	ND@6	ND@5	ND@5	ND@5
CHLOROETHANE	ug/kg	ND@6	ND@5	ND@5	ND@5
CHLOROFORM (TRICHLOROMETHANE)	ug/kg	ND@6	ND@5	ND@5	ND@5
CHLOROMETHANE	ug/kg	ND@6	ND@5	ND@5	ND@5
CIS-1,2-DICHLOROETHENE	ug/kg	ND@6	ND@5	ND@5	ND@5
CIS-1,3-DICHLOROPROPENE	ug/kg	ND@6	ND@5	ND@5	ND@5
ETHYLBENZENE	ug/kg	ND@6	ND@5	ND@5	ND@5
METHYL BUTYL KETONE (2-HEXANONE)	ug/kg	ND@11	ND@10	ND@10	ND@10
METHYL ETHYL KETONE (MEK, 2-BUTANONE)	ug/kg	ND@11	11	ND@10	ND@10
METHYLENE CHLORIDE (DICHLOROMETHANE)	ug/kg	ND@6	ND@5	ND@5	ND@5
MIBK (4-METHYL-2-PENTANONE)	ug/kg	ND@11	ND@10	ND@10	ND@10
STYRENE	ug/kg	ND@6	ND@5	ND@5	ND@5
TETRACHLOROETHENE	ug/kg	ND@6	ND@5	ND@5	ND@5
TOLUENE	ug/kg	ND@6	ND@5	ND@5	ND@5
TRANS-1,2-DICHLOROETHENE	ug/kg	ND@6	ND@5	ND@5	ND@5
TRANS-1,3-DICHLOROPROPENE	ug/kg	ND@6	ND@5	ND@5	ND@5
TRICHLOROETHENE	ug/kg	ND@6	ND@5	1 J	ND@5
VINYL CHLORIDE	ug/kg	ND@6	ND@5	ND@5	ND@5
XYLENES, TOTAL	ug/kg	1 J	ND@5	ND@5	ND@5
MOISTURE	%	6.1	12.9	10	7.7

Soil Analytical Chemistry Data

P001 Remedial Alternatives Investigation, Owego, New York

April-May 2018

Sample Location		810	810	811	811
Sample Depth		05-06'	25-26'	11-12'	23-24'
Sample Date		04/23/2018	04/23/2018	04/24/2018	04/25/2018
Laboratory Sample I.D.		9573417	9573418	9575108	9578071
Parameter	**Units**				
1,1,1-TRICHLOROETHANE	ug/kg	ND@5	ND@5	ND@6	4 J
1,1,2,2-TETRACHLOROETHANE	ug/kg	ND@5	ND@5	ND@6	ND@5
1,1,2-TRICHLOROETHANE	ug/kg	ND@5	ND@5	ND@6	ND@5
1,1-DICHLOROETHANE	ug/kg	ND@5	1 J	ND@6	ND@5
1,1-DICHLOROETHENE	ug/kg	ND@5	19	ND@6	30
1,2-DICHLOROETHANE (EDC)	ug/kg	ND@5	ND@5	ND@6	ND@5
1,2-DICHLOROPROPANE	ug/kg	ND@5	ND@5	ND@6	ND@5
ACETONE	ug/kg	16 J	7 J	ND@23	8 J
BENZENE	ug/kg	ND@5	ND@5	ND@6	ND@5
BROMODICHLOROMETHANE	ug/kg	ND@5	ND@5	ND@6	ND@5
BROMOFORM (TRIBROMOMETHANE)	ug/kg	ND@5	ND@5	ND@6	ND@5
BROMOMETHANE	ug/kg	ND@5	ND@5	ND@6	ND@5
CARBON DISULFIDE	ug/kg	ND@5	1 J	ND@6	ND@5
CARBON TETRACHLORIDE	ug/kg	ND@5	ND@5	ND@6	ND@5
CHLOROBENZENE	ug/kg	ND@5	ND@5	ND@6	ND@5
CHLORODIBROMOMETHANE	ug/kg	ND@5	ND@5	ND@6	ND@5
CHLOROETHANE	ug/kg	ND@5	ND@5	ND@6	ND@5
CHLOROFORM (TRICHLOROMETHANE)	ug/kg	ND@5	ND@5	ND@6	ND@5
CHLOROMETHANE	ug/kg	ND@5	ND@5	ND@6	ND@5
CIS-1,2-DICHLOROETHENE	ug/kg	ND@5	ND@5	ND@6	ND@5
CIS-1,3-DICHLOROPROPENE	ug/kg	ND@5	ND@5	ND@6	ND@5
ETHYLBENZENE	ug/kg	ND@5	ND@5	ND@6	ND@5
METHYL BUTYL KETONE (2-HEXANONE)	ug/kg	ND@9	ND@9	ND@12	ND@10
METHYL ETHYL KETONE (MEK, 2-BUTANONE)	ug/kg	ND@9	ND@9	ND@12	ND@10
METHYLENE CHLORIDE (DICHLOROMETHANE)	ug/kg	ND@5	ND@5	ND@6	ND@5
MIBK (4-METHYL-2-PENTANONE)	ug/kg	ND@9	ND@9	ND@12	ND@10
STYRENE	ug/kg	ND@5	ND@5	ND@6	ND@5
TETRACHLOROETHENE	ug/kg	ND@5	ND@5	ND@6	ND@5
TOLUENE	ug/kg	ND@5	ND@5	ND@6	ND@5
TRANS-1,2-DICHLOROETHENE	ug/kg	ND@5	ND@5	ND@6	ND@5
TRANS-1,3-DICHLOROPROPENE	ug/kg	ND@5	ND@5	ND@6	ND@5
TRICHLOROETHENE	ug/kg	ND@5	7	ND@6	ND@5
VINYL CHLORIDE	ug/kg	ND@5	ND@5	ND@6	ND@5
XYLENES, TOTAL	ug/kg	ND@5	ND@5	ND@6	ND@5
MOISTURE	%	11.3	9	11.2	13.4

Soil Analytical Chemistry Data

P001 Remedial Alternatives Investigation, Owego, New York

April-May 2018

Sample Location		812	812	813	813
Sample Depth		04-05'	19-20'	09-10'	26-27'
Sample Date		04/25/2018	04/25/2018	04/30/2018	04/30/2018
Laboratory Sample I.D.		9578074	9578075	9585784	9585785
Parameter	**Units**				
1,1,1-TRICHLOROETHANE	ug/kg	ND@5	15	ND@5	15 J
1,1,2,2-TETRACHLOROETHANE	ug/kg	ND@5	ND@5	ND@5	ND@5 J
1,1,2-TRICHLOROETHANE	ug/kg	ND@5	2 J	ND@5	ND@5 J
1,1-DICHLOROETHANE	ug/kg	ND@5	2 J	ND@5	2300 J
1,1-DICHLOROETHENE	ug/kg	ND@5	26	ND@5	150 J
1,2-DICHLOROETHANE (EDC)	ug/kg	ND@5	ND@5	ND@5	4 J
1,2-DICHLOROPROPANE	ug/kg	ND@5	ND@5	ND@5	ND@5 J
ACETONE	ug/kg	45	ND@20	7 J	24 J
BENZENE	ug/kg	ND@5	ND@5	ND@5	ND@5 J
BROMODICHLOROMETHANE	ug/kg	ND@5	ND@5	ND@5	ND@5 J
BROMOFORM (TRIBROMOMETHANE)	ug/kg	ND@5	ND@5	ND@5	ND@5 J
BROMOMETHANE	ug/kg	ND@5	ND@5	ND@5	ND@5 J
CARBON DISULFIDE	ug/kg	ND@5	ND@5	ND@5	ND@5 J
CARBON TETRACHLORIDE	ug/kg	ND@5	ND@5	ND@5	ND@5 J
CHLOROBENZENE	ug/kg	ND@5	ND@5	ND@5	ND@5 J
CHLORODIBROMOMETHANE	ug/kg	ND@5	ND@5	ND@5	ND@5 J
CHLOROETHANE	ug/kg	ND@5	ND@5	ND@5	ND@5 J
CHLOROFORM (TRICHLOROMETHANE)	ug/kg	ND@5	ND@5	ND@5	ND@5 J
CHLOROMETHANE	ug/kg	ND@5	ND@5	ND@5	ND@5 J
CIS-1,2-DICHLOROETHENE	ug/kg	ND@5	2 J	ND@5	1600 J
CIS-1,3-DICHLOROPROPENE	ug/kg	ND@5	ND@5	ND@5	ND@5 J
ETHYLBENZENE	ug/kg	ND@5	ND@5	ND@5	ND@5 J
METHYL BUTYL KETONE (2-HEXANONE)	ug/kg	ND@10	ND@10	ND@9	ND@9 J
METHYL ETHYL KETONE (MEK, 2-BUTANONE)	ug/kg	6 J	5 J	ND@9	ND@9 J
METHYLENE CHLORIDE (DICHLOROMETHANE)	ug/kg	ND@5	ND@5	ND@5	ND@5 J
MIBK (4-METHYL-2-PENTANONE)	ug/kg	ND@10	ND@10	ND@9	ND@9 J
STYRENE	ug/kg	ND@5	ND@5	ND@5	ND@5 J
TETRACHLOROETHENE	ug/kg	ND@5	5	ND@5	ND@5 J
TOLUENE	ug/kg	ND@5	ND@5	ND@5	ND@5 J
TRANS-1,2-DICHLOROETHENE	ug/kg	ND@5	ND@5	ND@5	3 J
TRANS-1,3-DICHLOROPROPENE	ug/kg	ND@5	ND@5	ND@5	ND@5 J
TRICHLOROETHENE	ug/kg	ND@5	49	1 J	9 J
VINYL CHLORIDE	ug/kg	ND@5	ND@5	ND@5	1 J
XYLENES, TOTAL	ug/kg	ND@5	ND@5	ND@5	ND@5 J
MOISTURE	%	14.6	10.8	8	7.2

Soil Analytical Chemistry Data

P001 Remedial Alternatives Investigation, Owego, New York

April-May 2018

Sample Location		814	814	815	815
Sample Depth		09-10'	23-24'	09-10'	19-20'
Sample Date		04/26/2018	04/26/2018	04/30/2018	04/30/2018
Laboratory Sample I.D.		9581039	9581040	9585786	9587999
Parameter	**Units**				
1,1,1-TRICHLOROETHANE	ug/kg	2 J	14	4 J	4 J
1,1,2,2-TETRACHLOROETHANE	ug/kg	ND@5	ND@5	ND@5	ND@5
1,1,2-TRICHLOROETHANE	ug/kg	ND@5	ND@5	ND@5	ND@5
1,1-DICHLOROETHANE	ug/kg	ND@5	6	ND@5	8
1,1-DICHLOROETHENE	ug/kg	ND@5	3 J	ND@5	4 J
1,2-DICHLOROETHANE (EDC)	ug/kg	ND@5	ND@5	ND@5	ND@5
1,2-DICHLOROPROPANE	ug/kg	ND@5	ND@5	ND@5	ND@5
ACETONE	ug/kg	ND@21	ND@19	27	9 J
BENZENE	ug/kg	ND@5	ND@5	ND@5	ND@5
BROMODICHLOROMETHANE	ug/kg	ND@5	ND@5	ND@5	ND@5
BROMOFORM (TRIBROMOMETHANE)	ug/kg	ND@5	ND@5	ND@5	ND@5
BROMOMETHANE	ug/kg	ND@5	ND@5	ND@5	ND@5
CARBON DISULFIDE	ug/kg	ND@5	ND@5	ND@5	ND@5
CARBON TETRACHLORIDE	ug/kg	ND@5	ND@5	ND@5	ND@5
CHLOROBENZENE	ug/kg	ND@5	ND@5	ND@5	ND@5
CHLORODIBROMOMETHANE	ug/kg	ND@5	ND@5	ND@5	ND@5
CHLOROETHANE	ug/kg	ND@5	ND@5	ND@5	ND@5
CHLOROFORM (TRICHLOROMETHANE)	ug/kg	ND@5	ND@5	ND@5	ND@5
CHLOROMETHANE	ug/kg	ND@5	ND@5	ND@5	ND@5
CIS-1,2-DICHLOROETHENE	ug/kg	ND@5	7	ND@5	12
CIS-1,3-DICHLOROPROPENE	ug/kg	ND@5	ND@5	ND@5	ND@5
ETHYLBENZENE	ug/kg	ND@5	ND@5	ND@5	ND@5
METHYL BUTYL KETONE (2-HEXANONE)	ug/kg	ND@10	ND@9	ND@10	ND@10
METHYL ETHYL KETONE (MEK, 2-BUTANONE)	ug/kg	ND@10	ND@9	ND@10	ND@10
METHYLENE CHLORIDE (DICHLOROMETHANE)	ug/kg	ND@5	ND@5	ND@5	ND@5
MIBK (4-METHYL-2-PENTANONE)	ug/kg	ND@10	ND@9	ND@10	ND@10
STYRENE	ug/kg	ND@5	ND@5	ND@5	ND@5
TETRACHLOROETHENE	ug/kg	ND@5	16	ND@5	ND@5
TOLUENE	ug/kg	ND@5	1 J	ND@5	ND@5
TRANS-1,2-DICHLOROETHENE	ug/kg	ND@5	ND@5	ND@5	ND@5
TRANS-1,3-DICHLOROPROPENE	ug/kg	ND@5	ND@5	ND@5	ND@5
TRICHLOROETHENE	ug/kg	6	58	27	30
VINYL CHLORIDE	ug/kg	ND@5	ND@5	ND@5	ND@5
XYLENES, TOTAL	ug/kg	ND@5	ND@5	ND@5	ND@5
MOISTURE	%	6.9	7	11.1	5.2

Soil Analytical Chemistry Data

P001 Remedial Alternatives Investigation, Owego, New York

April-May 2018

Sample Location		816	816	817	817
Sample Depth		09-10'	20-21'	14-15'	19-20'
Sample Date		05/01/2018	05/01/2018	04/25/2018	04/25/2018
Laboratory Sample I.D.		9588000	9588001	9578072	9578073
Parameter	**Units**				
1,1,1-TRICHLOROETHANE	ug/kg	13	21	5	58
1,1,2,2-TETRACHLOROETHANE	ug/kg	ND@5	ND@4	ND@5	ND@5
1,1,2-TRICHLOROETHANE	ug/kg	ND@5	ND@4	ND@5	ND@5
1,1-DICHLOROETHANE	ug/kg	1 J	150	2 J	82
1,1-DICHLOROETHENE	ug/kg	2 J	20	61	630 J
1,2-DICHLOROETHANE (EDC)	ug/kg	ND@5	ND@4	ND@5	4 J
1,2-DICHLOROPROPANE	ug/kg	ND@5	ND@4	ND@5	ND@5
ACETONE	ug/kg	8 J	12 J	ND@19	ND@19
BENZENE	ug/kg	ND@5	ND@4	ND@5	ND@5
BROMODICHLOROMETHANE	ug/kg	ND@5	ND@4	ND@5	ND@5
BROMOFORM (TRIBROMOMETHANE)	ug/kg	ND@5	ND@4	ND@5	ND@5
BROMOMETHANE	ug/kg	ND@5	ND@4	ND@5	ND@5
CARBON DISULFIDE	ug/kg	ND@5	ND@4	ND@5	ND@5
CARBON TETRACHLORIDE	ug/kg	ND@5	ND@4	ND@5	ND@5
CHLOROBENZENE	ug/kg	ND@5	ND@4	ND@5	ND@5
CHLORODIBROMOMETHANE	ug/kg	ND@5	ND@4	ND@5	ND@5
CHLOROETHANE	ug/kg	ND@5	ND@4	ND@5	ND@5
CHLOROFORM (TRICHLOROMETHANE)	ug/kg	ND@5	ND@4	ND@5	1 J
CHLOROMETHANE	ug/kg	ND@5	ND@4	ND@5	ND@5
CIS-1,2-DICHLOROETHENE	ug/kg	ND@5	11	3 J	75
CIS-1,3-DICHLOROPROPENE	ug/kg	ND@5	ND@4	ND@5	ND@5
ETHYLBENZENE	ug/kg	ND@5	ND@4	ND@5	ND@5
METHYL BUTYL KETONE (2-HEXANONE)	ug/kg	ND@10	ND@8	ND@10	ND@10
METHYL ETHYL KETONE (MEK, 2-BUTANONE)	ug/kg	ND@10	ND@8	ND@10	ND@10
METHYLENE CHLORIDE (DICHLOROMETHANE)	ug/kg	ND@5	2 J	ND@5	ND@5
MIBK (4-METHYL-2-PENTANONE)	ug/kg	ND@10	ND@8	ND@10	ND@10
STYRENE	ug/kg	ND@5	ND@4	ND@5	ND@5
TETRACHLOROETHENE	ug/kg	ND@5	2 J	ND@5	ND@5
TOLUENE	ug/kg	ND@5	2 J	ND@5	ND@5
TRANS-1,2-DICHLOROETHENE	ug/kg	ND@5	ND@4	ND@5	4 J
TRANS-1,3-DICHLOROPROPENE	ug/kg	ND@5	ND@4	ND@5	ND@5
TRICHLOROETHENE	ug/kg	100	1900	180	1300 J
VINYL CHLORIDE	ug/kg	ND@5	ND@4	ND@5	1 J
XYLENES, TOTAL	ug/kg	ND@5	ND@4	ND@5	ND@5
MOISTURE	%	5.5	8	8.7	11.6

Soil Analytical Chemistry Data

P001 Remedial Alternatives Investigation, Owego, New York

April-May 2018

Sample Location		818	818	819	819
Sample Depth		10-11'	18-19'	10-11'	30-31'
Sample Date		04/26/2018	04/26/2018	04/27/2018	04/27/2018
Laboratory Sample I.D.		9582597	9582598	9582599	9582600
Parameter	**Units**				
1,1,1-TRICHLOROETHANE	ug/kg	ND@4	7	ND@5	2 J
1,1,2,2-TETRACHLOROETHANE	ug/kg	ND@4	ND@5	ND@5	ND@5
1,1,2-TRICHLOROETHANE	ug/kg	ND@4	ND@5	ND@5	ND@5
1,1-DICHLOROETHANE	ug/kg	ND@4	1 J	ND@5	1700 J
1,1-DICHLOROETHENE	ug/kg	ND@4	45	ND@5	89 J
1,2-DICHLOROETHANE (EDC)	ug/kg	ND@4	ND@5	ND@5	ND@5
1,2-DICHLOROPROPANE	ug/kg	ND@4	ND@5	ND@5	ND@5
ACETONE	ug/kg	ND@18	16 J	18 J	19 J
BENZENE	ug/kg	ND@4	ND@5	ND@5	ND@5
BROMODICHLOROMETHANE	ug/kg	ND@4	ND@5	ND@5	ND@5
BROMOFORM (TRIBROMOMETHANE)	ug/kg	ND@4	ND@5	ND@5	ND@5
BROMOMETHANE	ug/kg	ND@4	ND@5	ND@5	ND@5
CARBON DISULFIDE	ug/kg	ND@4	ND@5	ND@5	ND@5
CARBON TETRACHLORIDE	ug/kg	ND@4	ND@5	ND@5	ND@5
CHLOROBENZENE	ug/kg	ND@4	ND@5	ND@5	ND@5
CHLORODIBROMOMETHANE	ug/kg	ND@4	ND@5	ND@5	ND@5
CHLOROETHANE	ug/kg	ND@4	ND@5	ND@5	ND@5
CHLOROFORM (TRICHLOROMETHANE)	ug/kg	ND@4	ND@5	ND@5	ND@5
CHLOROMETHANE	ug/kg	ND@4	ND@5	ND@5	ND@5
CIS-1,2-DICHLOROETHENE	ug/kg	ND@4	1 J	ND@5	1300 J
CIS-1,3-DICHLOROPROPENE	ug/kg	ND@4	ND@5	ND@5	ND@5
ETHYLBENZENE	ug/kg	ND@4	ND@5	ND@5	ND@5
METHYL BUTYL KETONE (2-HEXANONE)	ug/kg	ND@9	ND@10	ND@9	ND@9
METHYL ETHYL KETONE (MEK, 2-BUTANONE)	ug/kg	ND@9	ND@10	ND@9	ND@9
METHYLENE CHLORIDE (DICHLOROMETHANE)	ug/kg	ND@4	ND@5	ND@5	ND@5
MIBK (4-METHYL-2-PENTANONE)	ug/kg	ND@9	ND@10	ND@9	ND@9
STYRENE	ug/kg	ND@4	ND@5	ND@5	ND@5
TETRACHLOROETHENE	ug/kg	ND@4	ND@5	ND@5	ND@5
TOLUENE	ug/kg	ND@4	ND@5	ND@5	ND@5
TRANS-1,2-DICHLOROETHENE	ug/kg	ND@4	ND@5	ND@5	1 J
TRANS-1,3-DICHLOROPROPENE	ug/kg	ND@4	ND@5	ND@5	ND@5
TRICHLOROETHENE	ug/kg	2 J	2 J	ND@5	ND@5
VINYL CHLORIDE	ug/kg	ND@4	ND@5	ND@5	3 J
XYLENES, TOTAL	ug/kg	ND@4	ND@5	ND@5	ND@5
MOISTURE	%	9.2	7.8	9.6	7.1

Soil Analytical Chemistry Data

P001 Remedial Alternatives Investigation, Owego, New York

April-May 2018

Sample Location		820	820	821	821
Sample Depth		05-06'	16-17'	10-11'	21-22'
Sample Date		04/20/2018	04/20/2018	04/24/2018	04/24/2018
Laboratory Sample I.D.		9570918	9570919	9575104	9575105
Parameter	**Units**				
1,1,1-TRICHLOROETHANE	ug/kg	ND@4	3 J	ND@5	ND@5
1,1,2,2-TETRACHLOROETHANE	ug/kg	ND@4	ND@5	ND@5	ND@5
1,1,2-TRICHLOROETHANE	ug/kg	ND@4	ND@5	ND@5	ND@5
1,1-DICHLOROETHANE	ug/kg	ND@4	ND@5	ND@5	ND@5
1,1-DICHLOROETHENE	ug/kg	ND@4	10	ND@5	ND@5
1,2-DICHLOROETHANE (EDC)	ug/kg	ND@4	ND@5	ND@5	ND@5
1,2-DICHLOROPROPANE	ug/kg	ND@4	ND@5	ND@5	ND@5
ACETONE	ug/kg	8 J	ND@20	39	10 J
BENZENE	ug/kg	ND@4	ND@5	ND@5	ND@5
BROMODICHLOROMETHANE	ug/kg	ND@4	ND@5	ND@5	ND@5
BROMOFORM (TRIBROMOMETHANE)	ug/kg	ND@4	ND@5	ND@5	ND@5
BROMOMETHANE	ug/kg	ND@4	ND@5	ND@5	ND@5
CARBON DISULFIDE	ug/kg	ND@4	ND@5	ND@5	ND@5
CARBON TETRACHLORIDE	ug/kg	ND@4	ND@5	ND@5	ND@5
CHLOROBENZENE	ug/kg	ND@4	ND@5	ND@5	ND@5
CHLORODIBROMOMETHANE	ug/kg	ND@4	ND@5	ND@5	ND@5
CHLOROETHANE	ug/kg	ND@4	ND@5	ND@5	ND@5
CHLOROFORM (TRICHLOROMETHANE)	ug/kg	ND@4	ND@5	ND@5	ND@5
CHLOROMETHANE	ug/kg	ND@4	ND@5	ND@5	ND@5
CIS-1,2-DICHLOROETHENE	ug/kg	ND@4	ND@5	ND@5	ND@5
CIS-1,3-DICHLOROPROPENE	ug/kg	ND@4	ND@5	ND@5	ND@5
ETHYLBENZENE	ug/kg	ND@4	ND@5	ND@5	ND@5
METHYL BUTYL KETONE (2-HEXANONE)	ug/kg	ND@9	ND@10	ND@11	ND@11
METHYL ETHYL KETONE (MEK, 2-BUTANONE)	ug/kg	4 J	7 J	7 J	ND@11
METHYLENE CHLORIDE (DICHLOROMETHANE)	ug/kg	ND@4	ND@5	ND@5	ND@5
MIBK (4-METHYL-2-PENTANONE)	ug/kg	ND@9	ND@10	ND@11	ND@11
STYRENE	ug/kg	ND@4	ND@5	ND@5	ND@5
TETRACHLOROETHENE	ug/kg	ND@4	ND@5	ND@5	ND@5
TOLUENE	ug/kg	ND@4	ND@5	ND@5	ND@5
TRANS-1,2-DICHLOROETHENE	ug/kg	ND@4	ND@5	ND@5	ND@5
TRANS-1,3-DICHLOROPROPENE	ug/kg	ND@4	ND@5	ND@5	ND@5
TRICHLOROETHENE	ug/kg	ND@4	34	ND@5	ND@5
VINYL CHLORIDE	ug/kg	ND@4	ND@5	ND@5	ND@5
XYLENES, TOTAL	ug/kg	ND@4	ND@5	ND@5	ND@5
MOISTURE	%	12	10.1	11.8	7.7

Soil Analytical Chemistry Data

P001 Remedial Alternatives Investigation, Owego, New York

April-May 2018

Sample Location		822	822	823	823
Sample Depth		10-11'	25-26'	09-10'	19-20'
Sample Date		04/24/2018	04/24/2018	04/26/2018	04/26/2018
Laboratory Sample I.D.		9575106	9575107	9581037	9581038
Parameter	**Units**				
1,1,1-TRICHLOROETHANE	ug/kg	ND@6	ND@5	ND@5	38
1,1,2,2-TETRACHLOROETHANE	ug/kg	ND@6	ND@5	ND@5	ND@5
1,1,2-TRICHLOROETHANE	ug/kg	ND@6	ND@5	ND@5	1 J
1,1-DICHLOROETHANE	ug/kg	ND@6	ND@5	ND@5	3 J
1,1-DICHLOROETHENE	ug/kg	ND@6	ND@5	ND@5	11
1,2-DICHLOROETHANE (EDC)	ug/kg	ND@6	ND@5	ND@5	ND@5
1,2-DICHLOROPROPANE	ug/kg	ND@6	ND@5	ND@5	ND@5
ACETONE	ug/kg	16 J	170	ND@19	ND@19
BENZENE	ug/kg	ND@6	8	ND@5	ND@5
BROMODICHLOROMETHANE	ug/kg	ND@6	ND@5	ND@5	ND@5
BROMOFORM (TRIBROMOMETHANE)	ug/kg	ND@6	ND@5	ND@5	ND@5
BROMOMETHANE	ug/kg	ND@6	ND@5	ND@5	ND@5
CARBON DISULFIDE	ug/kg	ND@6	2 J	ND@5	ND@5
CARBON TETRACHLORIDE	ug/kg	ND@6	ND@5	ND@5	ND@5
CHLOROBENZENE	ug/kg	ND@6	ND@5	ND@5	ND@5
CHLORODIBROMOMETHANE	ug/kg	ND@6	ND@5	ND@5	ND@5
CHLOROETHANE	ug/kg	ND@6	ND@5	ND@5	ND@5
CHLOROFORM (TRICHLOROMETHANE)	ug/kg	ND@6	ND@5	ND@5	ND@5
CHLOROMETHANE	ug/kg	ND@6	ND@5	ND@5	ND@5
CIS-1,2-DICHLOROETHENE	ug/kg	ND@6	ND@5	ND@5	5
CIS-1,3-DICHLOROPROPENE	ug/kg	ND@6	ND@5	ND@5	ND@5
ETHYLBENZENE	ug/kg	ND@6	11	ND@5	ND@5
METHYL BUTYL KETONE (2-HEXANONE)	ug/kg	ND@11	6 J	ND@10	ND@10
METHYL ETHYL KETONE (MEK, 2-BUTANONE)	ug/kg	8 J	68	ND@10	ND@10
METHYLENE CHLORIDE (DICHLOROMETHANE)	ug/kg	ND@6	ND@5	ND@5	ND@5
MIBK (4-METHYL-2-PENTANONE)	ug/kg	ND@11	ND@10	ND@10	ND@10
STYRENE	ug/kg	ND@6	ND@5	ND@5	ND@5
TETRACHLOROETHENE	ug/kg	ND@6	ND@5	ND@5	30
TOLUENE	ug/kg	ND@6	38	ND@5	1 J
TRANS-1,2-DICHLOROETHENE	ug/kg	ND@6	ND@5	ND@5	ND@5
TRANS-1,3-DICHLOROPROPENE	ug/kg	ND@6	ND@5	ND@5	ND@5
TRICHLOROETHENE	ug/kg	ND@6	ND@5	2 J	270
VINYL CHLORIDE	ug/kg	ND@6	ND@5	ND@5	ND@5
XYLENES, TOTAL	ug/kg	ND@6	29	ND@5	ND@5
MOISTURE	%	12.4	13.9	10.3	9.5

Soil Analytical Chemistry Data

P001 Remedial Alternatives Investigation, Owego, New York

April-May 2018

Sample Location		824	824	825	825
Sample Depth		09-10'	14-15'	09-10'	22-23'
Sample Date		05/01/2018	05/01/2018	05/01/2018	05/01/2018
Laboratory Sample I.D.		9588002	9588003	9590183	9590184
Parameter	**Units**				
1,1,1-TRICHLOROETHANE	ug/kg	ND@5	9	4 J	180 J
1,1,2,2-TETRACHLOROETHANE	ug/kg	ND@5	ND@5	ND@4	ND@240
1,1,2-TRICHLOROETHANE	ug/kg	ND@5	ND@5	ND@4	ND@240
1,1-DICHLOROETHANE	ug/kg	ND@5	44	3 J	590
1,1-DICHLOROETHENE	ug/kg	ND@5	30	1 J	2400
1,2-DICHLOROETHANE (EDC)	ug/kg	ND@5	ND@5	ND@4	ND@240
1,2-DICHLOROPROPANE	ug/kg	ND@5	ND@5	ND@4	ND@240
ACETONE	ug/kg	13 J	30	35	ND@950
BENZENE	ug/kg	ND@5	ND@5	ND@4	ND@240
BROMODICHLOROMETHANE	ug/kg	ND@5	ND@5	ND@4	ND@240
BROMOFORM (TRIBROMOMETHANE)	ug/kg	ND@5	ND@5	ND@4	ND@240
BROMOMETHANE	ug/kg	ND@5	ND@5	ND@4	ND@240
CARBON DISULFIDE	ug/kg	ND@5	ND@5	ND@4	ND@240
CARBON TETRACHLORIDE	ug/kg	ND@5	ND@5	ND@4	ND@240
CHLOROBENZENE	ug/kg	ND@5	ND@5	ND@4	ND@240
CHLORODIBROMOMETHANE	ug/kg	ND@5	ND@5	ND@4	ND@240
CHLOROETHANE	ug/kg	ND@5	ND@5	ND@4	ND@240
CHLOROFORM (TRICHLOROMETHANE)	ug/kg	ND@5	ND@5	ND@4	ND@240
CHLOROMETHANE	ug/kg	ND@5	ND@5	ND@4	ND@240
CIS-1,2-DICHLOROETHENE	ug/kg	ND@5	ND@5	13	460
CIS-1,3-DICHLOROPROPENE	ug/kg	ND@5	ND@5	ND@4	ND@240
ETHYLBENZENE	ug/kg	ND@5	ND@5	ND@4	ND@240
METHYL BUTYL KETONE (2-HEXANONE)	ug/kg	ND@10	ND@10	ND@9	ND@470
METHYL ETHYL KETONE (MEK, 2-BUTANONE)	ug/kg	ND@10	ND@10	ND@9	ND@470
METHYLENE CHLORIDE (DICHLOROMETHANE)	ug/kg	ND@5	ND@5	ND@4	ND@240
MIBK (4-METHYL-2-PENTANONE)	ug/kg	ND@10	ND@10	ND@9	ND@470
STYRENE	ug/kg	ND@5	ND@5	ND@4	ND@240
TETRACHLOROETHENE	ug/kg	ND@5	ND@5	ND@4	ND@240
TOLUENE	ug/kg	ND@5	ND@5	ND@4	ND@240
TRANS-1,2-DICHLOROETHENE	ug/kg	ND@5	ND@5	ND@4	ND@240
TRANS-1,3-DICHLOROPROPENE	ug/kg	ND@5	ND@5	ND@4	ND@240
TRICHLOROETHENE	ug/kg	ND@5	13	50	5600
VINYL CHLORIDE	ug/kg	ND@5	ND@5	ND@4	ND@240
XYLENES, TOTAL	ug/kg	ND@5	ND@5	ND@4	ND@240
MOISTURE	%	11.4	4.5	9.1	6.4

Soil Analytical Chemistry Data

P001 Remedial Alternatives Investigation, Owego, New York

April-May 2018

Sample Location		826	826	827	827
Sample Depth		09-10'	54-55'	24-25'	54-55'
Sample Date		05/02/2018	05/02/2018	05/02/2018	05/02/2018
Laboratory Sample I.D.		9590185	9590186	9590187	9592827
Parameter	**Units**				
1,1,1-TRICHLOROETHANE	ug/kg	ND@5	29	ND@6	8
1,1,2,2-TETRACHLOROETHANE	ug/kg	ND@5	ND@5	ND@6	ND@5
1,1,2-TRICHLOROETHANE	ug/kg	ND@5	ND@5	ND@6	ND@5
1,1-DICHLOROETHANE	ug/kg	ND@5	13	ND@6	8
1,1-DICHLOROETHENE	ug/kg	ND@5	11	ND@6	7
1,2-DICHLOROETHANE (EDC)	ug/kg	ND@5	ND@5	ND@6	ND@5
1,2-DICHLOROPROPANE	ug/kg	ND@5	ND@5	ND@6	ND@5
ACETONE	ug/kg	37	8 J	29	10 J
BENZENE	ug/kg	ND@5	ND@5	ND@6	ND@5
BROMODICHLOROMETHANE	ug/kg	ND@5	ND@5	ND@6	ND@5
BROMOFORM (TRIBROMOMETHANE)	ug/kg	ND@5	ND@5	ND@6	ND@5
BROMOMETHANE	ug/kg	ND@5	ND@5	ND@6	ND@5
CARBON DISULFIDE	ug/kg	ND@5	ND@5	ND@6	ND@5
CARBON TETRACHLORIDE	ug/kg	ND@5	ND@5	ND@6	ND@5
CHLOROBENZENE	ug/kg	ND@5	ND@5	ND@6	ND@5
CHLORODIBROMOMETHANE	ug/kg	ND@5	ND@5	ND@6	ND@5
CHLOROETHANE	ug/kg	ND@5	ND@5	ND@6	ND@5
CHLOROFORM (TRICHLOROMETHANE)	ug/kg	ND@5	ND@5	ND@6	ND@5
CHLOROMETHANE	ug/kg	ND@5	ND@5	ND@6	ND@5
CIS-1,2-DICHLOROETHENE	ug/kg	ND@5	11	ND@6	5
CIS-1,3-DICHLOROPROPENE	ug/kg	ND@5	ND@5	ND@6	ND@5
ETHYLBENZENE	ug/kg	ND@5	ND@5	ND@6	ND@5
METHYL BUTYL KETONE (2-HEXANONE)	ug/kg	ND@9	ND@9	ND@13	ND@9
METHYL ETHYL KETONE (MEK, 2-BUTANONE)	ug/kg	4 J	ND@9	8 J	ND@9
METHYLENE CHLORIDE (DICHLOROMETHANE)	ug/kg	ND@5	ND@5	ND@6	ND@5
MIBK (4-METHYL-2-PENTANONE)	ug/kg	ND@9	ND@9	ND@13	ND@9
STYRENE	ug/kg	ND@5	ND@5	ND@6	ND@5
TETRACHLOROETHENE	ug/kg	ND@5	ND@5	ND@6	ND@5
TOLUENE	ug/kg	ND@5	ND@5	ND@6	ND@5
TRANS-1,2-DICHLOROETHENE	ug/kg	ND@5	ND@5	ND@6	ND@5
TRANS-1,3-DICHLOROPROPENE	ug/kg	ND@5	ND@5	ND@6	ND@5
TRICHLOROETHENE	ug/kg	ND@5	1300	ND@6	44
VINYL CHLORIDE	ug/kg	ND@5	ND@5	ND@6	ND@5
XYLENES, TOTAL	ug/kg	ND@5	ND@5	ND@6	ND@5
MOISTURE	%	11	9.1	26.1	5.6

Soil Analytical Chemistry Data

P001 Remedial Alternatives Investigation, Owego, New York

April-May 2018

Sample Location		828	828
Sample Depth		19-20'	25-26'
Sample Date		05/03/2018	05/03/2018
Laboratory Sample I.D.		9592828	9592829
Parameter	**Units**		
1,1,1-TRICHLOROETHANE	ug/kg	ND@5	ND@5
1,1,2,2-TETRACHLOROETHANE	ug/kg	ND@5	ND@5
1,1,2-TRICHLOROETHANE	ug/kg	ND@5	ND@5
1,1-DICHLOROETHANE	ug/kg	ND@5	ND@5
1,1-DICHLOROETHENE	ug/kg	ND@5	ND@5
1,2-DICHLOROETHANE (EDC)	ug/kg	ND@5	ND@5
1,2-DICHLOROPROPANE	ug/kg	ND@5	ND@5
ACETONE	ug/kg	16 J	19 J
BENZENE	ug/kg	ND@5	ND@5
BROMODICHLOROMETHANE	ug/kg	ND@5	ND@5
BROMOFORM (TRIBROMOMETHANE)	ug/kg	ND@5	ND@5
BROMOMETHANE	ug/kg	ND@5	ND@5
CARBON DISULFIDE	ug/kg	ND@5	ND@5
CARBON TETRACHLORIDE	ug/kg	ND@5	ND@5
CHLOROBENZENE	ug/kg	ND@5	ND@5
CHLORODIBROMOMETHANE	ug/kg	ND@5	ND@5
CHLOROETHANE	ug/kg	ND@5	ND@5
CHLOROFORM (TRICHLOROMETHANE)	ug/kg	ND@5	ND@5
CHLOROMETHANE	ug/kg	ND@5	ND@5
CIS-1,2-DICHLOROETHENE	ug/kg	ND@5	ND@5
CIS-1,3-DICHLOROPROPENE	ug/kg	ND@5	ND@5
ETHYLBENZENE	ug/kg	ND@5	ND@5
METHYL BUTYL KETONE (2-HEXANONE)	ug/kg	ND@10	ND@10
METHYL ETHYL KETONE (MEK, 2-BUTANONE)	ug/kg	ND@10	ND@10
METHYLENE CHLORIDE (DICHLOROMETHANE)	ug/kg	ND@5	ND@5
MIBK (4-METHYL-2-PENTANONE)	ug/kg	ND@10	ND@10
STYRENE	ug/kg	ND@5	ND@5
TETRACHLOROETHENE	ug/kg	ND@5	ND@5
TOLUENE	ug/kg	ND@5	ND@5
TRANS-1,2-DICHLOROETHENE	ug/kg	ND@5	ND@5
TRANS-1,3-DICHLOROPROPENE	ug/kg	ND@5	ND@5
TRICHLOROETHENE	ug/kg	ND@5	ND@5
VINYL CHLORIDE	ug/kg	ND@5	ND@5
XYLENES, TOTAL	ug/kg	ND@5	ND@5
MOISTURE	%	12.7	8.8

Soil Analytical Chemistry Data
P001 Remedial Alternatives Investigation, Owego, New York
April-May 2018

Explanation of Reporting Conventions and Key to Comment Codes

Reporting Conventions

NA	Not Analyzed
ND@X	Not Detected at Detection Limit X

Code	**Explanation**
J	Estimated value

APPENDIX E

Groundwater Analytical Chemistry Data

Groundwater Analytical Chemistry Data
Volatile Organic Compounds
Owego, New York

Sample Location		128	378	379	393	394	395
Sample Description		GROUNDWATER	GROUNDWATER	GROUNDWATER	GROUNDWATER	GROUNDWATER	GROUNDWATER
Sample Date		05/14/18	05/15/18	05/16/18	05/14/18	05/16/18	05/16/18
Laboratory Sample I.D.		9608732	9611699	9614229	9608733	9614230	9614226
Parameter	Units						
Volatile Organics							
1,1,1-TRICHLOROETHANE	ug/L	1600	340	7.8	720	12	920
1,1,2-TRICHLORO-1,2,2-TRIFLUOROETHANE	ug/L	39	41	0.6	74	0.6	100
1,1,2-TRICHLOROETHANE	ug/L	10 J	ND@5	ND@0.5	ND@10	ND@0.5	ND@13
1,1-DICHLOROETHANE	ug/L	340	570	6.7	970	4.3	1000
1,1-DICHLOROETHENE	ug/L	730	50	1.5	91	3.2	91
1,2-DICHLORO-1,2,2-TRIFLUOROETHANE	ug/L	ND@25	11	ND@0.5	17	0.2 J	19
1,2-DICHLOROETHANE (EDC)	ug/L	5.9 J	ND@5	ND@0.5	ND@10	ND@0.5	ND@13
CHLOROETHANE	ug/L	ND@25	ND@5	ND@0.5	ND@10	ND@0.5	ND@13
CHLOROFORM (TRICHLOROMETHANE)	ug/L	ND@25	ND@5	ND@0.5	ND@10	ND@0.5	ND@13
CIS-1,2-DICHLOROETHENE	ug/L	670	72	1.4	140	2.4	130
DICHLORODIFLUOROMETHANE (FREON 12)	ug/L	ND@25	ND@5	ND@0.5	ND@10	ND@0.5	ND@13
METHYLENE CHLORIDE (DICHLOROMETHANE)	ug/L	ND@25	ND@5	ND@0.5	ND@10	ND@0.5	ND@13
TETRACHLOROETHENE	ug/L	ND@25	ND@5	ND@0.5	ND@10	ND@0.5	ND@13
TRICHLOROETHENE	ug/L	440	80	9	190	18	190
TRICHLOROFLUOROMETHANE (FREON 11)	ug/L	ND@25	ND@5	ND@0.5	ND@10	ND@0.5	ND@13
VINYL CHLORIDE	ug/L	34	8.2	ND@0.5	15	0.1 J	12 J

Groundwater Analytical Chemistry Data
Volatile Organic Compounds
Owego, New York

Sample Location		397	398	521	522	529	608
Sample Description		GROUNDWATER	GROUNDWATER	GROUNDWATER	GROUNDWATER	GROUNDWATER	GROUNDWATER
Sample Date		05/15/18	05/17/18	05/15/18	05/15/18	05/17/18	05/16/18
Laboratory Sample I.D.		9611696	9616463	9611694	9611695	9616462	9614231
Parameter	Units						
Volatile Organics							
1,1,1-TRICHLOROETHANE	ug/L	1.9	2.7	140	210	0.4 J	4.8
1,1,2-TRICHLORO-1,2,2-TRIFLUOROETHANE	ug/L	ND@0.5	ND@0.5	15	24	ND@0.5	0.3 J
1,1,2-TRICHLOROETHANE	ug/L	ND@0.5	ND@0.5	ND@2.5	ND@5	ND@0.5	ND@0.5
1,1-DICHLOROETHANE	ug/L	0.9	2	620	570	0.2 J	5.5
1,1-DICHLOROETHENE	ug/L	0.6	1.3	40	41	0.1 J	3
1,2-DICHLORO-1,2,2-TRIFLUOROETHANE	ug/L	ND@0.5	ND@0.5	10	10	ND@0.5	0.3 J
1,2-DICHLOROETHANE (EDC)	ug/L	ND@0.5	ND@0.5	ND@2.5	ND@5	ND@0.5	ND@0.5
CHLOROETHANE	ug/L	ND@0.5	ND@0.5	2.2 J	1.1 J	ND@0.5	ND@0.5
CHLOROFORM (TRICHLOROMETHANE)	ug/L	ND@0.5	ND@0.5	ND@2.5	ND@5	ND@0.5	ND@0.5
CIS-1,2-DICHLOROETHENE	ug/L	0.3 J	0.7	47	53	0.1 J	2.1
DICHLORODIFLUOROMETHANE (FREON 12)	ug/L	ND@0.5	ND@0.5	ND@2.5	ND@5	ND@0.5	ND@0.5
METHYLENE CHLORIDE (DICHLOROMETHANE)	ug/L	ND@0.5	ND@0.5	ND@2.5	ND@5	ND@0.5	ND@0.5
TETRACHLOROETHENE	ug/L	0.3 J	ND@0.5	ND@2.5	ND@5	ND@0.5	ND@0.5
TRICHLOROETHENE	ug/L	2.5	3.9	9.4	31	0.8	24
TRICHLOROFLUOROMETHANE (FREON 11)	ug/L	ND@0.5	ND@0.5	ND@2.5	ND@5	ND@0.5	ND@0.5
VINYL CHLORIDE	ug/L	ND@0.5	ND@0.5	14	8.9	ND@0.5	0.2 J

Groundwater Analytical Chemistry Data
Volatile Organic Compounds
Owego, New York

Sample Location		610	612	613	700	700	701
Sample Description		GROUNDWATER	GROUNDWATER	GROUNDWATER	GROUNDWATER	GROUNDWATER	GROUNDWATER
Sample Date		05/15/18	05/16/18	05/17/18	04/25/18	05/15/18	04/25/18
Laboratory Sample I.D.		9611698	9614227	9616464	9584037	9611697	9584036
Parameter	Units						
Volatile Organics							
1,1,1-TRICHLOROETHANE	ug/L	170	180	110	490	560	530
1,1,2-TRICHLORO-1,2,2-TRIFLUOROETHANE	ug/L	4.8	4.5 J	2.3 J	57	70	61
1,1,2-TRICHLOROETHANE	ug/L	1.6 J	1.5 J	1 J	ND@10	ND@13	ND@10
1,1-DICHLOROETHANE	ug/L	53	87	41	660	810	820
1,1-DICHLOROETHENE	ug/L	70	73	40	58	73	70
1,2-DICHLORO-1,2,2-TRIFLUOROETHANE	ug/L	ND@2.5	ND@5	ND@2.5	12	16	15
1,2-DICHLOROETHANE (EDC)	ug/L	0.6 J	1.9 J	0.9 J	ND@10	ND@13	ND@10
CHLOROETHANE	ug/L	ND@2.5	1.2 J	0.9 J	ND@10	ND@13	ND@10
CHLOROFORM (TRICHLOROMETHANE)	ug/L	0.7 J	ND@5	ND@2.5	ND@10	ND@13	ND@10
CIS-1,2-DICHLOROETHENE	ug/L	51	100	52	85	110	99
DICHLORODIFLUOROMETHANE (FREON 12)	ug/L	ND@2.5	ND@5	ND@2.5	ND@10	ND@13	ND@10
METHYLENE CHLORIDE (DICHLOROMETHANE)	ug/L	2.9	6.6	1.9 J	ND@10	ND@13	ND@10
TETRACHLOROETHENE	ug/L	14	2.2 J	5.9	ND@10	ND@13	ND@10
TRICHLOROETHENE	ug/L	240	470	240	110	140	120
TRICHLOROFLUOROMETHANE (FREON 11)	ug/L	ND@2.5	ND@5	ND@2.5	ND@10	ND@13	ND@10
VINYL CHLORIDE	ug/L	0.5 J	5.5	3	11	12 J	13

Groundwater Analytical Chemistry Data
Volatile Organic Compounds
Owego, New York

Sample Location		701	B-800	B-800	B-801	B-802	B-803
Sample Description		GROUNDWATER	GROUNDWATER	REPLICATE	GROUNDWATER	GROUNDWATER	GROUNDWATER
Sample Date		05/16/18	04/26/18	04/26/18	04/26/18	04/26/18	04/25/18
Laboratory Sample I.D.		9614225	9584041	9584040	9584042	9584043	9584038
Parameter	**Units**						
Volatile Organics							
1,1,1-TRICHLOROETHANE	ug/L	580	4400	4200	2100	1100	0.3 J
1,1,2-TRICHLORO-1,2,2-TRIFLUOROETHANE	ug/L	63	450	450	200	100	ND@0.5
1,1,2-TRICHLOROETHANE	ug/L	ND@10	ND@50	ND@50	ND@25	ND@13	ND@0.5
1,1-DICHLOROETHANE	ug/L	890	2200	2200	880	790	0.2 J
1,1-DICHLOROETHENE	ug/L	76	95	100	18 J	55	ND@0.5
1,2-DICHLORO-1,2,2-TRIFLUOROETHANE	ug/L	15	44 J	46 J	26	14	ND@0.5
1,2-DICHLOROETHANE (EDC)	ug/L	ND@10	ND@50	ND@50	ND@25	ND@13	ND@0.5
CHLOROETHANE	ug/L	ND@10	ND@50	ND@50	ND@25	ND@13	ND@0.5
CHLOROFORM (TRICHLOROMETHANE)	ug/L	ND@10	ND@50	ND@50	ND@25	ND@13	ND@0.5
CIS-1,2-DICHLOROETHENE	ug/L	120	90	90	23 J	76	ND@0.5
DICHLORODIFLUOROMETHANE (FREON 12)	ug/L	ND@10	ND@50	ND@50	ND@25	ND@13	ND@0.5
METHYLENE CHLORIDE (DICHLOROMETHANE)	ug/L	ND@10	ND@50	ND@50	ND@25	ND@13	ND@0.5
TETRACHLOROETHENE	ug/L	ND@10	ND@50	ND@50	ND@25	ND@13	ND@0.5
TRICHLOROETHENE	ug/L	130	100	100	25 J	140	0.1 J
TRICHLOROFLUOROMETHANE (FREON 11)	ug/L	ND@10	ND@50	ND@50	ND@25	ND@13	ND@0.5
VINYL CHLORIDE	ug/L	12	11 J	11 J	ND@25	7.2 J	ND@0.5

Groundwater Analytical Chemistry Data
Volatile Organic Compounds
Owego, New York

Sample Location		B-804	B-805	B-805	B-806	B-807	B-808
Sample Description		GROUNDWATER	GROUNDWATER	REPLICATE	GROUNDWATER	GROUNDWATER	GROUNDWATER
Sample Date		04/30/18	05/01/18	05/01/18	05/02/18	04/27/18	04/27/18
Laboratory Sample I.D.		9593754	9593755	9593756	9593761	9584046	9584044
Parameter	Units						
Volatile Organics							
1,1,1-TRICHLOROETHANE	ug/L	870	120	120	1.8	37	1.1
1,1,2-TRICHLORO-1,2,2-TRIFLUOROETHANE	ug/L	93	ND@5	ND@5	ND@0.5	5.9	ND@0.5
1,1,2-TRICHLOROETHANE	ug/L	ND@10	1.4 J	1.1 J	ND@0.5	0.3 J	ND@0.5
1,1-DICHLOROETHANE	ug/L	1500	93	94	42	180	0.4 J
1,1-DICHLOROETHENE	ug/L	240	51	51	11	57	ND@0.5
1,2-DICHLORO-1,2,2-TRIFLUOROETHANE	ug/L	28	ND@5	ND@5	ND@0.5	2.3	ND@0.5
1,2-DICHLOROETHANE (EDC)	ug/L	ND@10	1.8 J	2 J	0.3 J	0.7	ND@0.5
CHLOROETHANE	ug/L	5.9 J	3.4 J	3.6 J	15	6.2	ND@0.5
CHLOROFORM (TRICHLOROMETHANE)	ug/L	ND@10	ND@5	ND@5	ND@0.5	ND@0.5	ND@0.5
CIS-1,2-DICHLOROETHENE	ug/L	160	91	91	12	48	ND@0.5
DICHLORODIFLUOROMETHANE (FREON 12)	ug/L	ND@10	ND@5	ND@5	ND@0.5	ND@0.5	ND@0.5
METHYLENE CHLORIDE (DICHLOROMETHANE)	ug/L	ND@10	ND@5	ND@5	2.2	0.4 J	ND@0.5
TETRACHLOROETHENE	ug/L	ND@10	ND@5	ND@5	ND@0.5	ND@0.5	ND@0.5
TRICHLOROETHENE	ug/L	200	350	350	6.7	66	0.2 J
TRICHLOROFLUOROMETHANE (FREON 11)	ug/L	ND@10	ND@5	ND@5	ND@0.5	ND@0.5	ND@0.5
VINYL CHLORIDE	ug/L	28	7	6.9	3.8	11	ND@0.5

Groundwater Analytical Chemistry Data
Volatile Organic Compounds
Owego, New York

Sample Location		B-809	B-810	B-811	B-812	B-813	B-814
Sample Description		GROUNDWATER	GROUNDWATER	GROUNDWATER	GROUNDWATER	GROUNDWATER	GROUNDWATER
Sample Date		05/02/18	05/02/18	05/02/18	05/02/18	05/02/18	05/02/18
Laboratory Sample I.D.		9593766	9593765	9593769	9593770	9593771	9593759
Parameter	**Units**						
Volatile Organics							
1,1,1-TRICHLOROETHANE	ug/L	ND@0.5	ND@0.5	ND@0.5	48	ND@10	91
1,1,2-TRICHLORO-1,2,2-TRIFLUOROETHANE	ug/L	ND@0.5	ND@0.5	ND@0.5	1	ND@10	ND@25
1,1,2-TRICHLOROETHANE	ug/L	ND@0.5	ND@0.5	ND@0.5	0.5	ND@10	ND@25
1,1-DICHLOROETHANE	ug/L	ND@0.5	0.3 J	ND@0.5	14	700	850
1,1-DICHLOROETHENE	ug/L	ND@0.5	0.7	0.3 J	21	71	230
1,2-DICHLORO-1,2,2-TRIFLUOROETHANE	ug/L	ND@0.5	ND@0.5	ND@0.5	ND@0.5	5.8 J	ND@25
1,2-DICHLOROETHANE (EDC)	ug/L	ND@0.5	ND@0.5	ND@0.5	0.3 J	ND@10	ND@25
CHLOROETHANE	ug/L	ND@0.5	ND@0.5	ND@0.5	ND@0.5	8.4 J	ND@25
CHLOROFORM (TRICHLOROMETHANE)	ug/L	ND@0.5	ND@0.5	ND@0.5	0.2 J	ND@10	ND@25
CIS-1,2-DICHLOROETHENE	ug/L	ND@0.5	ND@0.5	ND@0.5	2.4	440	1300
DICHLORODIFLUOROMETHANE (FREON 12)	ug/L	ND@0.5	ND@0.5	ND@0.5	ND@0.5	ND@10	ND@25
METHYLENE CHLORIDE (DICHLOROMETHANE)	ug/L	ND@0.5	ND@0.5	ND@0.5	0.9	ND@10	ND@25
TETRACHLOROETHENE	ug/L	ND@0.5	ND@0.5	ND@0.5	ND@0.5	ND@10	ND@25
TRICHLOROETHENE	ug/L	0.2 J	0.2 J	ND@0.5	5.9	ND@10	19 J
TRICHLOROFLUOROMETHANE (FREON 11)	ug/L	ND@0.5	ND@0.5	ND@0.5	ND@0.5	ND@10	ND@25
VINYL CHLORIDE	ug/L	ND@0.5	ND@0.5	ND@0.5	0.3 J	19	15 J

Groundwater Analytical Chemistry Data
Volatile Organic Compounds
Owego, New York

Sample Location		B-814	B-815	B-816	B-817	B-818	B-819
Sample Description		REPLICATE	GROUNDWATER	GROUNDWATER	GROUNDWATER	GROUNDWATER	GROUNDWATER
Sample Date		05/02/18	05/08/18	05/07/18	05/02/18	05/02/18	05/02/18
Laboratory Sample I.D.		9593760	9606881	9606879	9593767	9593768	9593773
Parameter	Units						
Volatile Organics							
1,1,1-TRICHLOROETHANE	ug/L	96	500	2000	36	7.8	3.3
1,1,2-TRICHLORO-1,2,2-TRIFLUOROETHANE	ug/L	ND@25	ND@10	ND@25	6.3	ND@0.5	0.3 J
1,1,2-TRICHLOROETHANE	ug/L	ND@25	ND@10	ND@25	ND@2.5	ND@0.5	0.5
1,1-DICHLOROETHANE	ug/L	910	390	810	360	1	130
1,1-DICHLOROETHENE	ug/L	240	170	320	1900	3	25
1,2-DICHLORO-1,2,2-TRIFLUOROETHANE	ug/L	ND@25	ND@10	ND@25	1.2 J	ND@0.5	0.9
1,2-DICHLOROETHANE (EDC)	ug/L	ND@25	ND@10	ND@25	7.1	ND@0.5	0.7
CHLOROETHANE	ug/L	ND@25	ND@10	ND@25	0.7 J	ND@0.5	0.4 J
CHLOROFORM (TRICHLOROMETHANE)	ug/L	ND@25	ND@10	ND@25	0.7 J	ND@0.5	ND@0.5
CIS-1,2-DICHLOROETHENE	ug/L	1600	360	200	120	0.2 J	120
DICHLORODIFLUOROMETHANE (FREON 12)	ug/L	ND@25	ND@10	ND@25	ND@2.5	ND@0.5	ND@0.5
METHYLENE CHLORIDE (DICHLOROMETHANE)	ug/L	ND@25	ND@10	ND@25	ND@2.5	ND@0.5	ND@0.5
TETRACHLOROETHENE	ug/L	ND@25	ND@10	ND@25	ND@2.5	ND@0.5	ND@0.5
TRICHLOROETHENE	ug/L	18 J	170	1700	160	0.2 J	0.7
TRICHLOROFLUOROMETHANE (FREON 11)	ug/L	ND@25	ND@10	ND@25	ND@2.5	ND@0.5	ND@0.5
VINYL CHLORIDE	ug/L	16 J	5.5 J	7.6 J	21	ND@0.5	2.3

Groundwater Analytical Chemistry Data
Volatile Organic Compounds
Owego, New York

Sample Location		B-820	B-821	B-822	B-823	B-824	B-825
Sample Description		GROUNDWATER	GROUNDWATER	GROUNDWATER	GROUNDWATER	GROUNDWATER	GROUNDWATER
Sample Date		05/02/18	05/02/18	05/02/18	05/02/18	05/08/18	05/08/18
Laboratory Sample I.D.		9593764	9593763	9593762	9593772	9606884	9606883
Parameter	**Units**						
Volatile Organics							
1,1,1-TRICHLOROETHANE	ug/L	ND@0.5	ND@0.5	ND@0.5	1.3	320	400
1,1,2-TRICHLORO-1,2,2-TRIFLUOROETHANE	ug/L	ND@0.5	ND@0.5	ND@0.5	ND@0.5	ND@5	ND@50
1,1,2-TRICHLOROETHANE	ug/L	ND@0.5	ND@0.5	ND@0.5	ND@0.5	ND@5	ND@50
1,1-DICHLOROETHANE	ug/L	ND@0.5	ND@0.5	0.1 J	7.2	210	1200
1,1-DICHLOROETHENE	ug/L	ND@0.5	ND@0.5	ND@0.5	2.4	180	1800
1,2-DICHLORO-1,2,2-TRIFLUOROETHANE	ug/L	ND@0.5	ND@0.5	ND@0.5	ND@0.5	ND@5	ND@50
1,2-DICHLOROETHANE (EDC)	ug/L	ND@0.5	ND@0.5	ND@0.5	ND@0.5	ND@5	ND@50
CHLOROETHANE	ug/L	ND@0.5	ND@0.5	ND@0.5	0.1 J	ND@5	ND@50
CHLOROFORM (TRICHLOROMETHANE)	ug/L	ND@0.5	ND@0.5	ND@0.5	ND@0.5	ND@5	ND@50
CIS-1,2-DICHLOROETHENE	ug/L	ND@0.5	ND@0.5	ND@0.5	3.2	50	860
DICHLORODIFLUOROMETHANE (FREON 12)	ug/L	ND@0.5	ND@0.5	ND@0.5	ND@0.5	ND@5	ND@50
METHYLENE CHLORIDE (DICHLOROMETHANE)	ug/L	ND@0.5	ND@0.5	ND@0.5	ND@0.5	3 J	100
TETRACHLOROETHENE	ug/L	ND@0.5	ND@0.5	ND@0.5	ND@0.5	ND@5	ND@50
TRICHLOROETHENE	ug/L	ND@0.5	ND@0.5	ND@0.5	2.8	400	5700
TRICHLOROFLUOROMETHANE (FREON 11)	ug/L	ND@0.5	ND@0.5	ND@0.5	ND@0.5	ND@5	ND@50
VINYL CHLORIDE	ug/L	ND@0.5	ND@0.5	ND@0.5	0.4 J	3.5 J	210

Groundwater Analytical Chemistry Data
Volatile Organic Compounds
Owego, New York

Sample Location		B-826	B-827	B-828
Sample Description		GROUNDWATER	GROUNDWATER	GROUNDWATER
Sample Date		05/09/18	05/09/18	05/08/18
Laboratory Sample I.D.		9606885	9606886	9606882
Parameter	**Units**			
Volatile Organics				
1,1,1-TRICHLOROETHANE	ug/L	190	50	0.2 J
1,1,2-TRICHLORO-1,2,2-TRIFLUOROETHANE	ug/L	17	ND@0.5	ND@0.5
1,1,2-TRICHLOROETHANE	ug/L	ND@5	0.1 J	ND@0.5
1,1-DICHLOROETHANE	ug/L	600	30	ND@0.5
1,1-DICHLOROETHENE	ug/L	75	20	ND@0.5
1,2-DICHLORO-1,2,2-TRIFLUOROETHANE	ug/L	9	ND@0.5	ND@0.5
1,2-DICHLOROETHANE (EDC)	ug/L	ND@5	0.2 J	ND@0.5
CHLOROETHANE	ug/L	7.7	19	ND@0.5
CHLOROFORM (TRICHLOROMETHANE)	ug/L	ND@5	0.2 J	ND@0.5
CIS-1,2-DICHLOROETHENE	ug/L	55	16	ND@0.5
DICHLORODIFLUOROMETHANE (FREON 12)	ug/L	ND@5	ND@0.5	ND@0.5
METHYLENE CHLORIDE (DICHLOROMETHANE)	ug/L	ND@5	1.7	ND@0.5
TETRACHLOROETHENE	ug/L	ND@5	ND@0.5	ND@0.5
TRICHLOROETHENE	ug/L	57	44	ND@0.5
TRICHLOROFLUOROMETHANE (FREON 11)	ug/L	ND@5	ND@0.5	ND@0.5
VINYL CHLORIDE	ug/L	8.9	4.1	ND@0.5

Groundwater Analytical Chemistry Data
Indicator Parameters, Inorganics, and Metals
Owego, New York

Sample Location		128	378	379	393	394	395
Sample Description		GROUNDWATER	GROUNDWATER	GROUNDWATER	GROUNDWATER	GROUNDWATER	GROUNDWATER
Sample Date		05/14/2018	05/15/2018	05/16/2018	05/14/2018	05/16/2018	05/16/2018
Laboratory Sample I.D.		9608732	9611699	9614229	9608733	9614230	9614226
Parameter	**Units**						
Indicator Parameters							
DISSOLVED ORGANIC CARBON	mg/L	1.1	0.81 J	0.9 J	0.76 J	3.1	0.75 J
DISSOLVED OXYGEN	mg/L	0.94	0.03	0.27	0.16	0.11	0
ETHANE	ug/L	ND@5.0	0.42 J	0.2 J	0.68 J	0.23 J	0.72 J
ETHENE	ug/L	1.3 J	2 J	ND@5	3.8 J	ND@5	2.7 J
FREE CARBON DIOXIDE	ug/L	31000	78000	89000	53000	240000	48000
METHANE	ug/L	ND@5.0	88	27	150	90	130
OXIDATION-REDUCTION POTENTIAL	mV	216.8	-42.8	-11.4	-82.9	45.5	-58.9
PH	SU	6.27	6.63	6.54	6.74	6.43	6.89
SPECIFIC CONDUCTANCE	umhos/cm	6475	2794	2198	3059	3574	2793
TEMPERATURE	C	16.8	13.1	12.8	16.7	12.9	12.4
TURBIDITY	NTU	17.8	31.8	14.37	0.67	6316	>1000
Inorganics							
ALKALINITY, TOTAL	mg/L	82.5	177	259	164	448	159
CHLORIDE	mg/L	1980	849	518	1200	872	822
NITRATE-NITROGEN	mg/L	5	ND@0.5	ND@0.5	ND@2.0	ND@0.5	ND@0.5
SULFATE	mg/L	112	21.8	18.2	27.2	10.8	21.1
SULFIDE, TOTAL	mg/L	ND@2.0	ND@2	ND@4	ND@2.0	ND@4	ND@4
Metals							
IRON, DISSOLVED	mg/L	ND@0.400	8.18	4.54	4.4	0.458	4.66
IRON, FERRIC	mg/L	ND@0.40	ND@2.5	ND@5	ND@1.3	ND@5	ND@5
IRON, FERROUS	mg/L	ND@0.050	8.6	11.6	4	13.1	24.7
MANGANESE, DISSOLVED	mg/L	2.73	2.8	4.6	2.93	4.91	2.91
SODIUM, DISSOLVED	mg/L	1080	278	165	330	212	342

Groundwater Analytical Chemistry Data
Indicator Parameters, Inorganics, and Metals
Owego, New York

Sample Location		397	398	521	522	529	608
Sample Description		GROUNDWATER	GROUNDWATER	GROUNDWATER	GROUNDWATER	GROUNDWATER	GROUNDWATER
Sample Date		05/15/2018	05/17/2018	05/15/2018	05/15/2018	05/17/2018	05/16/2018
Laboratory Sample I.D.		9611696	9616463	9611694	9611695	9616462	9614231
Parameter	**Units**						
Indicator Parameters							
DISSOLVED ORGANIC CARBON	mg/L	ND@1	1.3	0.84 J	0.66 J	0.66 J	1.4
DISSOLVED OXYGEN	mg/L	0.09	6.48	0.07	0.68	0.2	0.16
ETHANE	ug/L	ND@5	ND@5	0.57 J	0.52 J	ND@5	ND@5
ETHENE	ug/L	ND@5	0.23 J	3.3 J	2.8 J	0.39 J	ND@5
FREE CARBON DIOXIDE	ug/L	4000 J	56000	39000	48000	26000	65000
METHANE	ug/L	20	6.2	140	130	60	63
OXIDATION-REDUCTION POTENTIAL	mV	-98.7	167.3	-62.3	-23.7	-61.9	-17.4
PH	SU	7.84	6.41	6.94	6.81	7	6.78
SPECIFIC CONDUCTANCE	umhos/cm	725	441	3172	3034	1920	2293
TEMPERATURE	C	10.3	8.1	12.8	12.2	11.8	9.6
TURBIDITY	NTU	202.6	8.3	14.3	88.6	1.19	15.2
Inorganics							
ALKALINITY, TOTAL	mg/L	81.7	66.5	176	183	115	199
CHLORIDE	mg/L	160	84.3	937	1670	539	615
NITRATE-NITROGEN	mg/L	ND@0.5	ND@0.5	ND@0.5	ND@0.5	ND@0.5	ND@0.5
SULFATE	mg/L	7.9	8.2	17.8	17.2	9.3	10.1
SULFIDE, TOTAL	mg/L	ND@2	ND@2	ND@2	ND@2	ND@2	ND@2
Metals							
IRON, DISSOLVED	mg/L	0.185 J	ND@0.4	3.28	2.7	0.403	0.221 J
IRON, FERRIC	mg/L	ND@0.4	ND@0.4	ND@0.5	ND@0.5	ND@0.4	ND@0.4
IRON, FERROUS	mg/L	2.4	0.046 J	3.4	3.2	0.45	0.76
MANGANESE, DISSOLVED	mg/L	0.375	0.0603	2.17	1.84	2.05	0.521
SODIUM, DISSOLVED	mg/L	12.4	44.4	306	278	83.1	161

Groundwater Analytical Chemistry Data
Indicator Parameters, Inorganics, and Metals
Owego, New York

Sample Location		610	612	613	700	701
Sample Description		GROUNDWATER	GROUNDWATER	GROUNDWATER	GROUNDWATER	GROUNDWATER
Sample Date		05/15/2018	05/16/2018	05/17/2018	05/15/2018	05/16/2018
Laboratory Sample I.D.		9611698	9614227	9616464	9611697	9614225
Parameter	**Units**					
Indicator Parameters						
DISSOLVED ORGANIC CARBON	mg/L	1.1	1.4	1.6	1.9	0.95 J
DISSOLVED OXYGEN	mg/L	0.07	0.39	0.1	0.04	0.03
ETHANE	ug/L	ND@5	2 J	1.1 J	0.99 J	0.82 J
ETHENE	ug/L	ND@5	1.4 J	1.7 J	3.3 J	3.1 J
FREE CARBON DIOXIDE	ug/L	220000	220000	260000	45000	44000
METHANE	ug/L	230	1700	1800	130	130
OXIDATION-REDUCTION POTENTIAL	mV	214.7	190.5	227.8	-91.3	-118.3
PH	SU	5.09	5.62	5.09	6.82	6.74
SPECIFIC CONDUCTANCE	umhos/cm	16733	8985	12410	3106	3110
TEMPERATURE	C	14.1	13.9	13.8	13.4	12.6
TURBIDITY	NTU	57.4	5506	9.8	12.8	2801
Inorganics						
ALKALINITY, TOTAL	mg/L	22.2	78.3	30.3	168	169
CHLORIDE	mg/L	4780	2310	4180	860	889
NITRATE-NITROGEN	mg/L	1.7	ND@0.5	0.54	ND@0.5	ND@0.5
SULFATE	mg/L	95.1	37.8	46.7	20.3	19.9
SULFIDE, TOTAL	mg/L	ND@2	ND@4	ND@2	ND@2	ND@4
Metals						
IRON, DISSOLVED	mg/L	ND@0.4	ND@0.4	ND@0.4	4.87	5.09
IRON, FERRIC	mg/L	ND@0.4	ND@1	ND@0.4	ND@1.3	ND@5
IRON, FERROUS	mg/L	0.11	4	0.12	5.2	13.1
MANGANESE, DISSOLVED	mg/L	12.5	33.1	44.2	2.87	2.85
SODIUM, DISSOLVED	mg/L	2980	1520	1910	320	336

Groundwater Analytical Chemistry Data
P001 Area Remedial Alternatives Investigation
Owego, New York

Reporting Conventions

NA	Not Analyzed
ND@X	Not Detected at Detection Limit X

Code	**Explanation**
J	Estimated value