5 Sullivan Street
Cazenovia, NY 13035
Main: 315 655 3900
www.wspgroup.com/usa

VIA ELECTRONIC MAIL

June 10, 2014

Karen A. Cahill
Division of Environmental Remediation
New York State Department of Environmental Conservation
Region 7
615 Erie Boulevard West
Syracuse, NY 13204-2400

Re: AOC 1 Aquifer Testing Activities
Former Emerson Power Transmission, Ithaca, NY
Order on Consent #A7-0125-87-09

Dear Karen:

WSP USA Corp. is pleased to present this Report of Aquifer Testing activities conducted at the Former Emerson Power Transmission (EPT) site in Ithaca, New York. The aquifer pump test was completed in March and April 2014 on pumping well PTW-1 to determine the hydraulic properties of the shallow fractured bedrock aquifer affected by chlorinated volatile organic compounds (VOCs) in the vicinity of the former 507 degreaser department located in Area of Concern 1 (AOC 1). The general scope of work included installation of a groundwater pumping well and 5 piezometers, well development, water level measurements, and background, constant-rate, and recovery pumping tests and analysis.

Scope of Work

The following sections describe the aquifer testing activities, data evaluation, and conclusions.

Well Installation Activities

From March 17 through March 25, 2014, WSP installed a pumping well and five piezometers in the alley to the northwest of the location of the former 507 vapor degreaser in Building No. 4 (Figure 1). The pumping well (PTW-1) was installed to the south end and piezometers PZ-1 through PZ-4 were installed in a line at radial distances of approximately 3 feet, 5 feet, and 7 feet, and 10 feet, respectively, from PTW-1. Piezometer PZ-5 was installed approximately 7 feet to the west of PTW-1 (Figure 1).

Boreholes for the five piezometers (PZ-1 through PZ-5) were advanced from the ground surface to the top of bedrock using 4.25-inch inside diameter (ID) hollow-stem augers (HSAs). The overburden borehole at the pumping well (PTW-1) was installed using 8.25-inch ID HSAs. The overburden material was continuously-sampled at locations PTW-1 and PZ-1 using 2-foot long split spoon samplers, and recovered samples were logged for soil type, density, and moisture content, and screened for organic vapors in the field using a photoionization detector (PID). Upon reaching the top of bedrock as determined by refusal during either the split spoon or HSA advancement, the boreholes for the piezometers were advanced to the termination depths using a nominal 4-inch diameter rotary air hammer. Similarly, the bedrock borehole for the pumping well was advanced using an 8-inch diameter rotary air hammer.

The piezometers were constructed using 2-inch-ID threaded, flush jointed, Schedule 40 polyvinyl chloride (PVC) casing and screens, and the pumping well was constructed using 4-inch-ID threaded, flush-jointed Schedule 10 stainless-steel casing and screens. Each piezometer was constructed with 10 feet of 0.010-inch continuous wrap screen below the soil/bedrock interface from approximately 23 to 33 feet below ground surface (bgs) within the fractured portion of the upper bedrock zone (B-zone). The annular space around each screened interval was backfilled with filter sand, topped with a minimum 2-foot hydrated bentonite seal, and the remainder of the well annulus was backfilled with a mixture of 95/5 percent cement-bentonite grout mixture. All of the wells were completed above grade with cast aluminum protective manhole collars set in concrete for later conversion to flush-mount completion at grade.

The overburden at the 5 piezometer locations and the pumping well ranged in thickness from approximately 18 feet (PZ-3 and PZ-4) to 21.4 feet (PZ-1). The overburden consisted of light gray fill comprised of silt, gravel, brick fragments and cinders overlying native brown to dark gray or black silt with varying amounts of clay and angular siltstone fragments grading into weathered siltstone with depth. Cuttings from the drilling indicated that the bedrock in the test area is a gray siltstone identical to the bedrock encountered elsewhere at the site.

Most of the boreholes were dry at the completion of bedrock drilling and required 12 to 24 hours of recharge before a measurable water column was present in the open borehole or well. Piezometer PZ-4 was the lone exception, with water noted in the open borehole prior to the casing installation. Boring logs, which include the lithologic soil descriptions and headspace results, are included in Enclosure A.

Well Development

Piezometers PZ-1 through PZ-3 and PZ-5 were developed by removing groundwater with bailers. The pumping well, PTW-1, and piezometer PZ-4 were developed using a submersible pump. PTW-1 was monitored for drawdown to estimate well yield. Development continued until each of the wells was bailed dry (typically within one calculated well volume, the only exception being PZ-4 which became dry after approximately 3 well volumes were purged) or discharge was relatively free of suspended sediments. No water was added during the drilling and installation activities for the new pumping well and piezometers.

Well Gauging

On March 31, 2014, a preliminary gauging event was conducted on the pump test well and piezometer network, as well as existing monitoring wells MW-25B and MW-26B. Data-logging pressure transducers were installed near the bottom of each well. The depth to water was measured and verified for the presence of light non-aqueous phase liquid (LNAPL) using an interface probe. All measurements were recorded in a field notebook for later calculation of groundwater elevations as presented in Table 1. No oily residue or LNAPL was observed in any of the wells in the test area.

Equipment Decontamination, Investigation-Derived Wastes, and Land Surveying

All downhole drilling equipment (augers and rods) were decontaminated using a portable steam cleaner in accordance with WSP's Standard Operating Procedures (SOPs). Split-spoon samplers were decontaminated between each use with non-phosphate soap and de-ionized water.

All soil cuttings, purge water, decontamination fluid, and other investigation-derived wastes (IDW) generated during the drilling and sampling activities were contained in 55-gallon U.S. Department of Transportation (DOT) approved steel drums. The drums were labeled and moved to an onsite staging area. The IDW will be characterized for disposal at a later time.

Land Surveying

Upon completion of the work, the elevations of the ground surface at the pumping well and each new piezometer and the top of the PVC or stainless steel well casing were surveyed to the nearest 0.01 foot by a New York State-licensed land surveyor. The horizontal locations of the new piezometers and well were determined to the nearest 0.1 foot. All survey data are referenced to the state plane coordinate system and tied into the existing base map for the site (Table 1; Figure 1).

Aquifer Testing Procedures

PTW-1 Yield Test

After the well casing was installed, a yield test was conducted during well development by pumping the well at an average rate of 160 ml/min. This created a drawdown of approximately 3 feet over a period of 4 hours. The test produced a specific capacity (Q/s) of approximately 54 ml/min per foot (ml/min/ft). Consequently the target pumping rate of 50 ml/min was estimated between the recharge rate (45 ml/min) and the specific capacity (54 ml/min/foot).

PTW-1 Pumping Test

The pumping test was performed from March 31 through April 16, 2014 and included a background test to determine the long term trends in water levels within the pump test well network, a step drawdown/yield test to determine the likely sustainable pumping rate for the constant rate test, a constant rate test to estimate the aquifer properties, and a recovery test. Water levels in pumping well PTW-1 and the piezometers were monitored using In-Situ Inc.'s LevelTroll® 700 data-logging pressure transducers. The transducers were set at approximately 33 feet bgs in each well (i.e., just above the total depth of each well). Depth to water measurements were collected after the transducers were deployed and before the beginning of each test (Table 1).

At the beginning of the background monitoring period the groundwater level in PTW-1 and piezometers ranged from 555.92 feet above mean sea level (amsl) in PZ-1 to 568.71 feet amsl in PZ-4. These data indicate the absence of a systematic gradient in groundwater elevations with no consistent water table elevation between the five wells in the test network. The initial brief background test included pressure transducer measurements under non-pumping conditions and was completed on April 2, 2014.

A step-drawdown test was attempted on April 2 to determine the maximum yield of pumping well PTW-1. However, the submersible pump selected for this phase of work malfunctioned. The step-drawdown test was followed by a more prolonged background test conducted between April 2 and 7, 2014 to monitor ambient water levels in the well network.

On April 9 through 11, 2014, a constant rate test was conducted to obtain a record of drawdown at a sustainable pumping rate and monitor the response in the surrounding observation wells. The pumping

test was initially conducted using a peristaltic pump fitted with 3/8-inch outside diameter (OD) low density polyethylene tubing that was inserted to a depth of approximately 33 feet bgs (i.e., near the bottom of the screened interval). The peristaltic pump was operated at an average rate of 50 ml/min. After the peristaltic pump began cavitating, it was replaced with a QED Systems Sample Pro bladder pump operating at the same pumping rate with the intake set at approximately 32 feet bgs. The pumping rate was monitored using timed collections of measured purge volumes in a 200 milliliter graduated cylinder.

Following the constant rate test, a recovery test was conducted between April 11 and 16, 2014, to monitor the return of water levels to ambient conditions and to monitor the ongoing background trends in the piezometers.

PZ-4 Yield Test

On April 16, 2014, at the completion of the recovery test, a brief yield test was conducted at piezometer PZ-4 to determine if a higher pumping rate could be achieved in this well than in pumping well PTW-1. A secondary purpose was to determine if a drawdown response was observed in nearby wells. Piezometer PZ-4 was selected for yield testing because only this well yielded more than one well volume of water during well development (the remaining five piezometers/wells in the network became dry after only one well volume of water was removed during development).

Water was extracted from piezometer PZ-4 using a Geotech Stainless-Steel Geosub submersible pump with AC controller. The pumping rate was controlled using both the electronic controller and a needle valve at the discharge end of the tubing. Drawdown was monitored in piezometers PZ-3 and PZ-5, and existing monitoring wells MW-25B and MW-26B using the LevelTroll® transducers (Figure 1). The pumping rate during the test averaged approximately 250 to 300 ml/min; however, a steady rate could not be maintained.

Aquifer Testing Analysis

The pressure transducer data collected during the constant rate test activities were analyzed using HydroSOLV's AQTESOLV® software to estimate the aquifer hydraulic parameters of the shallow water-bearing unit. Only the data collected from the test on pumping well PTW-1 was used in the analysis.

The time-drawdown data from the constant rate test were evaluated using the Theis solution for flow to a fully or partially penetrating well in a confined aquifer (Theis 1935, Hantush 1961a, Hantush 1961b[1]). Many of the assumptions of the Theis solution could not be met. For example, the areal extent of the aquifer is not infinite, the aquifer is not of uniform thickness, and the water table is not horizontal. Therefore, the resultant analysis is provisional.

The Theis solution that best fit the constant rate data did not yield a reasonable fit for the recovery data, essentially overestimating the amount of time the well took to recover. For this reason, the recovery

[1] Theis, C.V., 1935. The relation between the lowering of the piezometric surface and the rate and duration of discharge of a well using groundwater storage, Am. Geophys. Union Trans., vol. 16, pp. 519-524.

Hantush, M.S., 1961a. Drawdown around a partially penetrating well, Jour. of the Hyd. Div., Proc. of the Am. Soc. of Civil Eng., vol. 87, no. HY4, pp. 83-98.

Hantush, M.S., 1961b. Aquifer tests on partially penetrating wells, Jour. of the Hyd. Div., Proc. of the Am. Soc. of Civil Eng., vol. 87, no. HY5, pp. 171-194.

data were re-analyzed using a residual-drawdown method that matches the Theis curve to the recovery data as plotted in a converted time plot called an Agarwal plot. This method has the advantage of presenting recovery data in a manner that is equivalent to drawdown data in a constant rate test. The results of this analysis were compared to the pumping test data.

Aquifer Testing Results

Results for the PTW-1 pumping test activities are discussed below. Initial and final water levels for each test are provided in Table 1. Plots of the groundwater level logs during pump test activities are provided in Figures 2 through 4.

Background Test

During the course of background monitoring, several water level trends in the pumping test well network became apparent. Between March 31 and April 9, 2014, the water levels in PZ-4 and PZ-5 were stable or declined very gradually and the water levels in PZ-1 through PZ-3 gradually increased (Figure 2). The data trends also show no significant increases or decreases due to weather events throughout the duration of the background test.

The long term trend of the water level in PTW-1 prior to initial attempts at starting the pumping test on April 8, 2014, indicates an average increase of approximately 0.5 foot over the duration of the background test. In contrast to the piezometers, the background trend in PTW-1 is somewhat noisy, perhaps in response to daily weather changes. The magnitude of those fluctuations is on the order of 0.5 foot or less over a given 24-hour time period. The more significant fluctuations in water level in the pumping well on April 7 through 9 are due to the initial constant rate test attempts. Note that the long-term trends in the water levels in the piezometers continue without change during those attempts.

Constant Rate Test

After testing pumps and pumping rates between April 7 and 8, 2014, the constant-rate test was initiated on April 9. An average pumping rate of approximately 50 ml/min was maintained throughout the 45-hour duration of the test. Three significant rate changes occurred during the test and were accounted for in the aquifer properties analysis (see below). Early in the test, the peristaltic pump lost prime and began cavitating due to head decline in the well. WSP rapidly altered the test setup, deploying a bladder pump and resuming the test. This event resulted in a brief period of recharge of less than 0.5 foot before pumping resumed approximately one hour later. In the early morning of April 10, the pumping rate declined to approximately 25 ml/min, which again resulted in recharge in the well for a time period of approximately 4 hours, before being corrected.

The total drawdown in the pumping well at the end of the test was approximately 4.3 feet, which corresponds to within 0.25 foot of the intake of the pump. The test was completed once drawdown reached asymptotic levels. No response to pumping was observed in any of the 5 piezometers at any point during the pumping test. The water levels in PZ-1, PZ-2, and PZ-3 continued to increase slightly at the same steady background rate as was observed during the background test throughout the duration of pumping. Similarly, the water levels in PZ-4 and PZ-5 remained stable or gradually declining, changing less than 0.05 foot during the duration of the test with no noise in the data and no characteristic response to pumping.

Recovery Test

Water levels in PTW-1 began recharging immediately after cessation of pumping and for the subsequent 24 hours (Figure 3). During this time period, the response data collected from the pumping well followed an asymptotic curve typical of recovery after stressing the aquifer. No discernible response to the cessation of pumping was recorded in any of the observation wells. Water levels in PZ-1, PZ-2, and PZ-3 continued to increase along a relatively steady slope consistent with the long-term background trend, while water levels in PZ-4 and PZ-5 remained relatively constant or gradually declining, again with no characteristic response to the cessation of pumping.

PZ-4 Yield Test Results

The drawdown data collected while pumping PZ-4 is shown on Figure 4. The total drawdown during the yield test was approximately 13 feet after approximately 3.5 hours of pumping, with a period of recharge occurring halfway through the test due to loss of prime in the submersible pump. No response was observed in any of the nearby piezometers or monitoring wells.

At the completion of testing, an oily-residue was observed on all of the downhole equipment from this piezometer, indicating that the bedrock aquifer at this location is in communication with the saturated overburden. The piezometer was gauged at the completion of the test, and a petroleum sheen was observed on the surface of the water table. No oil was observed in any of the other piezometers.

Estimation of Aquifer Parameters

The input parameters used in the aquifer analysis are provided in Table 2. The aquifer thickness (b) was estimated to be 5.72 feet, which is based on the initial height of the water column within the pumping well before the test began with the assumption that flow to the screened interval during pumping was principally in the horizontal direction. The depth from the top of the aquifer to the top of the screen was therefore estimated to be 0 feet (i.e., the screened interval straddles the top of the aquifer) and the screened interval length (L) is therefore estimated as equal to the aquifer thickness. Well diameter (r(w); 0.33 foot) and casing diameter (r(c); 0.17 foot) for PTW-1 were the diameters of the bedrock borehole and stainless steel casing, respectively.

The drawdown and recovery data from the pumping test at PTW-1 were used to calculate the transimissivity (T) of the bedrock formation in the vicinity of the screened interval of the well. The Theis solution for the constant rate data produced a value for T of 0.17 square feet per day (ft^2/day; 1.85E-03 square centimeters per second [cm^2/s]) and the recovery data produced a slightly lower T of 0.098 ft^2/day (1.06E-03 cm^2/s). These data correspond to hydraulic conductivities ranging from 0.017 (6.07E-06 cm/s) to 0.030 (1.06E-05 cm/s) feet per day. These values are within the range of published values for unfractured fine-grained rocks such as siltstone and shale.

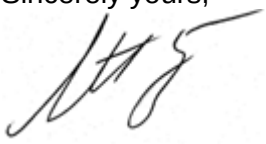
Conclusions

The drawdown in well PTW-1 stabilized towards the end of the constant rate test, indicating that the maximum sustainable yield of the well is 50 ml/min. Pumping was terminated when the drawdown approached the pump intake near the bottom of the well and remained stable for approximately 8 hours.

The aquifer test revealed a lack of connectivity between the pumping well and piezometers, low hydraulic conductivity, and low transmissivity values for the aquifer. No radius of influence could be determined from the pumping test results other than to indicate that it is less than 3 feet based on the distance to the closest piezometer. Based on the test results, WSP concludes that remedies involving pumping or injection are not technically feasible to address VOCs in groundwater in AOC 1.

If you have any questions or comments on this report, please do not hesitate to contact us.

Sincerely yours,

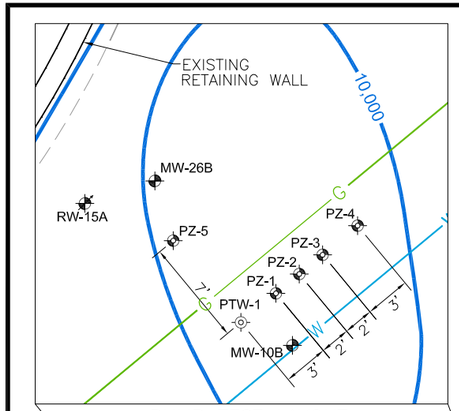


Scott P. Haitz
Vice President

CC: Derek Chase, Emerson
Steve Karpinski, New York State Department of Health
Dan Noll, LaBella Associates, D.P.C.

SPH:esr
c:\$client\emerson\ept\e0004507_05-20-14_ptw-1 pump test_letter.docx

Enclosures



PUMP TEST LAYOUT
SCALE: 1"=10'

LEGEND
- MONITORING WELL
- EXTRACTION WELL
- COLUMN ID
- EXISTING WATER LINE
- EXISTING SANITARY SEWER
- EXISTING STORM SEWER
- EXISTING STORM SEWER–HISTORICALLY ABANDONED AND REMOVED
- EXISTING GAS LINE
- VOC CONTOUR (B–ZONE)
- PUMP TEST EXTRACTION WELL
- PIEZOMETER

NOTE:
1. INTERIOR BUILDING AND EXISTING UTILITIES DIGITIZED FROM MORSE CHAIN CO. SHOP DRAWINGS TITLED PROPOSED FLOOR REPLACEMENT, BLDG. 3 BASEMENT DEPT. 507 PRESS ROOM, DRAWING NUMBER 118795, DATED 8–5–69. INTERIOR BUILDING AND EXISTING UTILITY LOCATIONS ARE APPROXIMATE.
2. THE LOCATIONS OF SUB–SURFACE UTILITIES SHOWN ON THESE DRAWINGS MAY NOT BE ACCURATE. FIELD CHECK THE LOCATION OF ALL SUBSURFACE UTILITIES. WSP MAKES NO WARRANTEE/GUARANTEE AS TO THE ACCURACY OF THE LOCATIONS OF SUBSURFACE UTILITIES SHOWN ON THESE DRAWINGS
3. CONCENTRATIONS ARE IN UNITS OF MICROGRAMS PER LITER (ug/l).

N

0 20 40
SCALE IN FEET

THE ORIGINAL VERSION OF THIS DRAWING IS IN COLOR. BLACK AND WHITE COPIES MAY NOT ACCURATELY DEPICT CERTAIN INFORMATION.

B

R:\ACAD\CADD\00004507-IthacaCAD\00004507-124.dwg 5/27/2014 8:30 AM USEC01012

Drawn By: EGC
Checked: [signature] 4/7/2014
Approved:
DWG Name: 00004507–124

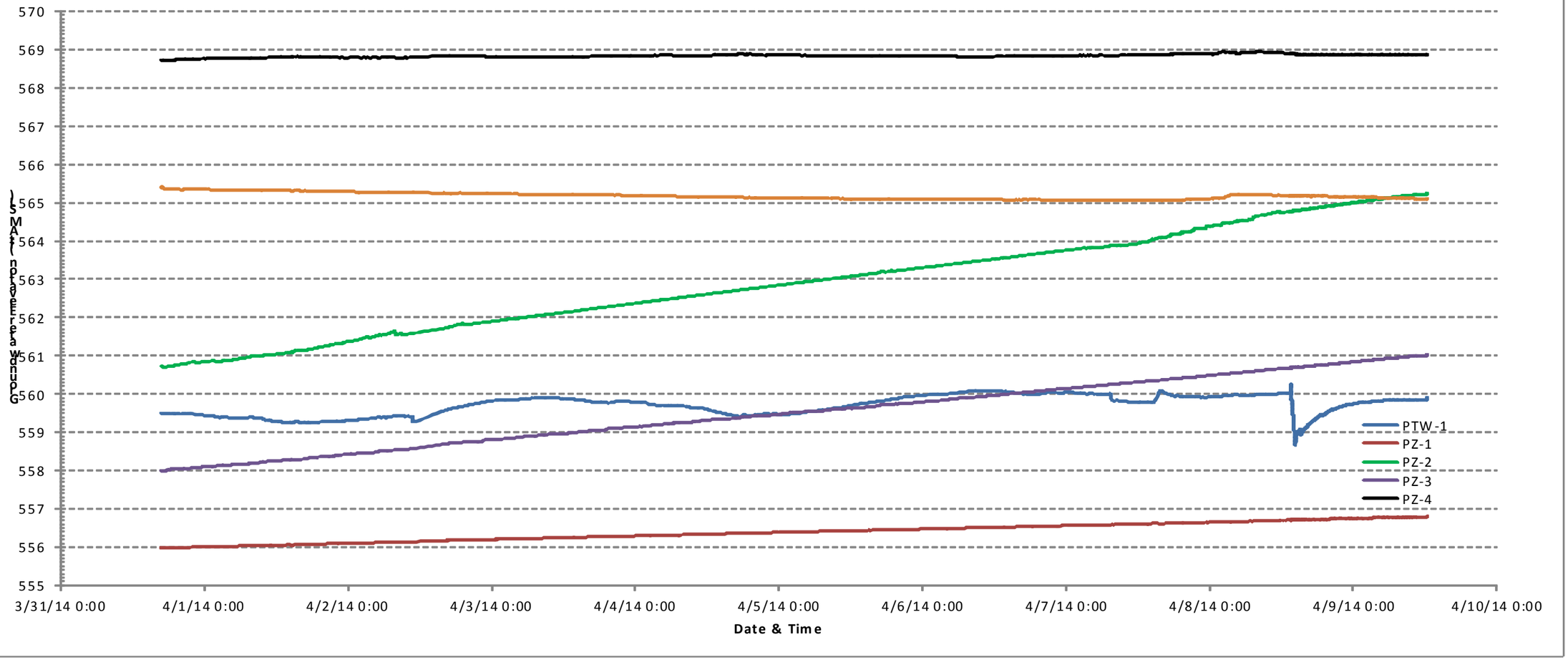
EMERSON POWER TRANSMISSION
ITHACA, NEW YORK
PREPARED FOR
EMERSON
ST. LOUIS, MISSOURI

Figure 1

LOCATION OF AOC 1 AND
PUMP TEST LAYOUT

WSP
WSP USA Corp.
11190 Sunrise Valley Drive, Suite 300
Reston, Virginia 20191
(703) 709-6500
www.wspenvironmental.com/usa

PTW-1 Background Test Groundwater Elevations



B

Drawn by: ESR

Checked:

Approved:

PUB Name: E0004507-0514Apub

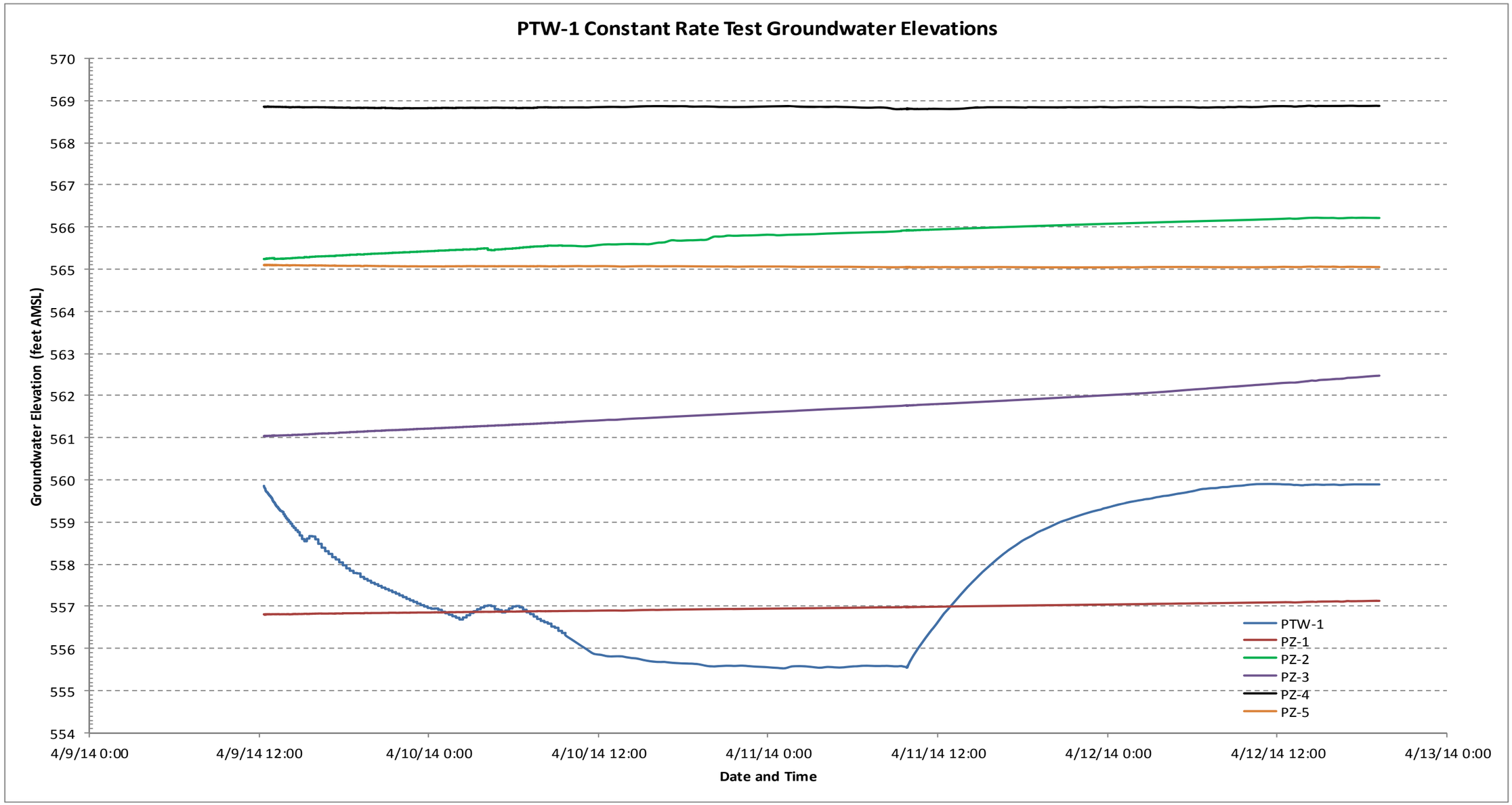
Former Emerson Power Transmission
Ithaca New York

PREPARED FOR
Emerson

FIGURE 2

BACKGROUND MONITORING
GROUNDWATER ELEVATIONS

WSP
WSP USA Corp.
11190 Sunrise Valley Drive
Reston, VA 20191
(703) 709-6500
www.wspenvironmental.com/usa



NOTICE: THIS DRAWING HAS BEEN PREPARED UNDER THE DIRECTION OF A PROFESSIONAL. DO NOT ALTER THIS DOCUMENT IN ANY WAY WITHOUT THE WRITTEN CONSENT OF WSP USA CORP.

THE ORIGINAL VERSION OF THIS DRAWING IS IN COLOR. BLACK AND WHITE COPIES MAY NOT ACCURATELY DEPICT CERTAIN INFORMATION.

B

Drawn by: ESR

Checked:

Approved:

PUB Name: E0004507-0514Bpub

Former Emerson Power Transmission
Ithaca New York

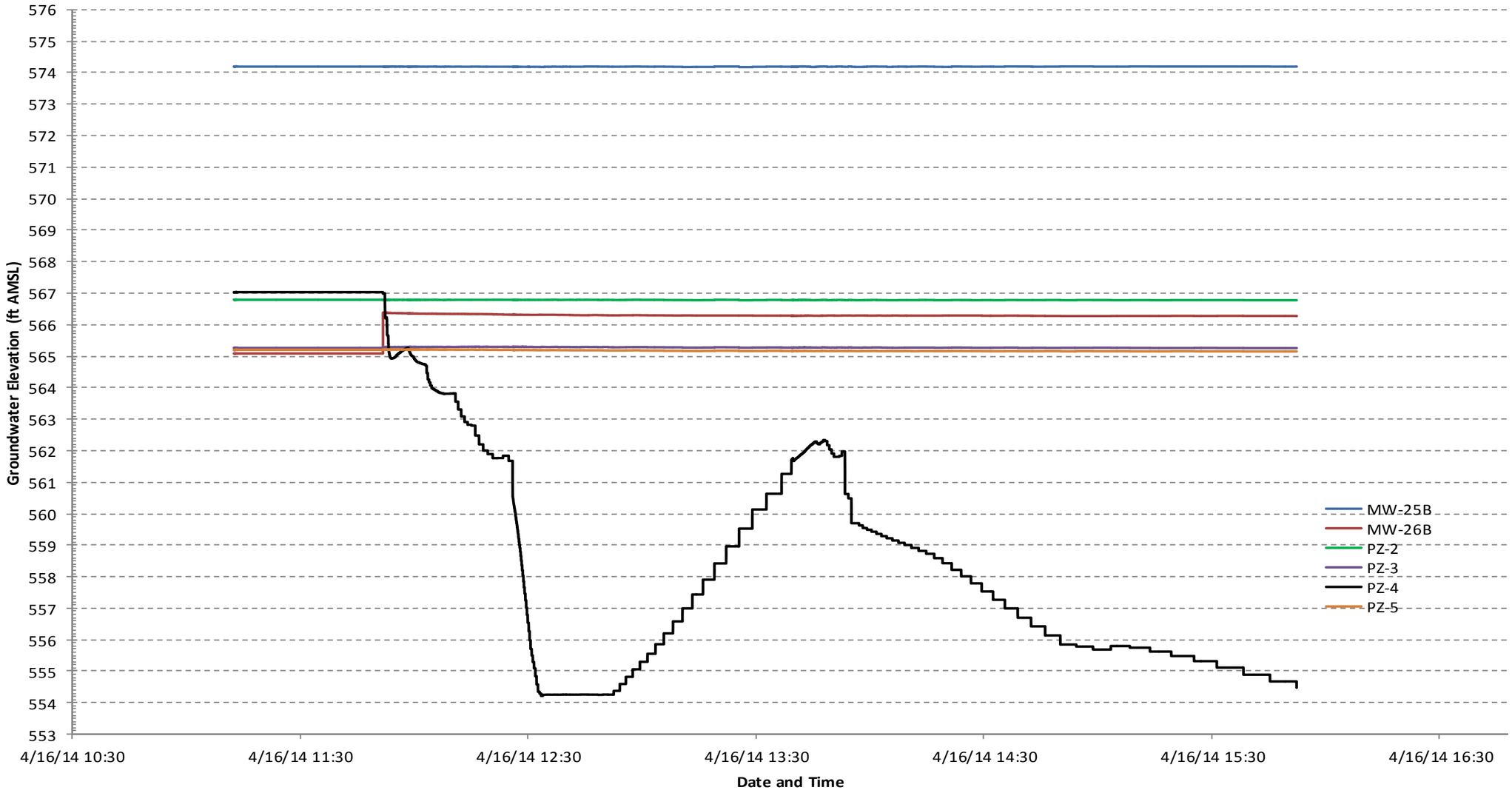
PREPARED FOR
Emerson

FIGURE 3

PTW-1 Constant Rate Test and Recovery Test
GROUNDWATER ELEVATIONS

WSP
WSP USA Corp.
11190 Sunrise Valley Drive
Reston, VA 20191
(703) 709-6500
www.wspenvironmental.com/usa

PZ-4 Yield Test Groundwater Elevations



B

NOTICE: THIS DRAWING HAS BEEN PREPARED UNDER THE DIRECTION OF A PROFESSIONAL. DO NOT ALTER THIS DOCUMENT IN ANY WAY WITHOUT THE WRITTEN CONSENT OF WSP USA CORP.

THE ORIGINAL VERSION OF THIS DRAWING IS IN COLOR. BLACK AND WHITE COPIES MAY NOT ACCURATELY DEPICT CERTAIN INFORMATION.

Drawn by: ESR

Checked:

Approved:

PUB Name: E0004507-0514Cpub

Former Emerson Power Transmission
Ithaca New York

PREPARED FOR
Emerson

FIGURE 4

PZ-4 Yield Test
GROUNDWATER ELEVATIONS

WSP
WSP USA Corp.
11190 Sunrise Valley Drive
Reston, VA 20191
(703) 709-6500
www.wspenvironmental.com/usa

Table 1

Groundwater Elevation Measurements - PTW-1 Pump Test
Former Emerson Power Transmission
Ithaca, New York (a)

Parameter	PTW-1	PZ-1	PZ-2	PZ-3	PZ-4	PZ-5	MW-25B	MW-26B
Depth to Bedrock (feet)	19.3	21.4	18.5	18	18	19		
Total Depth (feet)	35.42	34	34.4	34.69	35.08	34.47		
Total Depth bgs (feet)	33.25	33.1	33.08	33.22	33.6	32.95		
Original Stickup Height (feet)	2.2	1	1.41	1.59	1.7	1.62		
Modified Stickup Height (feet)	2.17	0.9	1.32	1.47	1.48	1.52	NA	NA
Transducer Depth BTOC (feet)	35.15	33.61	34.01	34.24	34.43	33.84	19.98	22.98
TOC Elevation (feet AMSL)	589.36	588.07	588.51	588.67	588.66	588.3	586.84	586.19
Transducer Elevation (feet AMSL)	554.21	554.46	554.5	554.43	554.23	554.46	566.86	563.21

Date	Comments	Depth to Water (Feet BTOC)							
03/31/14	Start Background	29.99	32.15	27.93	30.72	19.95	22.94	-	-
04/02/14	Attempt Step	29.97	31.92	26.89	30.02	19.85	23.04	-	-
04/02/14		29.81	31.91	26.83	30.00	19.83	23.05	-	-
04/09/14	Start CR	29.7	31.29	23.31	27.62	19.82	23.22	-	-
04/11/14	End CR	34.14	31.11	23.67	26.88	19.87	21.78	-	-
04/16/14	PZ-4 Test	29.63	30.55	21.78	23.4	19.83	23.14	12.66	19.78

Date	Comments	Groundwater Elevation (feet AMSL)							
03/31/14	Start Background	559.37	555.92	560.58	557.95	568.71	565.36	-	-
04/02/14	Attempt Step	559.39	556.15	561.62	558.65	568.81	565.26	-	-
04/02/14		559.55	556.16	561.68	558.67	568.83	565.25	-	-
04/09/14	Start CR	559.66	556.78	565.2	561.05	568.84	565.08	-	-
04/11/14	End CR	555.22	556.96	564.84	561.79	568.79	566.52	-	-
04/16/14	PZ-4 Test	559.73	557.52	566.73	565.27	568.83	565.16	574.18	566.41

a/ BTOC = below top of casing; bgs = below ground surface; AMSL = above mean sea level

Table 2

Aquifer Test Parameters
Former Emerson Power Transmission
Ithaca, New York (a)

Aqtesolv Inputs	Variable	Value
Aquifer thickness (feet)	b	5.72
Depth to top of screen from top of aquifer (feet)	d	0
Saturated length of screen (feet)	L	5.72
Radius of casing (feet)	r(c)	0.17
Radius of equipment (transducer and tubing) (feet)	r(eq)	0.02
Radius of well (feet)	r(w)	0.33

Aqtesolv Results	T		K		S	Ss	
	($feet^2$/day)	(cm^2/sec)	(feet/day)	(cm/s)	unitless	($feet^{-1}$)	(cm^{-1})
Contant Rate Test (Theis Solution)	0.17	1.85E-03	0.030	1.06E-05	0.15	0.027	8.71E-04
Recovery Test (Theis Solution/Argawal Method)	0.098	1.06E-03	0.017	6.07E-06	0.16	0.029	9.44E-04

a/ T = transmissivity; K = hydraulic conductivity; S = storativity; S_s = specific storage.

Enclosure A – Boring Logs and As-Built Diagrams

Boring Log: PTW-1

Project: Emerson Power Transmission
Project No.: 4507/Legacy 127491
Location: Ithaca, New York
Completion Date: 3/18/2014

Surface Elevation (feet AMSL*): 587.19
TOC Elevation (feet AMSL*): 589.36
Total Depth (feet): 33
Borehole Diameter (inches): 12.25/

Sample Data					Subsurface Profile		
Depth	Sample/Interval	PID/OVM (ppm)	Blow Count	% Recovery	Lithology	Description	Well Details
						Ground Surface	
						Concrete	
2						***Poorly-Graded Gravel with Silt and Sand (GP-GM)*** Dark gray silty gravel.	
4	1	NA	- - - -	NA			
6							
8							
10	2	NM	6 6 4 5	25		***Poorly-Graded Gravel with Silt and Sand (GP-GM)*** Black silty gravel, little fine to coarse-grained sand; medium dense; dry.	
12	3	NM	7 10 6 5	35		***Poorly-Graded Gravel with Silt (GP-GM)*** Gray angular siltstone fragments to 2-inches in diameter with silt, little clay; medium dense; dry.	
14	4	NM	2 5 8 6	35		***Poorly-Graded Gravel with Silt (GP-GM)*** Brown (7.5 YR 4/4) gravel, little silt and clay; dry.	
16	5	NM	3 3 6 6	25		***Poorly-Graded Gravel with Silt (GP-GM)*** Dark gray gravel, little silt and clay; moist, petroleum-like odor and sheen.	
18	6	NM	6 7 12 13	25		***Gravelly Silt (ML)*** Dark grayish-brown (10YR 4/2) silt and clay, some gravel; medium dense; dry.	
	7	NM	50/0.3	100		***Poorly-Graded Gravel with Silt (GP-GM)*** Light olive brown (2.5Y 5/4) angular siltstone fragments, little silt;	
20							

Geologist(s): Erik S. Reinert
Subcontractor: Parratt Wolff, Inc.
Driller/Operator: Shawn Bodah
Method: HSA/Air Rotary

WSP USA Corp.
5 Sullivan Street
Cazenovia, NY 13035
(315) 655-3900

Boring Log: PTW-1

Project: Emerson Power Transmission
Project No.: 4507/Legacy 127491
Location: Ithaca, New York
Completion Date: 3/18/2014

Surface Elevation (feet AMSL*): 587.19
TOC Elevation (feet AMSL*): 589.36
Total Depth (feet): 33
Borehole Diameter (inches): 12.25/

Sample Data					Subsurface Profile		
Depth	Sample/Interval	PID/OVM (ppm)	Blow Count	% Recovery	Lithology	Description	Well Details
						medium dense; dry.	
22						***Siltstone*** *(continued)*	
24							
26							
28							
30							
32							
						Bottom of Boring at 33 feet	
34							
36							
38							
40							

Geologist(s): Erik S. Reinert
Subcontractor: Parratt Wolff, Inc.
Driller/Operator: Shawn Bodah
Method: HSA/Air Rotary

WSP USA Corp.
5 Sullivan Street
Cazenovia, NY 13035
(315) 655-3900

Boring Log: PZ-1

Project: Emerson Power Transmission
Project No.: 4507/Legacy 127491
Location: Ithaca, New York
Completion Date: 3/18/2014

Surface Elevation (feet AMSL*): 587.17
TOC Elevation (feet AMSL*): 588.07
Total Depth (feet): 33
Borehole Diameter (inches): 8.25/4

Sample Data					Subsurface Profile		
Depth	Sample/Interval	PID/OVM (ppm)	Blow Count	% Recovery	Lithology	Description	Well Details
						Ground Surface	
						Concrete	
2	1	0.1	56 52	100		***Poorly-Graded Gravel with Silt and Sand (GP-GM)*** Light gray to black silty gravel, little fine to coarse sand; loose to medium dense; dry.	
	2	0.1	15 14 14 16	25			
4	3	9	3 4 9 9	50			
6	4	0.4	9 6 5 4	50		***Lean Clay with Sand (CL)*** Yellowish-brown clay, some silt, little sand and gravel; soft; dry. ***Poorly-Graded Gravel (GP)*** Red and black cinders, little gravel; loose; dry.	
8	5	3.6	6 7 6 6	50			
10	6	0.0	4 4 3 3	15		***Poorly-Graded Gravel with Silt and Sand (GP-GM)*** Gray sub-angular grave, little silt and sand; loose; dry.	
12	7	0.0	4 4 5 6	25			
14	8	15	4 5 5 6	25		***Lean Clay with Gravel (CL)*** Dark gray clay, little silt and gravel; medium soft; moist; strong petroleum-like odor and visible sheen.	
16	9	98.3	5 4 3 4	75			
18	10	41.0	9 15 11 7	50			
20							

Geologist(s): Erik S. Reinert
Subcontractor: Parratt Wolff, Inc.
Driller/Operator: Shawn Bodah
Method: HSA/Air Rotary

WSP USA Corp.
5 Sullivan Street
Cazenovia, NY 13035
(315) 655-3900

Boring Log: PZ-1

Project: Emerson Power Transmission
Project No.: 4507/Legacy 127491
Location: Ithaca, New York
Completion Date: 3/18/2014

Surface Elevation (feet AMSL*): 587.17
TOC Elevation (feet AMSL*): 588.07
Total Depth (feet): 33
Borehole Diameter (inches): 8.25/4

Sample Data					Subsurface Profile		
Depth	Sample/Interval	PID/OVM (ppm)	Blow Count	% Recovery	Lithology	Description	Well Details
	11	NA	6 10 40/0.4	14		***Poorly-Graded Gravel with Silt (GP-GM)*** Olive gray (2.5Y 5/4) angular siltstone fragments and silt; dense; dry; oil between shale partings and petroleum-like odor. *(continued)*	
22						***Siltstone***	
24							
26							
28							
30							
32							
						Bottom of Boring at 33 feet	
34							
36							
38							
40							

Geologist(s): Erik S. Reinert
Subcontractor: Parratt Wolff, Inc.
Driller/Operator: Shawn Bodah
Method: HSA/Air Rotary

WSP USA Corp.
5 Sullivan Street
Cazenovia, NY 13035
(315) 655-3900

Boring Log: PZ-2

Project: Emerson Power Transmission
Project No.: 4507/Legacy 127491
Location: Ithaca, New York
Completion Date: 3/19/2014

Surface Elevation (feet AMSL*): 587.19
TOC Elevation (feet AMSL*): 588.51
Total Depth (feet): 33
Borehole Diameter (inches): 8.25/4

Sample Data					Subsurface Profile		
Depth	Sample/Interval	PID/OVM (ppm)	Blow Count	% Recovery	Lithology	Description	Well Details
						Ground Surface	
						Silt with Sand and Gravel Overburden	
2							
4							
6							
8							
	1						
10							
12							
14							
16							
18							
						Siltstone	
20							

Geologist(s): Erik S. Reinert
Subcontractor: Parratt Wolff, Inc.
Driller/Operator: Shawn Bodah
Method: HSA/Air Rotary

WSP USA Corp.
5 Sullivan Street
Cazenovia, NY 13035
(315) 655-3900

Boring Log: PZ-2

Project: Emerson Power Transmission
Project No.: 4507/Legacy 127491
Location: Ithaca, New York
Completion Date: 3/19/2014

Surface Elevation (feet AMSL*): 587.19
TOC Elevation (feet AMSL*): 588.51
Total Depth (feet): 33
Borehole Diameter (inches): 8.25/4

Sample Data					Subsurface Profile		
Depth	Sample/Interval	PID/OVM (ppm)	Blow Count	% Recovery	Lithology	Description	Well Details
22						***Siltstone*** *(continued)*	
24							
26							
28							
30							
32							
34						Bottom of Boring at 33 feet	
36							
38							
40							

Geologist(s): Erik S. Reinert
Subcontractor: Parratt Wolff, Inc.
Driller/Operator: Shawn Bodah
Method: HSA/Air Rotary

WSP USA Corp.
5 Sullivan Street
Cazenovia, NY 13035
(315) 655-3900

Boring Log: PZ-3

Project: Emerson Power Transmission
Project No.: 4507/Legacy 127491
Location: Ithaca, New York
Completion Date: 3/19/2014

Surface Elevation (feet AMSL*): 587.2
TOC Elevation (feet AMSL*): 588.67
Total Depth (feet): 33
Borehole Diameter (inches): 8.25/4

Sample Data					Subsurface Profile		
Depth	Sample/Interval	PID/OVM (ppm)	Blow Count	% Recovery	Lithology	Description	Well Details
						Ground Surface	
0						***Sandy Silt with Gravel (ML)*** Overburden	
2							
4							
6							
8							
10	1						
12							
14							
16							
18						***Siltstone***	
20							

Geologist(s): Erik S. Reinert
Subcontractor: Parratt Wolff, Inc.
Driller/Operator: Shawn Bodah
Method: HSA/Air Rotary

WSP USA Corp.
5 Sullivan Street
Cazenovia, NY 13035
(315) 655-3900

Boring Log: PZ-3

Project: Emerson Power Transmission
Project No.: 4507/Legacy 127491
Location: Ithaca, New York
Completion Date: 3/19/2014

Surface Elevation (feet AMSL*): 587.2
TOC Elevation (feet AMSL*): 588.67
Total Depth (feet): 33
Borehole Diameter (inches): 8.25/4

Sample Data					Subsurface Profile		
Depth	Sample/Interval	PID/OVM (ppm)	Blow Count	% Recovery	Lithology	Description	Well Details
22						***Siltstone*** *(continued)*	
24							
26							
28							
30							
32							
34						Bottom of Boring at 33 feet	
36							
38							
40							

Geologist(s): Erik S. Reinert
Subcontractor: Parratt Wolff, Inc.
Driller/Operator: Shawn Bodah
Method: HSA/Air Rotary

WSP USA Corp.
5 Sullivan Street
Cazenovia, NY 13035
(315) 655-3900

Boring Log: PZ-4

Project: Emerson Power Transmission
Project No.: 4507/Legacy 127491
Location: Ithaca, New York
Completion Date: 3/20/2014

Surface Elevation (feet AMSL*): 587.18
TOC Elevation (feet AMSL*): 588.66
Total Depth (feet): 33
Borehole Diameter (inches): 8.25/4

Sample Data					Subsurface Profile		
Depth	Sample/Interval	PID/OVM (ppm)	Blow Count	% Recovery	Lithology	Description	Well Details
						Ground Surface	
0						***Sandy Silt with Gravel (ML)*** Overburden	
2							
4							
6							
8							
10	1						
12							
14							
16							
18							
20						***Siltstone***	

Geologist(s): Erik S. Reinert
Subcontractor: Parratt Wolff, Inc.
Driller/Operator: Shawn Bodah
Method: HSA/Air Rotary

WSP USA Corp.
5 Sullivan Street
Cazenovia, NY 13035
(315) 655-3900

Boring Log: PZ-4

Project: Emerson Power Transmission
Project No.: 4507/Legacy 127491
Location: Ithaca, New York
Completion Date: 3/20/2014

Surface Elevation (feet AMSL*): 587.18
TOC Elevation (feet AMSL*): 588.66
Total Depth (feet): 33
Borehole Diameter (inches): 8.25/4

Sample Data					Subsurface Profile		
Depth	Sample/Interval	PID/OVM (ppm)	Blow Count	% Recovery	Lithology	Description	Well Details
22						***Siltstone*** *(continued)*	
24							
26							
28							
30							
32							
34						Bottom of Boring at 33 feet	
36							
38							
40							

Geologist(s): Erik S. Reinert
Subcontractor: Parratt Wolff, Inc.
Driller/Operator: Shawn Bodah
Method: HSA/Air Rotary

WSP USA Corp.
5 Sullivan Street
Cazenovia, NY 13035
(315) 655-3900

Boring Log: PZ-5

Project: Emerson Power Transmission
Project No.: 4507/Legacy 127491
Location: Ithaca, New York
Completion Date: 3/19/2014

Surface Elevation (feet AMSL*): 586.78
TOC Elevation (feet AMSL*): 588.3
Total Depth (feet): 33
Borehole Diameter (inches): 8.25/4

Sample Data					Subsurface Profile		
Depth	Sample/Interval	PID/OVM (ppm)	Blow Count	% Recovery	Lithology	Description	Well Details
						Ground Surface	
						Gravelly Silt with Sand (ML) Overburden	
2							
4							
6							
8							
10	1						
12							
14							
16							
18							
20						***Siltstone***	

Geologist(s): Erik S. Reinert
Subcontractor: Parratt Wolff, Inc.
Driller/Operator: Shawn Bodah
Method: HSA/Air Rotary

WSP USA Corp.
5 Sullivan Street
Cazenovia, NY 13035
(315) 655-3900

Boring Log: PZ-5

Project: Emerson Power Transmission
Project No.: 4507/Legacy 127491
Location: Ithaca, New York
Completion Date: 3/19/2014

Surface Elevation (feet AMSL*): 586.78
TOC Elevation (feet AMSL*): 588.3
Total Depth (feet): 33
Borehole Diameter (inches): 8.25/4

Sample Data					Subsurface Profile		
Depth	Sample/Interval	PID/OVM (ppm)	Blow Count	% Recovery	Lithology	Description	Well Details
22						***Siltstone*** *(continued)*	
24							
26							
28							
30							
32							
34						Bottom of Boring at 33 feet	
36							
38							
40							

Geologist(s): Erik S. Reinert
Subcontractor: Parratt Wolff, Inc.
Driller/Operator: Shawn Bodah
Method: HSA/Air Rotary

WSP USA Corp.
5 Sullivan Street
Cazenovia, NY 13035
(315) 655-3900