April 11, 2018

Mr. Brian Sadowski
Division of Environmental Remediation
New York State Department of Environmental Conservation
270 Michigan Ave.
Buffalo, New York 14203-2999

Re: Work Plan for Hydrogeologic Investigation
Former Stauffer Management Company Site
Lewiston, New York
Site ID No. 932053
Langan Project No.: 130117301

Dear Mr. Sadowski:

On behalf of the Stauffer Management Company (SMC), Langan Engineering, Environmental, Surveying and Landscape Architecture, DPC (Langan) has prepared the enclosed work plan for a hydrogeologic investigation at the former SMC Site in Lewiston, New York. The primary objective is to provide data to update and refine the Site's hydrogeologic site conceptual model with a more complete understanding of bedrock fracture flow conditions, the distribution of volatile organic compound (VOC) mass in groundwater, and groundwater hydraulics. We are providing this work plan to inform the New York State Department of Environmental Conservation (NYSDEC) of the planned investigation and the need to temporarily shut down part of the groundwater extraction system for a period of about six weeks to collect downhole data in select wells. The work plan provides details of the planned investigation activities and a conceptual schedule for field activities that will be performed. The actual timing for the start of field activities has not yet been determined; however, we will notify your office of the anticipated start date in advance.

We request NYSDEC's concurrence to temporarily shut down groundwater extraction wells, EW-1, EW-2, EW-3, and EW-5 to allow for the downhole data to be collected as prescribed in the work plan. If you have any questions or should you need additional information, please contact us. We look forward to working with you on the project.

Sincerely,
Langan Engineering, Environmental, Surveying and Landscape Architecture, DPC

Stewart H. Abrams, PE
Vice President
Director of Remediation Technology

Enclosure(s): Work Plan for Hydrogeologic Investigation

cc: John-Paul Rossi, SMC/Astra Zeneca
Kurt Batsel, Dextra Group (representing SMC)
Howard Nichols, Jeff Smith, Adam Hackenberg, Langan

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WORK PLAN FOR HYDROGEOLOGIC INVESTIGATION

STAUFFER MANAGEMENT COMPANY SITE
5608 OLD LEWISTON ROAD
LEWISTON, NY 14092

Prepared For:

AstraZeneca
1800 Concord Pike
Wilmington DE, 19803

Prepared By:

Langan Engineering and Environmental Services, Inc.
124 Lennox Drive, Suite 124
Lawrenceville, NJ 08648

April 6, 2018
130117301

LANGAN

WORK PLAN FOR HYDROGEOLOGIC INVESTIGATION

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Adam Hackenberg, P.G.
Senior Project Manager

Jeffery Smith, P.G.
Associate

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1.0 OBJECTIVES

On behalf of AstraZeneca, Langan Engineering & Environmental Services, Inc. ("Langan") has prepared this Work Plan for a Hydrogeologic Investigation at the Stauffer Management Company ("SMC") Site (the "Site") located in Lewiston, New York. The primary objective is to provide data to update and refine the Site's hydrogeologic site conceptual model with a more complete understanding of bedrock fracture flow conditions, the distribution of volatile organic compound (VOC) mass in groundwater, and groundwater hydraulics. This information will be used to optimize the existing groundwater extraction and treatment system.

This hydrogeologic investigation is focused on collecting Site-specific data to validate the relevance of concepts described in a regional hydrogeologic model. Specific data to be obtained include:

- The depth and orientation of discrete bedrock fracture flow zones;
- The connectivity of these fracture zones;
- The distribution of site constituents of concern in groundwater; and
- The zone of hydraulic influence of the extraction wells in the existing groundwater extraction system.

2.0 SITE DESCRIPTION

2.1 Physical Setting

The Site is located at 5608 Old Lewiston Road in Lewiston, New York. A Site Location Map showing the Site on a USGS Topographic Map is provided as Figure 1. A cemetery is located north of the Site. Interstate 190, the Niagara Thruway, is located east of the Site. State Route 104 and the Niagara River are located west of the Site. The forebay of the New York Power Authority (NYPA) Robert Moses Power Plant is located directly south of the Site. Components of the power plant are located on the eastern and western ends of the forebay.

The forebay connects the Lewiston Reservoir, located east of the Site, with the Niagara River, located west of the Site beyond State Route 104 in a steeply-sided gorge. Site topography slopes gently to the west and southwest.

2.2 Site History

The Site is a former chemical manufacturing facility originally owned and operated by Stauffer Chemical Company. The Site operated as a plant for producing metallic aluminum from about 1900 to 1930. Between 1930 and 1976, the plant produced carbon tetrachloride and various metal chlorides. The primary chemical feedstock was carbon disulfide which was reacted with chlorine to produce carbon tetrachloride and sulfur chlorides. Parachlorothiophenol was also produced from chlorobenzene and sulfur chlorides. Bulk methylene chloride and tetrachloroethene (also known as perchloroethylene or "PCE") were also handled at the plant. Chemical operations ceased in 1976. All structures associated with the former plant were demolished in the early 1980s.

In 1995, in accordance with Consent Order (CO) #B9 0137 86 04 with the New York State Department of Environmental Conservation (NYSDEC), SMC initiated remedial construction activities for soil and groundwater. The NYSDEC approved the Site-specific contaminants of concern (COCs) proposed by SMC to be as follows.

- Benzene
- Carbon Disulfide
- Carbon tetrachloride
- PCE
- Trichloroethene (TCE)
- Chlorobenzene
- Chloroform
- Methylene chloride
- Toluene

These chemicals have been detected at varying concentrations in the groundwater, subsurface soils, seeps, and surface water runoff at, and in, the immediate vicinity of the Site. At one time, three separate soil vapor extraction (SVE) systems were operated and maintained to treat soil source areas. Two of the three SVE systems have been decommissioned with NYSDEC approval and demolished, and the third has been shut-down and is slated for demolition.

A groundwater extraction and treatment system has been in operation since 1995. The groundwater extraction network consists of a total of 11 active recovery wells. Two of the wells have been described as "deep bedrock" groundwater extraction wells (LR-66 and OW-3). There are also three intermediate/deep bedrock extraction wells (EW-1, EW-

2, EW-3); three shallow bedrock extraction wells (EW-4, EW-5, and EW-6); and three shallow (and formerly dual phase) extraction wells in Area A (DPA-201, DPA-202, and DPA-203). The locations of these extraction wells are shown on Figure 2.

The Site reportedly has 109 total wells (including extraction and monitoring wells) of various depths. Many of the well locations are shown on Figure 2. An inventory of the monitoring and extraction wells and well construction information gathered from review of previous environmental reports completed by others is provided as Table 1. In some instances the well completion details, i.e., screen depth, are not available. Table 1 will be updated as additional information is received.

The purpose of the groundwater extraction system is to control the potential migration of COCs in the groundwater at the Site and its immediate vicinity. The groundwater extraction wells are intended to contain the groundwater on-site and prevent migration of the contaminants off-site to the forebay, which leads to the Niagara River. The Site's groundwater extraction system has been in operation for over 20 years. During that time, it is estimated that some 69,000 pounds of VOCs have been removed from groundwater, and COC concentrations have declined in groundwater at individual wells through time. However, COC concentrations remain elevated; the maximum groundwater concentrations in 2016 include (GHD, 2017):

- Carbon tetrachloride at 190,000 micrograms per liter (µg/L),
- Carbon disulfide at 380,000 µg/L, and
- Chloroform at 48,000 µg/L.

Additionally, there have been on-going operational issues including biological fouling and/or mineral scaling resulting in excess operation and maintenance efforts. As part of ongoing efforts to assess and improve operational effectiveness, SMC is undertaking a review of Site hydrogeological conditions and the site conceptual model (SCM).

2.3 Geology

The surficial geology of the Site area consists of a relatively thin layer, 10 feet on average, of unconsolidated fill and soil of predominantly glacial till and lacustrine sediments, underlain by bedrock of the Niagaran Series. This bedrock includes portions of the Lockport Group (Eramosa, Goat Island and Gasport Dolomite Formations underlain by the Clinton Group (Descew Dolomite and Rochester Shale Formations). The Niagaran Series in Western New York is an approximately 370-foot thick deposit of Silurian-aged sedimentary rock, deposited in a shallow inland sea. The Lockport Group and Clinton Group geology is generally characterized as nearly flat-lying planar beds of dolomite, limestone, and shale. The geologic strata are generally continuous over the Niagara Region with a very gentle dip to the south-southeast at approximately 0.4 degree.

2.4 Hydrogeology

The water table is encountered in the upper bedrock at a depth of about 20 feet based on 2016 monitoring data (GHD, 2017). The current extraction and monitoring wells were installed based on the depths to four general hyrdostratigraphic designations, identified as:

- Upper Lockport Water Bearing Zone
- Lower Lockport Water Bearing Zone
- Lockport/Rochester Water Bearing Zone
- Rochester Water Bearing Zone

At the nearby Hyde Park Landfill Site, a very detailed groundwater characterization and hydrogeological site conceptual model was prepared as part of a comprehensive remedial characterization (by Conestoga-Rovers & Associates, Services Environmental, Inc., and SS. Papadopulous & Associates, Inc. 2004). The Hyde Park studies present a more detailed hydrogeologic system of eleven, discrete bedding-parallel groundwater flow zones that may or may not be relevant at the SMC Lewiston Site. Langan has designed a phased hydrogeological investigation focused on gathering more detailed hydraulic and chemistry characteristics within the discrete bedrock fractures to bolster understanding of Site characteristics, explore the relevance of concepts revealed at the nearby Hyde Park site, and update the SMC Lewiston site conceptual model.

3.0 HYDROGEOLOGIC INVESTIGATION

The investigation activities include water-level monitoring, downhole geophysics, vertical profiling of COC concentrations, packer testing and short-term pumping and recovery tests of select wells, as summarized on Table 2. This work will require temporarily shutting down part of the groundwater extraction system for a period of about 6 weeks. Wells were selected for investigation based on multiple factors, including:

- Construction of the well (a sufficient open borehole interval is needed to allow for borehole geophysics and bedrock fracture characterization);
- Location of the well with respect to potential source areas, with emphasis on zones downgradient of the source areas; and
- Location of the well with respect to other wells being investigated, to provide spatial coverage of mapped plume conditions.

Details of the hydrogeologic investigation are described in the remainder of this Section.

3.1 Health and Safety Plan

In accordance with 29 CFR OSHA Regulations 1910.120, a Site-specific Health and Safety Plan ("HASP") has been prepared by Langan for field activities at the Site, including the operation and maintenance of the groundwater extraction system and groundwater monitoring, which are not included in this Work Plan. The HASP updates will include descriptions of procedures and the potential hazards associated with the Site investigation.

3.2 Removal of Selected Extraction Well Pumps

Langan will temporarily shut-down and remove the pumps from bedrock extraction wells EW-1, EW-2, EW-3, and EW-5. These wells all have rather long (greater than 50 feet) open boreholes that are advantageous for conducting hydrogeologic testing. The pump removal will allow for performance of downhole geophysics, vertical profiling of contaminant distribution, and packer testing. Four pumps will be turned off and removed along with the associated piping by a drilling subcontractor, SJB Services, Inc. of Buffalo, New York, under the observation of Langan field staff.

3.3 Continuous Water-Level Monitoring

At least 24 hours before the pumps are shut off and removed (as described in Section 3.2), pressure transducers/data loggers (data loggers) will be deployed in about fifteen monitoring wells around EW-1, EW-2, EW-3 and EW-5 to establish baseline conditions and then monitor the water level response to the shut-down of the pumps in these four wells.

The Rugged TROLL 100 data logger by In-Situ™ will be used. These data loggers are capable of measuring pressure responses that equate to water level changes, with an accuracy of 0.01 foot, at intervals as small as one reading per second. Up to 120,000 data records can be stored on these data loggers. One Rugged BaroTROLL will also be deployed, which measures and logs the barometric pressure and temperature in air. The BaroTROLL data will be used to compensate the datalogger readings for barometric pressure effects.

The data loggers will record the water level changes in response to the sequential shut-down of the extraction system wells completed in different water bearing flow zones. The data loggers will remain in place for at least 24 hours after the last pump is removed. Additionally, manual measurements of groundwater levels will be taken during this period in other nearby surrounding wells to supplement the monitoring network. As with the prior Hyde Park Landfill study, we also assume that water-level monitoring data from the New York Power Authority for the forebay and reservoir will be available via a formal Freedom of Information Act request to further supplement our monitoring data set.

3.4 Downhole Geophysics

Downhole geophysics will be performed in the open boreholes of extraction wells EW-1, EW-2, EW-3, EW-5, and monitoring wells R-19 and R-62, to identify fracture zones, water-bearing zones and vertical flow directions along the length of the open borehole. Additionally, the geophysical logs will provide detailed information regarding hydrostratigraphy that can be correlated across the Site. The downhole geophysical survey will be performed by Earth Data Northeast, Inc. of Exton, Pennsylvania. The following logs will be performed:

- Televiewer/Video: provides a 360° view of the borehole walls that can be used to identify and determine the orientation of planar features such as bedding and fractures and the relative degree of hardness of formation materials. A downhole video can be used in a more dynamic or flexible way, to record the condition of each existing open-hole.

- Caliper: measures variations in borehole diameter as a function of depth. Enables the detection of competent or fractured geologic units, the location of washouts or tight zones, and may be an indicator of lithologic makeup and degree of consolidation.
- Gamma Ray: measures radioactivity from geologic units encountered in the borehole. The gamma ray log is an excellent lithologic indicator because fine-grained clays and shales contain a higher radioelement concentration than limestones or sands.
- Single Point Resistivity (SPR): used to detect fractures in the borehole following variations in the resistivity of the bedrock.
- Spontaneous Potential (SP): can be qualitatively used for permeability recognition. SP deflections from the shale base line commonly indicate the presence of a permeable bed.
- Normal Resistivity: measures electrical resistivity of current passing through bedrock. Formation resistivity is an intrinsic property of rocks and depends on the porosity and resistivity of the interstitial fluid and rock matrix.
- Fluid Resistivity: provides fluid column dissolved solids data which can be useful to help identify a water-producing zone that is corroborated by other logs.
- Fluid Temperature: measures changes in fluid temperature as a function of depth and can indicate the location of water-producing strata or fracture zones within the well. These data are used to evaluate groundwater flow in conjunction with the heat pulse flow meter.
- Heat Pulse Flow Meter (HPFM): measures the vertical flow rates within a borehole. The log may be used to identify contributing fracture zones and vertical flow under natural and pumping conditions.

Finally, these logs will provide a basis for the selection of the packer test intervals.

The geophysical logging will be performed at least two days after the pumps have been removed from the wells to allow for settling of sediment that may be agitated by removal of the pumps and piping. Geophysical and sampling work is planned to be done prior to well disinfection associated with extraction well maintenance; if borehole conditions are determined by downhole video or other inspection to be poor, then disinfection may be done first to produce better downhole data quality. Coupled with available water quality data and system operation and performance data, the geophysical data will provide additional insights into the nature and distribution of well fouling in extraction wells EW-1, EW-2, EW-3, and EW-5 by providing a picture of the borehole through televiewer/video logging.

3.5 Packer Testing

After evaluating the results of the geophysics, we will conduct straddle packer testing of the open borehole in one of the following wells: EW-1, EW-2, or EW-3. We will determine which well to test based on the initial borehole geophysics analysis and available characteristics for each well. These wells have longer open-hole intervals. These open intervals provide a greater opportunity to evaluate: the yield and hydraulic characteristics of multiple water bearing zones; hydraulic connectivity with nearby monitoring wells; and VOC concentrations of the pumped water. We plan for up to 13 zones to be tested. The actual extraction well and intervals to be tested will be selected based on existing performance monitoring data, the outcomes of the downhole geophysical logging, and/or to target zones of potentially elevated VOC concentrations from the vertical profiling.

Earth Data Northeast. Inc. will supply the straddle packer system to isolate each zone and assist with data collection and interpretation. The water from each straddle packer test interval will be pumped to evaluate yield and the response of water levels to pumping in, above and below the packer. Purge water will also be tested for field water quality indicator parameters including pH, specific conductivity, temperature, dissolved oxygen (DO), and oxidation-reduction potential (ORP). Water levels in nearby monitoring wells will also be evaluated using pressure transducers to determine if there is any influence from pumping during the packer test. A groundwater sample will be collected near the end of each packer test for laboratory analysis of the following: Site COCs using USEPA Method 8260C (benzene, chlorobenzene, carbon disulfide, chloroform, carbon tetrachloride, methylene chloride, PCE, toluene, and TCE), sulfate, chloride, fluoride and bromide by EPA 300.0, major cations and metals by EPA 6010C, total hardness as calcium carbonate by SM 2340 B/C, total dissolved solids by SM 2540C, total organic carbon by EPA 9060A and alkalinity by SM 2320B.

3.5 Vertical Profiling

Vertical profile sampling will be conducted to evaluate the concentrations of VOCs in various fracture zones of the open intervals of wells that were chosen because they have rather long (greater than 50 feet) open boreholes that are advantageous for conducting vertical profile sampling. Vertical profile groundwater samples will be collected in wells EW-5, R-19-95, R-62-95 and whichever of the following three extraction wells are not packer tested: EW-1, EW-2, EW-3. We propose to collect one sample for every 10 feet of saturated open borehole, using passive diffusion bags (PDBs). This equates to a total of 29 to 31 samples, as summarized below:

Well	Open Borehole Interval	Number of PDB Samples**
EW-1*	32 – 163	12
EW-2*	23 – 150	13
EW-3*	27 – 163	14
EW-5	13.5 – 69	5
R-19	95 – 151	6
R-62	104 – 160	6

*Vertical profile sampling will be performed using PDBs in two of these three wells; the other will be evaluated via packer testing

**Water table is assumed to be approximately 20 feet based on 2016 groundwater monitoring.

PDBs are ideal for vertical profiling; they are cost-effective to deploy, cause minimal disturbance to the water column, and provide a time-averaged concentration. The PDBs will be placed to target water-bearing zones identified during the geophysical logging. After a one- to two-week equilibration time, the PDBs will be removed from the well, and the water inside will be sent to Test America of Buffalo, New York, a New York State-certified laboratory (laboratory identification numbers 10026) for analysis of Site COCs by USEPA Method 8260C

3.6 Aquifer Testing

After the geophysical logging, vertical profiling, and packer testing are complete, the pumps will be re-installed in extraction wells EW-1, EW-2, EW-3, and EW-5 by SJB Services, Inc. under the observation of Langan. Disinfection operations may be performed just prior to pump insertion, if appropriate, for project efficiency.

The pump in EW-3 will then be used to perform a constant rate pumping test, to:

- Determe the orientation and radius/extent of pumping influence;
- Provide additional lines of evidence for refining the hydrogeologic site conceptual model; and
- Provide additional data for optimizing the bedrock groundwater recovery system.

Prior to the test, the other bedrock pumping wells, LR-66, OW-3, DPA-201, DPA-202, and DPA-203, will be temporarily shut-down to monitor water-levels under non-pumping conditions for 24 hours before the on-set of pump tests.

Prior to the test, some of the previously installed pressure transducers may be removed from more distant locations and re-installed in wells that are nearer to the designated pumped well to establish a network of about 15 wells to continuously monitor water levels during the pumping test. The same equipment and methods described in Section 3.3 will be used. Periodic manual measurements of water-levels in other wells will also be taken.

With all other system extraction wells shut-down, the pump in the designated constant rate test extraction well will be started and run a minimum of 24 hours to evaluate drawdown in the pumping well and nearby monitored wells. The pump will be run at the typical flow rate for that well. The pump will then be shut down and water-level recovery data will be monitored for at least 24 hours prior to conducting additional tests, if any. After the pumping test has been conducted, the pumps at all other system recovery wells will be re-started. The pressure transducers will remain in place a minimum of one day after all pumps have been re-started as a means to evaluate the water level drawdown in response to the concurrent pumping.

3.7 Reporting

Data obtained during the field work will be evaluated and summarized in a technical memorandum that updates the hydrogeologic site conceptual model with the new hydrogeological data. The report will include:

- The geophysical logging results and an interpretation of the findings;
- A discussion of the hydrogeological results of the packer testing, including the yield of the packed interval and the effect of pumping the packed interval on nearby wells;
- A summary of the results of the VOC samples collected from packed intervals;
- A summary of the vertical profiling of VOCs using PDBs in the three extraction wells and two monitoring wells;
- A discussion of the results of the aquifer testing, including the calculation of specific yield and transmissivity and a discussion of the radius of influence of pumping;
- A discussion of the drawdown observed in the monitoring wells during the pumping tests;
- Geologic cross-sections showing key geophysical logging data, vertical profiling results, packer testing results, and hydraulic profiles and gradients;
- A discussion of the effectiveness and efficiency of the existing groundwater pump-and-treat system in light of the updated hydrogeologic site conceptual model; and
- Recommendations, including potential upgrades and modifications to the existing recovery well network to assure enhanced control of the VOC plume.

We will submit the technical memorandum to NYSDEC upon completion of the work.

4.0 QUALITY ASSURANCE/QUALITY CONTROL

4.1 Data Quality Objectives

The objective of the hydrogeologic investigation is to provide information to update the hydrogeologic site conceptual model. The analytical samples that are going to be collected will be one-time samples from packer testing or PDBs for vertical profiling of monitoring and extraction wells. The data quality objective for these samples is to provide relative concentrations of COCs between water-bearing zones. These analytical samples will not be used to support a risk assessment or to evaluate regulatory compliance, or remedial end points. The remainder of this section discusses the field and laboratory quality assurance/quality control ("QA/QC") measures that will be incorporated into the field activities to meet this data quality objective.

4.2 Equipment Decontamination and Calibration

Before and between each location, sampling and testing equipment that comes in contact with groundwater will be decontaminated. For large equipment, such as the geophysical tools and packer assembly, a decontamination pad will be used. Large equipment will be decontaminated with successive rinses of detergent and water. Smaller equipment, such as the pressure transducers and water level meter, will be cleaned with an external non-phosphate detergent wash and distilled deionized water rinse. This cleaning process will be followed by a flush of distilled deionized water. Decontamination fluids will be diverted to the existing treatment system.

When possible, dedicated equipment, such as the PDB samplers, will be used. This equipment will be disposed of after use.

Prior to the use of field instruments (i.e. water quality meter and photo-ionization detector), each will be calibrated per the operating manual for that instrument. The calibration will be recorded in the field notes for the project.

4.3 Sample Preservation

Samples will be preserved, where necessary, with the addition of chemical preservatives, and by cooling the samples to 4°C before and during shipment to the laboratory in accordance with the laboratory method being employed. Chemical additives necessary for sample preservation will be added to the sample containers by the analytical laboratory prior to releasing them to sampling personnel.

4.4 Field and Laboratory Quality Assurance/Quality Control

The samples to be collected as part of this investigation, from the aquifer testing and vertical profiling, are being used to update the hydrogeologic site conceptual model and support optimization of the groundwater extraction system, not to evaluate regulatory compliance. Therefore, typical quality control or quality assurance samples are not needed, such as field duplicate samples, field blank samples, and trip blanks. Blank samples of the deionized water used to fill the PDB samplers will be collected to evaluate the presence of background contamination of this water. One blank sample will be collected for each container of deionized water being used to fill the PDB samplers. Quality control and quality assurance samples will be collected during the annual groundwater sampling of the extraction and monitoring wells in accordance with the Site Management Plan.

A New York State-certified laboratory, Test America of Buffalo, New York, will be used for sample analysis. Langan will review laboratory packages to confirm that the laboratory complied with quality assurance/quality control measures from the analytical method, including: holding times, sample preservation, laboratory blanks, laboratory control samples, matrix spike samples, lab duplicates, and system monitoring compounds.

4.5 Documentation

Field equipment will be calibrated to the manufacturer's specifications and a record of the calibration will be kept in the field log book. Chain-of-custody forms will be maintained throughout the sampling program to document sample acquisition, possession, and analysis. Chain-of-custody documentation accompanies samples from the field to the laboratory. Each sample is assigned a unique number that is recorded on permanent field notes.

5.0 SCHEDULE

A schedule for the field work is provided as Figure 3. This schedule is for field activities that will be initiated after any prerequisite activities are completed (e.g. mobilization, disinfection of existing recovery wells, or other preparation). The schedule is designed to minimize the time the extraction wells are shut-down, which is not expected to exceed a six week period. A technical memorandum will be provided to SMC within eight to ten weeks of completing the field activities.

6.0 REFERENCES

Conestoga-Rovers & Associates, Services Environmental, Inc., and SS. Papadopulous & Associates, Inc. August 2004. "Comprehensive Remedial Characterization Report, Hyde Park Landfill Site, Town of Niagara, New York".

GHD. April 2017. "2016 Operations and Maintenance Report, Stauffer Management Company LLC Site, Town of Lewiston, New York".

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TABLES

Table 1
Well Construction Summary Table
Stauffer Management Company Site
Lewiston, New York

Well ID	Northing (ft_NAD83)	Easting (ft_NAD83)	Elevation Top of Inner Casing (ft)	Northing, Easting, and Elevation of Top of Inner Casing Data Source	Ground Surface Elevation (ft)	Stickup Length (ft)	Well Depth (ft bgs)	Open Interval Top (ft bgs)	Open Interval Bottom (ft bgs)	Open Interval (ft)	Casing	Well Diameter (in)	Well Type
B-02**	1146250.38	1027130.61	569.84	GHD	566.8	3.04	106	102.8	104.3	1.5	PVC	1.5	screened
B-03	1146431.00	1026443.00	--	See Notes 1 and 2	559	--	--	--	--	--	--	--	--
D-05	1146055.00	1030610.00	--	See Notes 1 and 2	614	--	--	--	--	--	--	--	--
D-07	1145981.00	1030470.00	--	See Notes 1 and 2	512.5	--	--	--	--	--	--	--	--
DPA-201*	1146178.66	1027862.33	600.07	GHD	597	3.07	22	2	22	20	steel	4	screened
DPA-202*	1146133.86	1027999.73	602.08	GHD	598.5	3.58	26	5	25	20	steel	4	screened
DPA-203*	1146004.36	1028024.14	604.93	GHD	602	2.93	27.5	6.5	26.5	20	steel	4	screened
EW-1*	1146227.80	1027257.60	589.45	GHD	587	2.45	163	32	163	131	steel	6	open hole
EW-2*	1145964.82	1027521.43	592.09	GHD	588.4	3.69	150	23	150	127	steel	6	open hole
EW-3*	1145898.54	1028049.11	605.65	GHD	603.2	2.45	163	27	163	136	steel	6	open hole
EW-4*	1145868.64	1027640.35	595.4	GHD	592.9	2.5	71.6	16	71.6	55.6	steel	6	open hole
EW-5*	1146176.92	1027870.81	599.39	GHD	596.9	2.49	69	13.5	69	55.5	steel	6	open hole
EW-6*	1145962.39	1027927.15	601.28	GHD	598.8	2.48	71.5	16	71.5	55.5	steel	6	open hole
GPG-51	1146136.00	1026910.00	--	See Notes 1 and 2	577.25	--	--	--	--	--	--	--	--
IR-49	1146068.00	1027257.00	587.22	See Notes 1 and 2	586	1.22	--	--	--	--	--	--	--
IR-51	1146140.00	1026941.00	578.99	See Notes 1 and 2	576.75	2.24	--	--	--	--	--	--	--
LR-16	1146290.15	1027964.42	599.89	GHD	597.9	1.99	90.5	80.5	90.5	10	PVC	2	screened
LR-2	1145951.27	1027666.92	594.53	GHD	592.1	*2.43*	89	78	88	10	PVC	2	screened
LR-20	1146329.88	1027486.05	592.06	GHD	591.5	0.56	85	75	85	10	PVC	2	screened
LR-48	1145850.19	1027394.73	586.85	GHD	585	*1.85*	74.7	54	64	10	PVC	2	screened
LR-49	1146096.36	1027350.14	588.01	GHD	586.3	1.71	73	63	73	10	PVC	2	screened
LR-50	1146341.31	1027230.19	589.51	GHD	587.9	1.61	75	63.7	73.7	10	PVC	2	screened
LR-51	1146150.99	1027010.38	579.15	GHD	577.4	1.75	65	54	64	10	PVC	2	screened
LR-61	1145873.86	1027848.90	601.66	GHD	598	3.66	99	78	99	21	steel	4	open hole
LR-62	1145761.51	1028288.01	607.94	GHD	603.5	4.44	103	83	103	20	steel	4	open hole
LR-66*	1146212.49	1027664.93	595.8	GHD	592.8	3	89.5	79.5	89.5	10	PVC	2	screened
LR-67	1146063.28	1028342.07	605.74	GHD	603.5	2.24	100	90	100	10	PVC	2	screened
LR-69	1146003.13	1027277.74	585.87	GHD	583.4	2.47	85	75	85	10	PVC	2	screened
LR-87	--	--	--	See Notes 1 and 2	--	--	--	--	--	--	--	--	--
NX-3	1145569.00	1027916.00	--	See Notes 1 and 2	592.5	--	--	--	--	--	--	--	--
OW-1	1146001.26	1028777.69	614.07	See Notes 1 and 2	612	2.07	139.6	118.3	139.6	21.3	steel	4	open hole
OW-10	1146570.00	1026783.00	573.8	See Notes 1 and 2	573.69	0.11	13.89	9	14	5	steel	2	open hole
OW-11	1146484.76	1028230.73	574.9	GHD	577	-2.1	--	--	--	--	--	--	--
OW-2	1146000.14	1028751.00	614.6	See Notes 1 and 2	612.3	2.3	188	160.2	188	27.8	steel	2	open hole
OW-3*	1146319.42	1027449.45	591.8	GHD	589.7	2.1	128	108	128	20	PVC	2	screened
OW-4	1146300.54	1027412.96	592.26	See Notes 1 and 2	589.9	2.36	166.2	140.4	166.2	25.8	steel	2	open hole
OW-5	1145909.41	1028437.80	609.25	GHD	607.2	2.05	101.8	88.8	101.8	13	steel	2	open hole
OW-6	1146043.90	1027248.63	587.87	See Notes 1 and 2	585.9	1.97	257.5	220	257.5	37.5	steel	4	open hole
OW-7	1146234.89	1027912.33	600.24	See Notes 1 and 2	597.4	2.84	13.1	7.8	13	5.2	steel	2	screened
OW-8	1147321.00	1026874.00	575.55	See Notes 1 and 2	575.4	0.15	11	6	11	5	steel	2	screened
OW-9	--	--	574.9	See Notes 1 and 2	575	-0.1	14.6	9.5	14.5	5	steel	2	screened

Table 1
Well Construction Summary Table
Stauffer Management Company Site
Lewiston, New York

Well ID	Northing (ft_NAD83)	Easting (ft_NAD83)	Elevation Top of Inner Casing (ft)	Northing, Easting, and Elevation of Top of Inner Casing Data Source	Ground Surface Elevation (ft)	Stickup Length (ft)	Well Depth (ft bgs)	Open Interval Top (ft bgs)	Open Interval Bottom (ft bgs)	Open Interval (ft)	Casing	Well Diameter (in)	Well Type
R-16	1146281.03	1027977.96	600.28	GHD	598	2.28	131	110	130	20	PVC	2	screened
R-19	1145637.56	1027895.17	598.86	GHD	594.8	4.06	151	95	151	56	steel	4	open hole
R-48	1145861.30	1027385.19	587.81	GHD	585.4	2.41	140	91	140	49	steel	4	open hole
R-49	1146056.42	1027269.79	587.57	See Notes 1 and 2	586.1	1.47	112.2	110.7	111.7	1	PVC	2	screened
R-50	1146322.43	1027229.32	590.41	GHD	587.6	2.81	141	90	141	51	steel	4	open hole
R-51**	1146167.05	1027008.21	578.78	GHD	577.2	1.58	120.3	118.6	120.1	1.5	PVC	1.5	screened
R-60	1146082.82	1027266.28	588.45	GHD	585.6	2.85	139	89	139	50	steel	4	open hole
R-61	1145873.34	1027860.10	601.6	GHD	597.9	3.7	155.5	100	155.5	55.5	steel	4	open hole
R-62	1145762.38	1028269.96	607.9	GHD	603.5	4.4	159.9	104	159.9	55.9	steel	4	open hole
R-66	1146185.36	1027669.49	591.83	GHD	589.4	2.43	150.8	130.8	150.8	20	steel	4	open hole
R-67	1146065.45	1028319.50	605.77	GHD	603.5	2.27	141	120	140	20	PVC	2	screened
R-68	1146370.17	1027111.05	587.38	GHD	585.7	1.68	121	100	120	20	PVC	2	screened
T-4*	1145853.89	1027644.87	595.81	GHD	590	5.81	--	--	--	--	--	--	--
TEW2	--	--	591.38	See Notes 1 and 2	588.4	2.98	150.4	--	--	--	--	6	--
W-1	1146193.83	1030527.00	618.49	See Notes 1 and 2	616.4	2.09	27.9	15.9	25.9	10	PVC	2	screened
W-11	1145725.82	1029157.04	614.42	See Notes 1 and 2	612.8	1.62	31	19	29	10	PVC	2	screened
W-12	1145881.82	1029322.03	616.59	See Notes 1 and 2	615.1	1.49	32.8	10.8	30.8	20	PVC	2	screened
W-13	1146253.83	1028703.05	613.58	See Notes 1 and 2	611.6	1.98	21.6	15	20	5	PVC	2	screened
W-14	1146019.82	1028766.05	614.85	See Notes 1 and 2	613	1.85	26	19	24	5	PVC	2	screened
W-15A	1145769.82	1027936.07	612.89	See Notes 1 and 2	611	1.89	54	47	52	5	PVC	2	screened
W-15B	1145725.82	1028672.05	613.22	See Notes 1 and 2	611.3	1.92	34	22	32	10	PVC	2	screened
W-15C	1145718.82	1028639.05	612.99	See Notes 1 and 2	611.1	1.89	18	11	16	5	PVC	2	screened
W-16	1146282.07	1027935.51	599.77	GHD	599.3	0.47	29.7	17.9	27.8	9.9	PVC	2	screened
W-16L	1146272.96	1027962.60	*600.16*	GHD	598.1	2.06	65	55	65	10	PVC	2	screened
W-17	1145957.27	1027916.00	602.36	GHD	600.2	2.16	26.8	15	24.9	9.9	PVC	2	screened
W-18A	1145769.82	1027936.07	602.53	See Notes 1 and 2	600.7	1.83	27.5	15.5	25.5	10	PVC	2	screened
W-18L	1145770.58	1028012.82	*601.47*	GHD	599	2.47	71	42	71	29	steel	6	open hole
W-18R	1145793.75	1028009.96	*601.45*	GHD	--	--	--	--	--	--	--	--	--
W-19A	1145628.66	1027876.51	597.41	GHD	595.5	1.91	39.5	33.5	38.5	5	PVC	2	screened
W-19B	1145649.06	1027888.66	596.57	GHD	594.8	1.77	82	65	80	15	PVC	2	screened
W-19D	1145646.67	1027845.26	595.49	GHD	593.5	1.99	23	11	21	10	PVC	2	screened
W-20	1146342.25	1027461.31	593.75	GHD	591.7	2.05	26.8	15	24.9	9.9	PVC	2	screened
W-22A	1145764.31	1027628.34	592.24	GHD	589.9	2.34	22.1	10.1	20.1	10	PVC	2	screened
W-23A	1145898.82	1027507.09	594.7	See Notes 1 and 2	592.6	2.1	59	42.4	57.1	14.7	PVC	2	screened
W-23B	1145937.55	1027602.34	594.67	GHD	592.7	1.97	41.9	30.1	40	9.9	PVC	2	screened
W-23C	1145919.67	1027596.09	594.89	GHD	592.8	2.09	21	14.2	19.1	4.9	PVC	2	screened
W-29A	1146254.89	1030563.30	--	See Notes 1 and 2	615.6	--	--	--	--	--	--	--	--

Table 1
Well Construction Summary Table
Stauffer Management Company Site
Lewiston, New York

Well ID	Northing (ft_NAD83)	Easting (ft_NAD83)	Elevation Top of Inner Casing (ft)	Northing, Easting, and Elevation of Top of Inner Casing Data Source	Ground Surface Elevation (ft)	Stickup Length (ft)	Well Depth (ft bgs)	Open Interval Top (ft bgs)	Open Interval Bottom (ft bgs)	Open Interval (ft)	Casing	Well Diameter (in)	Well Type
W-29B	1146257.60	1030533.10	--	See Notes 1 and 2	615.3	--	--	--	--	--	--	--	--
W-2A	1146590.83	1030187.01	617.33	See Notes 1 and 2	615.5	1.83	31.5	15	20	5	PVC	2	screened
W-2B	1146583.83	1030186.01	617.33	See Notes 1 and 2	615.5	1.83	51.1	26.75	41.5	14.75	PVC	2	screened
W-2C	1146572.83	1030176.01	617.19	See Notes 1 and 2	615.5	1.69	13.2	8.2	13.2	5	PVC	2	screened
W-34	1146152.90	1030536.20	--	See Notes 1 and 2	615.8	--	--	--	--	--	--	--	--
W-3A	1146214.83	1029455.03	619.54	See Notes 1 and 2	617.4	2.14	60	44	54	10	PVC	2	screened
W-3B	--	--	--	See Notes 1 and 2	--	--	--	--	--	--	--	--	--
W-3C	1146208.83	1029462.03	619.11	See Notes 1 and 2	617.5	1.61	40.5	28.5	38.5	10	PVC	2	screened
W-3D	1146218.83	1029466.03	619.48	See Notes 1 and 2	617.6	1.88	17.8	10.8	15.8	5	PVC	2	screened
W-4	1146098.82	1029577.03	619.78	See Notes 1 and 2	617.8	1.98	21	9.3	19.2	9.9	PVC	2	screened
W-48E	1145859.39	1027396.47	587.7	GHD	585.9	1.8	38.2	27.4	37.2	9.8	PVC	2	screened
W-50L	1146328.51	1027248.64	589.96	GHD	588	1.96	65	55	65	10	PVC	2	screened
W-5A	1146005.82	1029865.02	619.81	See Notes 1 and 2	618	1.81	35.3	29.3	34.3	5	PVC	2	screened
W-5B	1146007.82	1029880.02	619.75	See Notes 1 and 2	617.9	1.85	26.1	18	23	5	PVC	2	screened
W-5C	1146019.82	1029868.02	619.82	See Notes 1 and 2	617.8	2.02	19.1	11	17	6	PVC	2	screened
W-6	1145913.82	1029764.02	619.93	See Notes 1 and 2	617.6	2.33	17	10.2	15.1	4.9	PVC	2	screened
W-60L	1146077.85	1027246.83	588.86	GHD	585.5	3.36	--	--	--	--	--	--	--
W-65	1145924.94	1027275.38	586.2	GHD	583.3	2.9	55	23	55	32	steel	6	open hole
W-66	1146185.58	1027646.92	595.1	GHD	592.5	2.6	46	19	46	27	steel	4	open hole
W-66L	1146207.72	1027640.84	594.26	GHD	592.3	1.96	64.7	55	65	10	PVC	2	screened
W-67	1146086.72	1028342.72	605.98	GHD	603.4	2.58	40	15	40	25	steel	4	open hole
W-67L	1146088.24	1028320.80	605.47	GHD	603.5	1.97	70	50	70	20	PVC	2	screened
W-70L	1145802.85	1027645.26	*594.57*	GHD	591.5	3.07	72	42	72	30	steel	6	open hole
W-7A	1145816.80	1029648.90	618.59	See Notes 1 and 2	616.8	1.79	34.4	28.4	33.4	5	PVC	2	screened
W-7B	1145817.82	1029668.02	618.83	See Notes 1 and 2	616.6	2.23	61.8	45.8	59.8	14	PVC	2	screened
W-7C	1145829.82	1029658.02	618.86	See Notes 1 and 2	616.8	2.06	19	12	17	5	PVC	2	screened
W-8A	1145734.82	1029567.03	617.97	See Notes 1 and 2	616	1.97	24.45	7.85	22.55	14.7	PVC	2	screened
W-9A	1145652.82	1029472.03	616.97	See Notes 1 and 2	614.9	2.07	54.5	42	52	10	PVC	2	screened
W-9B	1145642.82	1029457.03	617.06	See Notes 1 and 2	615.1	1.96	35	28	33	5	PVC	2	screened
W-9C	1145635.82	1029470.03	617.27	See Notes 1 and 2	615.2	2.07	26	14	24	10	PVC	2	screened

Notes:

1 Northing and easting coordinates were obtained from GHD in electronic format on February 28, 2018. Additional northing and easting coordinates were obtained from well logs, if available, and converted from NAD27 to NAD83. Otherwise coordinates were estimated from a survey map by Niagara Boundary and Mapping Services dated July 6, 1993.

2 Elevation data were obtained from GHD in electronic format on February 28, 2018. Additional ground surface elevations were obtained from well logs, if available. Otherwise, ground surface elevations were estimated from a survey map by Niagara Boundary and Mapping Services dated July 6, 1993.

NAD27 North American Datum of 1927
NAD83 North American Datum of 1983
ft - feet
bgs - below ground surface
in - inches
-- indicates no data is available.
* Extraction wells
** Well screens defined in well completion/boring logs as having a length of 1.5 feet and an outside diameter of 1.5 inches.

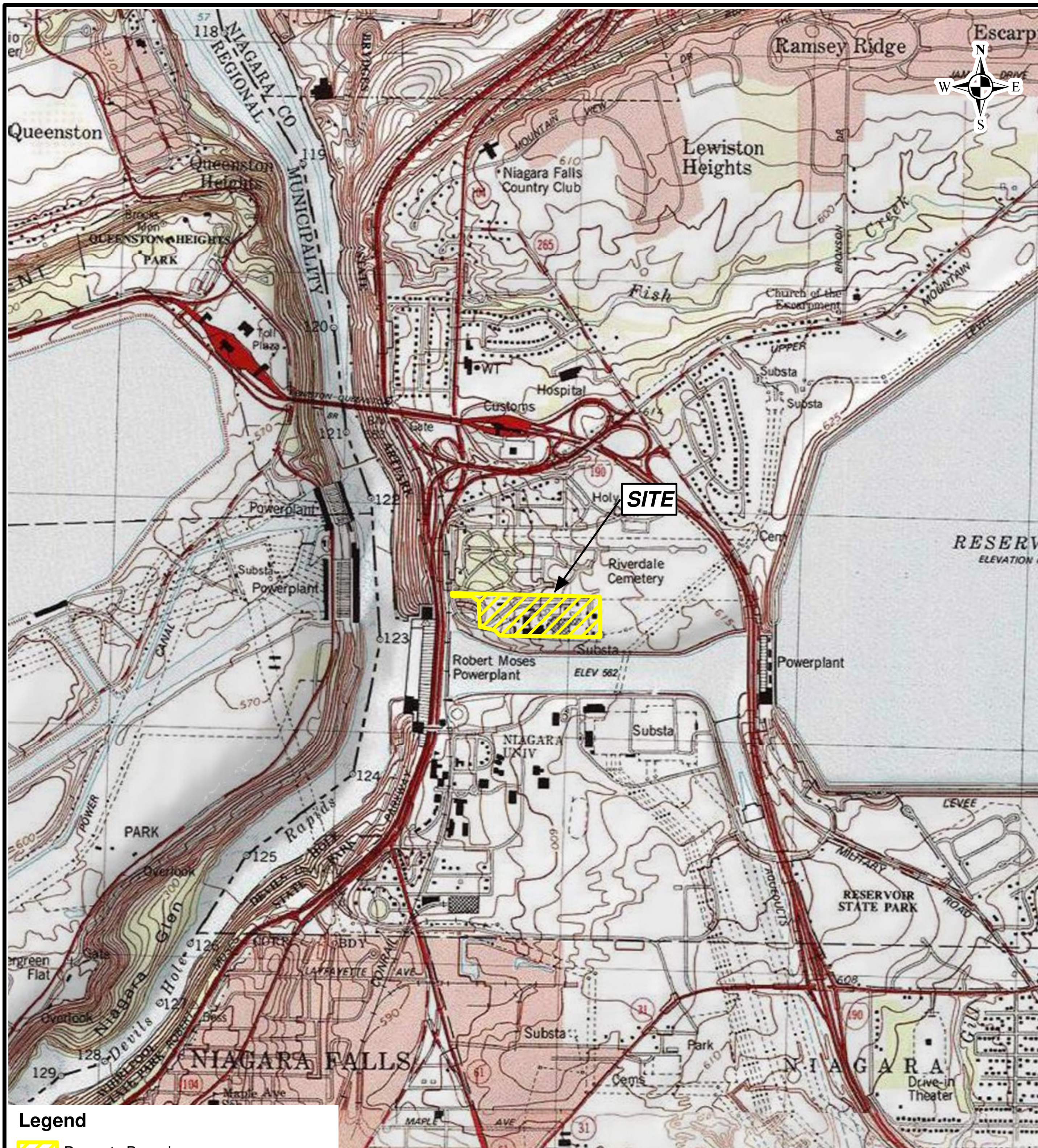
Table 2
Overview of Hydrogeologic Investigation
Stauffer Management Company Site
Lewiston, New York

Investigation Task, Data Collection & Objectives		**Downhole Geophysics**	**PDB Vertical Profiling of COCs**	**Packer Testing**	**Short-Term Pumping/Recovery Tests**
		• Identify/confirm water bearing fracture zones • Provide detailed information regarding hydrostratigraphy and fractured flow zones that can be correlated across the Site • Provide a basis for selection of packer test intervals and vertical profile sample intervals	• Resolve the vertical distribution of site COCs and contaminant mass	• Characterize hydraulic properties • Evaluate influence of pumping in discrete intervals at nearby wells • Sample discrete vertical intervals for inorganic and geochemical indicator parameters	• Evaluate radius and orientation of pumping influence for key extraction wells • Further characterize aquifer properties to bolster CSM and support future fate and transport and hydraulic control evaluations
Well	**Open BoreHole Interval (feet bgs)**				
EW-1*	32 - 163	X	X	X**	
EW-2*	23 - 150	X	X	X**	
EW-3*	27 - 163	X	X	X**	X
EW-5*	13.5 - 69	X	X		
R-19	95 - 151	X	X		
R-62	104 - 160	X	X		

* Assumes temporary shut-down of groundwater extraction, removal of pump and appurtenance for an estimated duration of 6 weeks.
** Packer testing will be performed at one of these three wells; the well chosen for packer testing will not be sampled with PDBs.

\\langan.com\data\LAW\data3\130117301\Project Data_Discipline\Environmental\Task 4 - Site Conceptual Model Update\Workplan\Tables\Table 2 - Overview of Investigation.docx

FIGURES



Legend

Property Boundary

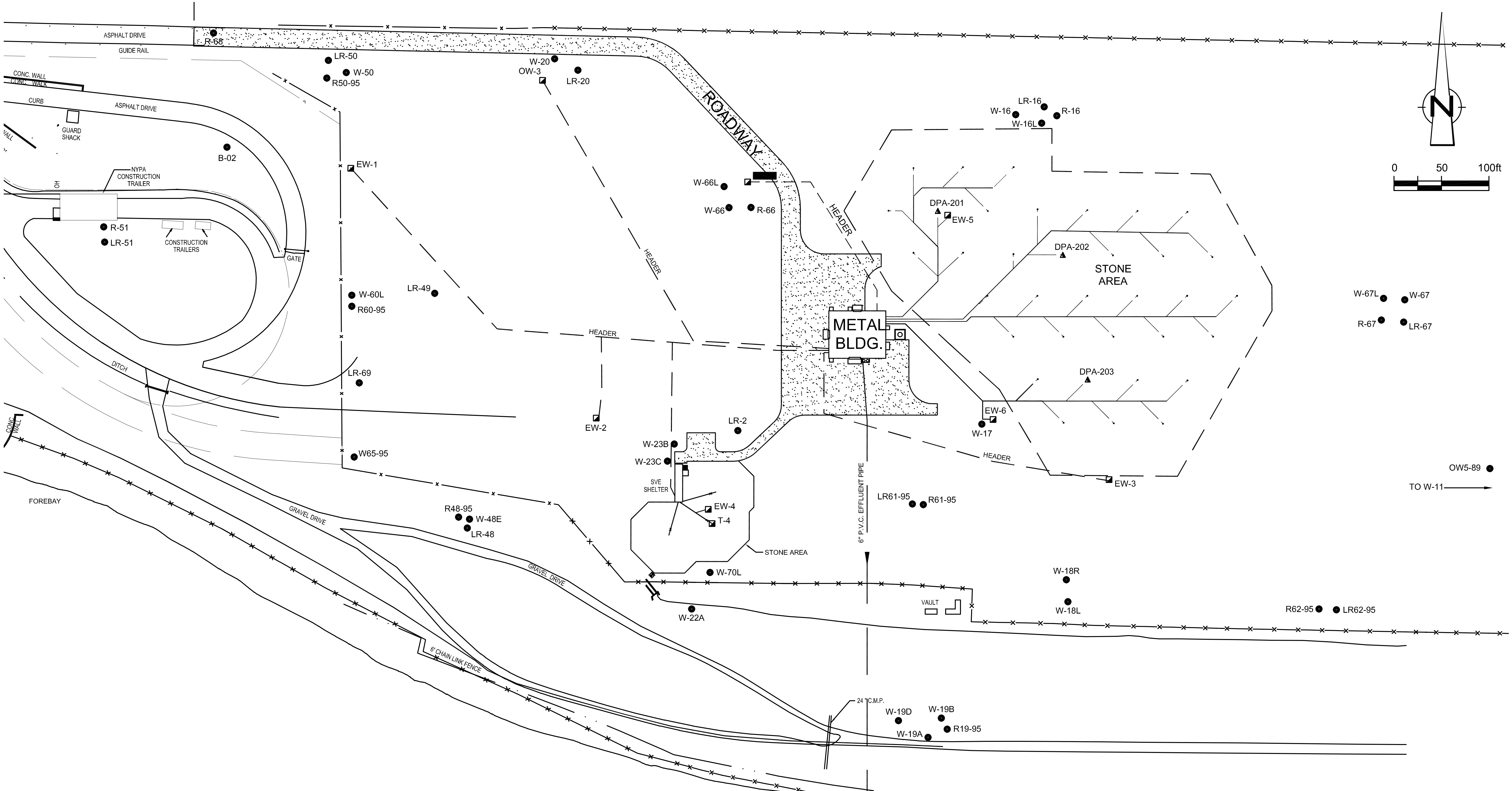
2,000 0 2,000

SCALE IN FEET

Notes:
1. Topographic basemap is provided through Langan's Esri ArcGIS software licensing and ArcGIS online © 2013 National Geographic Society, i-cubed.
2. Property boundary (parcel number 5715) referenced from Niagara County online GIS mapping system.

LANGAN	Project	Drawing Title	Project No.	Figure
989 Lenox Drive, Suite 124 Lawrenceville, NJ 08648 T: 609.282.8000 F: 609.282.8001 www.langan.com	STAUFFER MANAGEMENT COMPANY, LLC LEWISTOWN	SITE LOCATION MAP	130117301	1
Langan Engineering & Environmental Services, Inc. Langan Engineering, Environmental, Surveying and Landscape Architecture, D.P.C. Langan International LLC Collectively known as Langan			Date 3/5/2018	
			Scale 1"=2,000'	
			Drawn By MH	
NJ CERTIFICATE OF AUTHORIZATION No. 24GA27996400	NIAGARA COUNTY NEW YORK		Submission Date	

Path: \\langan.com\data\LAW\data3\130117301\Project Data\ArcGIS\MXD\Environmental_Figures\Figure 1 - Site Location Map_3-5-18.mxd Date: 3/5/2018 User: MHAGAN Time: 4:57:49 PM



LEGEND

W-66 ● MONITORING WELL

EW-2 ◪ GROUNDWATER EXTRACTION WELL

DPA-201 ▲ DUAL PHASE EXTRACTION WELLS

NOTES:

1. MAP PROVIDED BY GHD, TITLED FIGURE 1.3 EXTRACTION AND MONITORING WELLS.

LANGAN
989 Lenox Drive, Suite 124
Lawrenceville, NJ 08648
T: 609.282.8000 F: 609.282.8001 www.langan.com
Langan Engineering, Environmental, Surveying and Landscape Architecture, D.P.C. S.A
Langan Engineering, Environmental, Surveying and Landscape Architecture, D.P.C.
Langan Engineering and Environmental Services, Inc.
Langan CT, Inc.
Langan International LLC
Collectively known as Langan
NJ CERTIFICATE OF AUTHORIZATION No. 24GA27996400

Project

STAUFFER MANAGEMENT COMPANY, LLC

LEWISTOWN

NIAGARA COUNTY NEW YORK

Drawing Title

EXTRACTION AND MONITORING WELL LOCATIONS

Project No.	130117301
Date	3/5/2018
Scale	1"=100'
Drawn By	MH
Checked By	MS
Submission Date	
Drawing No.	2
Sheet	of

Filename: \\langan.com\data\LAW\data3\130117301\Project Data\CAD\01\2D-DesignFiles\Environmental\Well Locations_3-5-18.dwg Date: 3/5/2018 Time: 17:09 User: mhagan Style Table: Monochrome.ctb Layout: ANSIB-BL

Figure 3
Field Activities Schedule
Stauffer Management Company Site
Lewistown, New York

Activity	Week 1					Week 2					Week 3					Week 4					Week 5					Week 6				
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Deploy Transducers	■	■									■										■	■								
Retrieve Transducers						■	■									■										■	■			
Manual Gauging		■	■	■	■						■	■	■	■	■								■	■	■	■				
Remove Pumps (4)			■	■																										
Downhole Geophysics (six wells)						■	■	■	■	■																				
Deploy PDBs (five wells)											■	■																		
Retrieve PDBs (five wells)																			■	■										
Packer Testing (one well, 13 intervals)											■	■	■	■	■															
Reinstall Pumps (4)																					■	■								
Short Term Pumping Test (two tests)																							■	■	■					
Groundwater Extraction System Shut-Down																					■									
Groundwater Extraction System Start Up																										■				