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March 21, 2019

Submitted Via Email

Mr. Brian Sadowski
New York State Department of Environmental Conservation
Division of Environmental Remediation, Region 9
270 Michigan Avenue
Buffalo, New York 14203-2999

Subject: Former Carborundum Facility
2040 Cory Drive, Sanborn, NY
NYSDEC Site No. 932102
PW-4 / P-2 Injection Pilot Study Work Plan

Dear Mr. Sadowski,

On behalf of Elm Holdings Inc., AECOM Technical Services, Inc. (AECOM) is pleased to provide this PW-4 / P-2 Area Injection Pilot Study Work Plan (Work Plan) for completing a pilot study to evaluate enhancements to the groundwater control and extraction and treatment program at the former Carborundum Facility located at 2040 Cory Drive in the Village of Sanborn, Town of Wheatfield, New York (Site), New York State Department of Environmental Conservation (NYSDEC) Site No. 932102.

The pilot study will be performed to determine if an injectate (sodium permanganate) can help reduce remnant volatile organic compound (VOC) concentrations at select areas of the Site. In addition, the pilot study will be used to estimate parameters required to apply this enhancement approach as part of ongoing remedial efforts at the Site.

This work plan provides the following information:

- A brief summary of the Site background, including Site history, previous investigation and remediation activities, remedial action objectives (RAOs), and Site geology/hydrogeology;
- A summary of the recently completed membrane interface probe / hydraulic profiling tool (MIP/HPT) study completed at the Site;
- A detailed scope of work for the proposed injection pilot study including information on the injectate; and,
- A description of upcoming Site-related activities and a proposed groundwater sampling and reporting plan to monitor the effectiveness of the injection pilot study.

I. Site Background

The following summary presents a brief description of Site history, previous investigation and remediation activities, Site RAOs, and Site geology and hydrogeology.

Figure 1 shows the Project Location Plan and Figure 2 shows the Site Plan. The Site property is comprised of four parcels totaling approximately 40 acres. Currently, there are two manufacturing buildings (Pyrotek, Inc. doing business as Pyrotek and a subsidiary business Metaullics, Inc.) and associated administrative buildings on the property. Construction of the most recent addition to the

manufacturing facilities on the northernmost parcel was completed in November 2011. The majority of land immediately adjacent to the property is used for agricultural purposes. Private residences border the property along the western boundary of the Site. Surface topography generally slopes to the south toward the Niagara River. Surface water from the paved areas of the Site is collected by Metaullics' sewer system.

VOCs, including primarily trichloroethene (TCE), were previously released to the environment during operations at the manufacturing facility, are being addressed under the direction of NYSDEC under a 1991 Order on Consent and associated modifications. TCE and its primary breakdown constituents, cis-1,2 dichloroethene (DCE) and vinyl chloride (VC), are present at select locations in the groundwater.

The 1991 Record of Decision (ROD) selected soil vapor extraction for overburden soil and permitted groundwater recovery and treatment for bedrock groundwater. The recovery and treatment systems are operated with the goal of preventing offsite migration of dissolved VOCs.

The groundwater recovery system (GRS) began operation in mid-1993 and treats groundwater using air stripping technology and an activated carbon polish. The GRS is operated with goals to provide onsite hydraulic containment and to prevent offsite migration of groundwater containing dissolved VOCs. Post-treatment water is discharged via a NYSDEC permitted State Pollutant Discharge Elimination System (SPDES) outfall to Cayuga Creek. Weekly discharge compliance samples are collected and analyzed in compliance with the SPDES permit.

A soil vapor extraction system was operated in conjunction with the GRS until 2001 and was subsequently decommissioned by 2007. In 2001, per discussions with NYSDEC, the bedrock groundwater recovery wells were reconfigured to extract groundwater from a shallower depth, focusing on the zones immediately at the top of bedrock and below the top of bedrock (Zone 1). Additional deeper bedrock Zones 2, 3, 4, and 5 were found to be less impacted and suitable for monitored natural attenuation (MNA). This reconfiguration reduced the volume of bedrock groundwater extracted, reduced flow through the GRS, and focused capture of groundwater in the source area(s) and allowed deeper, less contaminated zones to be monitored for natural attenuation.

Sumps contained within three vaults in the Metaullics facility were connected to the GRS in 2012. The vault water collection and conveyance (VWCC) system was brought online on June 12, 2012.

Figure 2 shows the location of Site purge wells (P- and PW-series wells) and monitoring wells (B-series wells). Attachment 1 presents the location of the purge wells and the three vaults in the Metaullics facility.

Quarterly groundwater sampling began in 1988. In October 2005, NYSDEC agreed to revise the groundwater sampling program and reduce the number of groundwater samples collected on an annual basis. In February 2016, NYSDEC requested that an updated groundwater monitoring program be developed. In October 2016, an updated groundwater monitoring program including transition to a semi-annual program was presented to NYSDEC. The proposed program was conditionally approved in November 2016 and was initiated in December 2016.

Site Geology/Hydrogeology

Overburden

The native soils underlying the Site generally consist of unconsolidated glacial lake sediment and till, including interbedded silts and clays with discontinuous sporadic fine sand lenses (shallow overburden). A thin coarse-grained layer is located above the bedrock (deep overburden). Based

on information presented in the Remedial Investigation, the average thickness of the overburden is approximately 21 feet bgs; ranging from seven feet in the northern portion of the site to 26 feet in the southern portion.

Overburden groundwater is first encountered as a discontinuous perched zone approximately three to five feet below grade. A more continuous water-bearing zone is encountered at the overburden bedrock interface (known as the “top of rock” zone). The natural flow of groundwater at the bedrock interface is to the south-southeast.

Chlorinated organics in deep overburden soils may be introduced to the bedrock aquifer from fluctuations of bedrock groundwater which periodically penetrate the soil on a seasonal basis. South and southwest of the Site, groundwater is restricted to the bedrock throughout the year. While the overburden on Site is occasionally affected by higher levels of bedrock groundwater, its hydraulic conductivity is so low that it does not transmit significant amounts of groundwater laterally and is classified as an aquitard. The zone at the overburden-bedrock interface is considered “top of rock” and is considered bedrock groundwater.

Bedrock

Overburden at the site is underlain by the Lockport Dolomite. The Lockport Group has been described as a massive- to medium-bedded, argillaceous dolomite with minor amounts of dolomite and shale. The upper 10 to 25 feet of this unit can be heavily weathered and often contains abundant bedding planes and vertical fractures enlarged by dissolution and glacial scour.

As noted above, a number of laterally definable fracture zones have been identified at the Site, including top of rock (at the overburden interface), and zones 1, 2, 3, 4, and 5. The top of rock zone and zone 1 are the bedrock groundwater recovery zones on which the GRS is focused. The deeper bedrock zones 2, 3, 4, and 5 show limited VOC impact. Bedrock groundwater flow is primarily to the south, with a southwesterly component toward a rock quarry located west-southwest of the Site

Attachment 2 presents top of rock and zone 1 groundwater elevation contour figures developed using data collected June 2018 and December 2018, figures presenting VOC concentrations in the top of rock zone and zone 1 for Spring 2018 and Fall 2018, and time-series plots for PW-4 and P-2.

II. MIP/HPT Study

A Membrane Interface Probe/Hydraulic Profiling Tool (MIP/HPT) study will be completed in the proposed injection area to provide additional data to support evaluation of enhancement of groundwater control and treatment. A letter work plan similar to the PW-3 Injection Pilot Study Work Plan (January 2018) will be submitted to NYSDEC for review and approval prior to the start of field studies.

The MIP/HPT study will focus on the area of PW-4 / P-2. The MIP/HPT logs present direct-reading, continuous screening that will allow for quantitative evaluation of the subsurface without the delay associated with the collection of subsurface soil and groundwater samples for analytical laboratory testing. The proposed investigation area for the PW-4 / P-2 pilot study is shown on Figure 3.

III. Injection Pilot Study Scope of Work

Following completion and assessment of the MIP/HPT field study data, a pilot study is proposed in the area of PW-4 / P-2 to evaluate the performance of an injectate (sodium permanganate) to

enhance control of VOC-impacted groundwater. The pilot study area comprises approximately 8,300 square feet in the area of PW-4 / P-2. The pilot study area is shown on Figure 3.

Objectives

The injection pilot study will be performed to determine the effectiveness of VOC mass reduction within the treatment zone. The objectives of the pilot study include the following:

- Evaluate the reduction of VOC concentrations following pilot study injections;
- Assess the distribution and persistence of VOCs post-injections; and,
- Evaluate the longer-term response of Site geochemistry post-injections

Approach

Injectate will be delivered to the subsurface using a combination of delivery methods, as determined appropriate from a review of historical operations as described in the Remedial Investigation Report (E&E, 1990), existing groundwater monitoring data, Soil remediation Program Closure Report (H&A, 2001) direct-push technology (DPT) soil sample data, and MIP/HPT data. Injection may be completed using a series of DPT injection points and/or a series of dedicated zone 1 bedrock wells.

Top of Rock Zone: Based on successful implementation of PW-3 pilot study injection points, DPT injection points are anticipated to be spaced approximately 20 feet center-to-center and advanced to the top of bedrock. It is anticipated that up to 21 injection points will be advanced in the pilot study area. The target treatment area for the top of rock zone is anticipated to be on the order of approximately 8,300 square feet with a target thickness of two feet at the weathered top of bedrock zone. The final design will be determined following completion of the MIP/HPT field study.

Bedrock Zone 1: It is anticipated that a series of new, dedicated zone 1 bedrock wells will be used for delivery of injectate to bedrock zone 1. It is anticipated that the dedicated bedrock wells will be installed in an offset-grid pattern in the treatment area. Up to 4 new dedicated injection wells may be installed within the target treatment area for bedrock zone 1. The target treatment area is anticipated to be approximately 8,300 square feet. The final design will be determined following completion of the MIP/HPT field study.

Injectate Background

Chemical oxidation technology is based on the oxidative power of specific chemicals. Through the process of oxidation, groundwater contaminants are ultimately broken down into carbon dioxide and water. In-situ oxidation is currently recognized by the U.S. Environmental Protection Agency (EPA) as “a viable remediation technology for mass reduction in source areas as well as for plume treatment” (Remediation Technologies Screening Matrix and Reference Guide, Version 4.0. U.S. Environmental Protection Agency, Federal Remediation Technologies Roundtable).

Two common forms of in situ oxidation agents are potassium permanganate (KMnO4) and sodium permanganate (NaMnO4). NaMnO4 can be supplied as a concentrated liquid (up to 40%) but is usually diluted on site and applied at lower concentrations. The potential for higher concentrations of sodium permanganate solutions gives more flexibility in the design of the injection volume and, because it is in liquid form, the dusting hazards associated with dry KMnO4 solids are eliminated. Oxidation of sorbed and non-aqueous phase liquid chlorinated ethenes has been demonstrated with permanganate at various sites. These oxidation reactions occur in the dissolved aqueous phase after the contaminants desorb from the media and/or dissolve from the free phase. It can be used over a wide range of pH values and does not require a catalyst.

For the degradation of chlorinated organic compounds, the oxidation involves direct electron transfer rather than free radical processes that characterize oxidation by persulfate, hydrogen peroxide, or ozone. As an illustration, the stoichiometric reactions of KMnO4 with the various species of chlorinated ethenes are summarized below (Interstate Technology Regulatory Council, *Technical and Regulatory Guidance for In Situ Chemical Oxidation of Contaminated Soil and Groundwater* [2005]):

Perchloroethene (PCE)

$$4KMnO4 + 3C2Cl4 + 4H2O \rightarrow 6CO2 + 4MnO2(s) + 4K+ + 12Cl- + 8H+$$

Trichloroethene (TCE)

$$2KMnO4 + C2HCl3 \rightarrow 2CO2 + 2MnO2(s) + 3Cl– + H+ + 2K+$$

Dichloroethene (DCE)

$$8KMnO4 + 3C2H2Cl2 + 2H+ \rightarrow 6CO2 + 8MnO2(s) + 8K+ + 6Cl– + 4H2O$$

Vinyl chloride (VC)

$$10KMnO4 + 3C2H3Cl \rightarrow 6CO2 + 10MnO2(s) + 10K+ + 3Cl– + 7OH– + H2O$$

Permanganate tends to remain in the subsurface for a long time, allowing for more contaminant contact and the potential of reducing rebound.

IV. Pilot Study Injection Plan

Health and Safety

The approved Site-specific health and safety plan (HASP) will be updated to include task-specific health and safety concerns associated with subsurface drilling and injections. The Site-specific HASP will be updated and reviewed by the project team prior to initiating work described in this work plan. The update will include addition of the Material Safety Data Sheet (MSDS) for the injectate (sodium permanganate) acquired; a typical MSDS is provided in Attachment 3.

Pre-Mobilization

A United States Environmental Protection Agency (EPA) Region 2 Underground Injection Control (UIC) Permit is not required for Class V Remediation Wells; however, notification for inventory is required. Attachment 4 presents a sample EPA Region 2 UIC Notification Form (accessed at https://www.epa.gov/uic/underground-injection-control-reporting-forms-owners-or-operators). The notification form will be completed and submitted EPA Region 2 prior to implementing the pilot study; see https://www.epa.gov/uic/underground-injection-control-epa-region-2-nj-ny-pr-and-vi for submittal information). A copy of the completed form will be provided to NYSDEC prior to mobilizing to the Site.

Mobilization

Prior to beginning any intrusive activities, the drilling subcontractor will contact the Underground Facilities Protection Organization (UFPO) to markout utilities in proposed investigation areas. The intended drilling locations will be marked with spray paint or flagging and an independent utility mark out subcontractor will be called out to locate utilities in drilling areas not covered by the UFPO. In addition, Pyrotek Inc. will be contacted to provide available utility information to assist in locating on-site underground utilities. If necessary based on utility locations, drilling locations will be moved to avoid potential utilities.

Geophysical surveys will be conducted to obtain information on subsurface conditions or features, including utilities or obstructions. It is anticipated that ground-penetrating radar (GPR) will be the method utilized in this investigation. GPR utilizes high frequency radio waves to acquire subsurface information. From a small antenna, which is moved slowly across the ground surface, energy is radiated downward into the subsurface. This energy is then reflected back to the receiving antenna, where variations in the return signal are continuously recorded. This produces a continuous cross-section of the shallow subsurface conditions. Radar responds well to the different electrical properties between rock units, soils, groundwater, and most importantly for this application, buried pipes, utilities, and foundations.

At the start of intrusive fieldwork, clearance of underground utilities will be performed using non-mechanical means. An air knife and vacuum or equivalent will be utilized to advance each boring from the ground surface to approximately five feet to prevent disruption of any potential underground utilities. Disturbed soils will be managed in accordance with the Soil Management Plan (Revised May 2016).

Injections

The proposed pilot study targets the PW-4 / P-2 area as shown on Figure 3. Injection locations will be determined upon completion of the MIP/HPT field study. NYSDEC will be informed of the final determined number, type, and locations prior to implementation.

Due to the proximity of the injection locations to P-2 (PW-4 is already not currently operating as a recovery well), it is proposed that P-2 be turned off during the performance of the injections and throughout the performance monitoring period. Hydraulic control south of the manufacturing building will continue to be achieved by PW-1, P-3, and P-4 during this period.

Injectate

The injectate selected for application at the Site is sodium permanganate. The product has proven effective addressing similar VOCs at similar concentrations as are present at this Site. The injectate solution will be prepared on site as described below.

Injection Procedures

The injectate solution delivered to the top of rock zone will be applied to the subsurface via DPT injection targeting the bottom two feet of overburden and top of rock interface. An appropriately sized DPT rig will be used to advance temporary injection points. Injection of the solution will be performed at a 2-foot increment starting from the bottom of the borehole and working upwards, using 1.5-inch diameter drill rods. Injectate solution will be applied to the subsurface at a target volume to be determined upon evaluation of data from the MIP/HPT field study (this volume may be adjusted based on conditions encountered during field activities). Injection flow rates for this type of injection typically range from 2 to 10 gallons per minute at injection pressures ranging from 20 to 60 psi. Injections will be conducted at the lowest pressure practical which yields an acceptable flow rate. If the injectate delivery to the desired depth interval is not successful, the injectate volume not delivered to that interval will be added to an adjacent boring. After the injection is completed, the injection point (borehole) will be filled with bentonite chips and hydrated in order to minimize the potential for short circuiting of injection fluids from adjacent injection points.

The injectate solution delivered to bedrock zone 1 will be applied via dedicated shallow bedrock wells. Wells will be constructed of steel casing advanced to the top of rock and grouted into place. A bedrock core will be advanced in an initial 10 foot interval to determine the location of bedrock zone 1. A nominal 4-inch diameter open-hole bedrock well will be advanced to one foot below bedrock zone 1. Based on the construction data for recovery well P-2, it is anticipated that depth to bedrock is approximately 15 to 18 feet below grade, and the injection wells will be completed to

approximately 28 to 30 feet below grade. Injectate solution will be added directly via the open-bedrock borehole zone of the injection well. Injectate solution may be applied in sequential events spaced over a number of weeks to maximize delivery of the injectate solution to the subsurface (volume and frequency may be adjusted based on conditions encountered during field activities). If the injectate delivery to the desired depth interval is not successful, the injectate volume not delivered to that interval will be added to an adjacent boring.

The following data, associated with delivery hydraulics, will be collected during the injection process.

- Injection location;
- Injection interval;
- Injection solution flow rate;
- Injection pressure;
- Temperature, pH, and specific conductance of the injection solution; and,
- Cumulative volume of injection solution delivered to the injection point.

Attachment 5 contains an example injection log sheet that will be used to record data during injection activities.

A critical component of the pilot study will be groundwater monitoring to monitor performance. The performance monitoring program will include laboratory analysis and field measurement of selected parameters during performance monitoring events. The groundwater monitoring program established for the field test consists of three components:

- Baseline groundwater monitoring;
- Injection monitoring; and,
- Post-injection monitoring (process and performance).

Each component of the monitoring program is described in further detail below. Table 3 summarizes the monitoring program for the pilot study.

V. Pilot Study Groundwater Monitoring

Baseline Groundwater Monitoring

Baseline groundwater monitoring will be conducted prior to the initiation of injection activities. Results obtained during this sampling will serve as the basis for evaluating the overall efficacy of the pilot study. Baseline samples will be collected from well locations PW-4, P-2, and newly installed injection wells within the pilot study area.

Each baseline monitoring well will be sampled using low-flow ground water sampling procedures as described in the current monitoring and maintenance plan for the site. The proposed monitoring plan is specific to the objectives of the study and includes the following parameters:

- Static water level elevations;
- Field parameters including temperature, pH, specific conductance, oxidation-reduction potential (ORP), and dissolved oxygen (DO); and,

- Site-specific VOCs (EPA 8260C).

Microbiology (polymerase chain reaction (qPCR) for Dehalobacter spp., Dehalococcoides spp., and known dechlorination linked functional genes) is not proposed for this study as prior sampling has indicated low to very low populations.

Following collection, groundwater samples will be placed in laboratory supplied containers, packaged on ice, and shipped to the laboratories for analysis of the parameters specified above.

Injection Monitoring

Water levels will be measured periodically at PW-4, P-2, and newly installed dedicated injection wells. Water levels will be obtained using an electronic water level indicator. Vertically discrete down-hole water quality field parameters (temperature, pH, specific conductance, DO, and ORP) will be monitored during the injection event in PW-4, P-2, and newly installed dedicated injection wells.

Positive values of ORP and increases in DO concentrations reflect oxidizing conditions and generally coincide with the oxidant movement. Increases in groundwater temperature are often detected immediately after injection of oxidizing compounds. Slight increases in specific conductance may be observed following oxidant injections and may be useful tracking of oxidant dispersion.

A down-hole water quality meter (e.g., YSI Model 556 or equivalent) will be lowered into the well to the screened interval (i.e., approximately two feet above bottom of well) a minimum of four times per day (at the start of work, late morning, early afternoon, at the conclusion of work) to determine if injection solution may be influencing water quality criteria at that location. Readings will be recorded in the field notebook or on a dedicated log sheet for that well location.

Post-Injection Monitoring

Post-Injection monitoring will be conducted to evaluate the performance of the applied treatment with regards to shifts in conditions and response to injectate (i.e., contaminant reduction). Post-injection monitoring events will be conducted at intervals corresponding to approximately 30, 90, and 180 days after the completion of injections. During these monitoring events, PW-4, P-2, and newly installed dedicated injection wells will be sampled using low-flow groundwater sampling procedures. Post-Injection monitoring will include the following parameters:

- Static water level elevations;
- Field parameters including temperature, pH, specific conductance, ORP, and DO; and
- VOCs (EPA 8260C).

Following collection, groundwater samples will be placed in laboratory supplied containers, packaged on ice, and shipped to the laboratories for analysis of the parameters specified above.

VI. Pilot Study Reporting

Data obtained during the pilot study will be utilized in real-time to evaluate the performance monitoring program, and evaluate the need for follow-up injections, if appropriate. Monitoring data will be tabulated, reviewed, and interpreted to evaluate the effectiveness of the pilot study injections in terms of distribution, trending of aquifer geochemical conditions (i.e., field parameter data), and

contaminant reduction. If necessary, adjustments will be made to the monitoring program based on the results of the previous sampling round.

The results of the pilot study will be used to further refine the site conceptual model and if successful develop a plan to evaluate additional pilot studies in the areas of PW-1. The Pilot Study Report will contain, at a minimum, the following information;

- Statement of the pilot study objective and purpose,
- Summary of the pilot study field activities including any deviations from the approved work plan,
- Summary and interpretation of the pilot study results, and
- Subsequent recommendations whether or not to move forward with additional studies.

The report appendices will include relevant boring logs, injection logs, sample collection logs or field notes, and analytical data reports.

VII. Schedule

Following approval of this work plan, the injection pilot study will be performed. AECOM is tentatively scheduled to begin this work in early spring 2019. A summary report following the MIP/HPT field study will be prepared and include recommended number, type, and location of injection points, as well as type (percent solution) and volume of injectate for the PW-4 / P-2 pilot study.

If you have any questions regarding this submission, please do not hesitate to contact me at (716) 923-1300 or via email at james.kaczor@aecom.com.

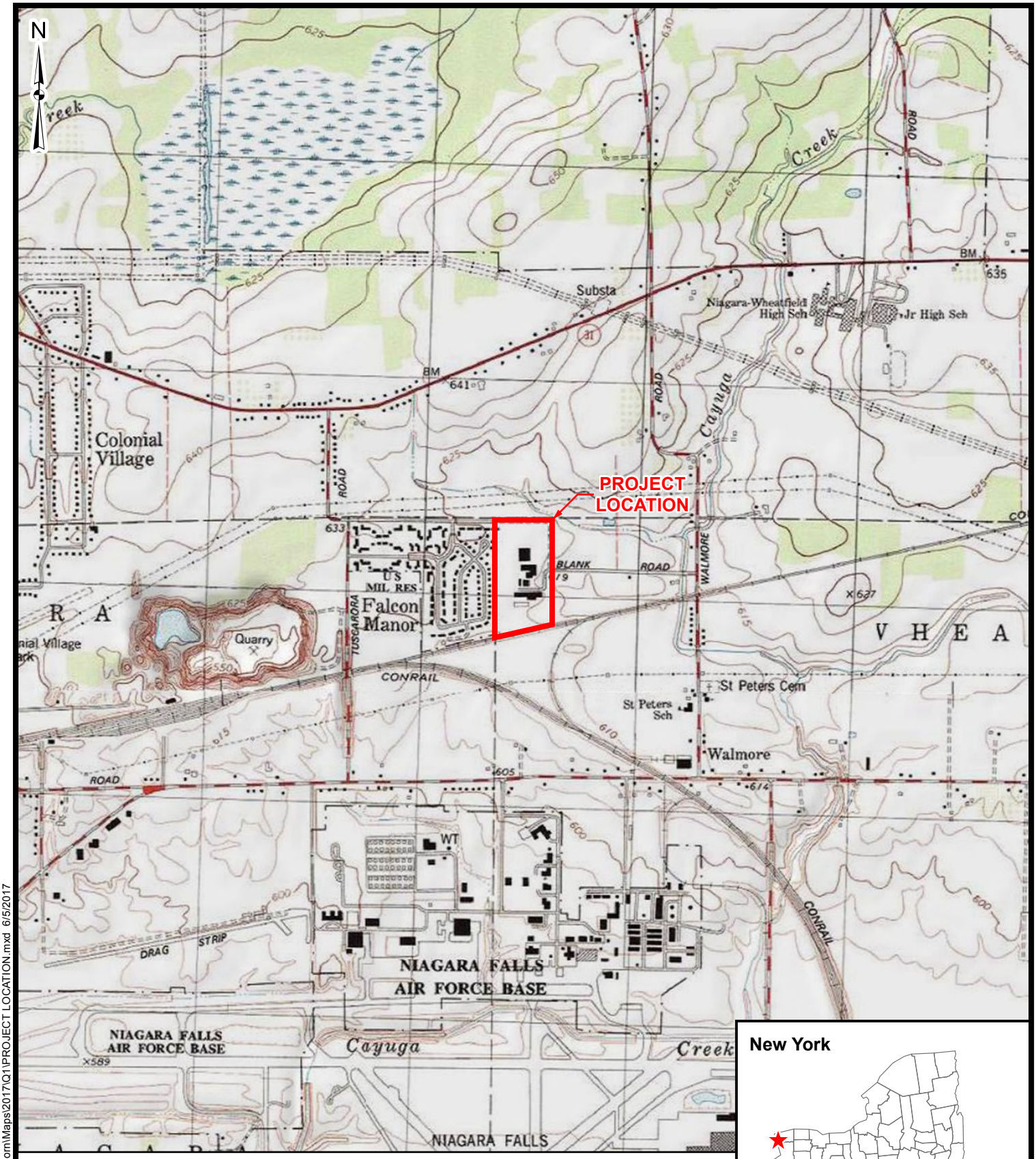
Sincerely yours,

James L. Kaczor, PG
Sanborn Site Task Manager
James.kaczor@aecom.com

Attachments

cc: Glenn May, NYSDEC
Project File 6048176.18

Figures



Source: USA Topo Maps, ESRI Map Service;
1:24,000-scale USGS Topographic Map,
Ransomville, 1996
Tonawanda West, 1996

2,000 0 2,000 Feet

AECOM

FORMER CARBORUNDUM FACILITY
SANBORN, NEW YORK
PROJECT LOCATION PLAN

FIGURE 1

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Legend

- Monitoring Well
- Monitoring Well (Abandoned)
- Recovery Well
- Recovery Well (Abandoned)

Source: ESRI World Imagery

500 0 500 Feet

FORMER CARBORUNDUM FACILITY
SANBORN, NEW YORK
SITE PLAN

AECOM

FIGURE 2

J:\Projects\60481767_BPIPO\MtSC\GIS\Sanborn\Maps\2017\Q1\SITE PLAN.mxd 6/5/2017

Legend

- Monitoring Well
- Recovery Well
- Recovery Well (Abandoned)
- Proposed Pilot Study Investigation Area

Source: ESRI World Imagery

40 0 40 Feet

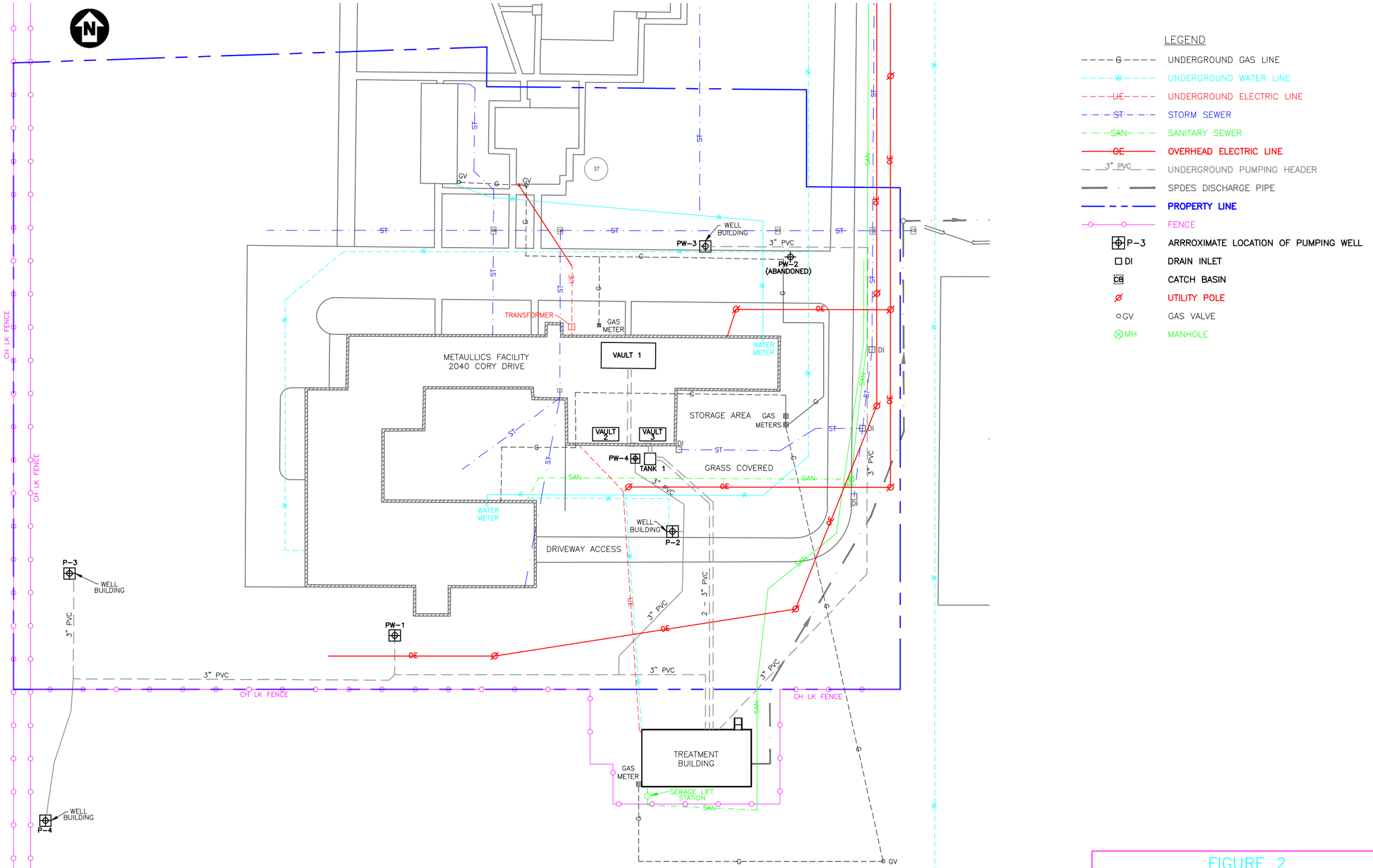
FORMER CARBORUNDUM FACILITY
2040 CORY DRIVE
SANBORN, NEW YORK
PW-04/P-02 PILOT STUDY AREA

AECOM

FIGURE 3

J:\Projects\60481767_BPIPO\MISC\GIS\Sanborn\Maps\MIP\PW-4_P-2_PilotStudyArea.mxd 3/21/2019

Attachment 1



PARSONS
40 LA RIVIERE DRIVE, SUITE 350
BUFFALO, NEW YORK 14202
716-541-0730

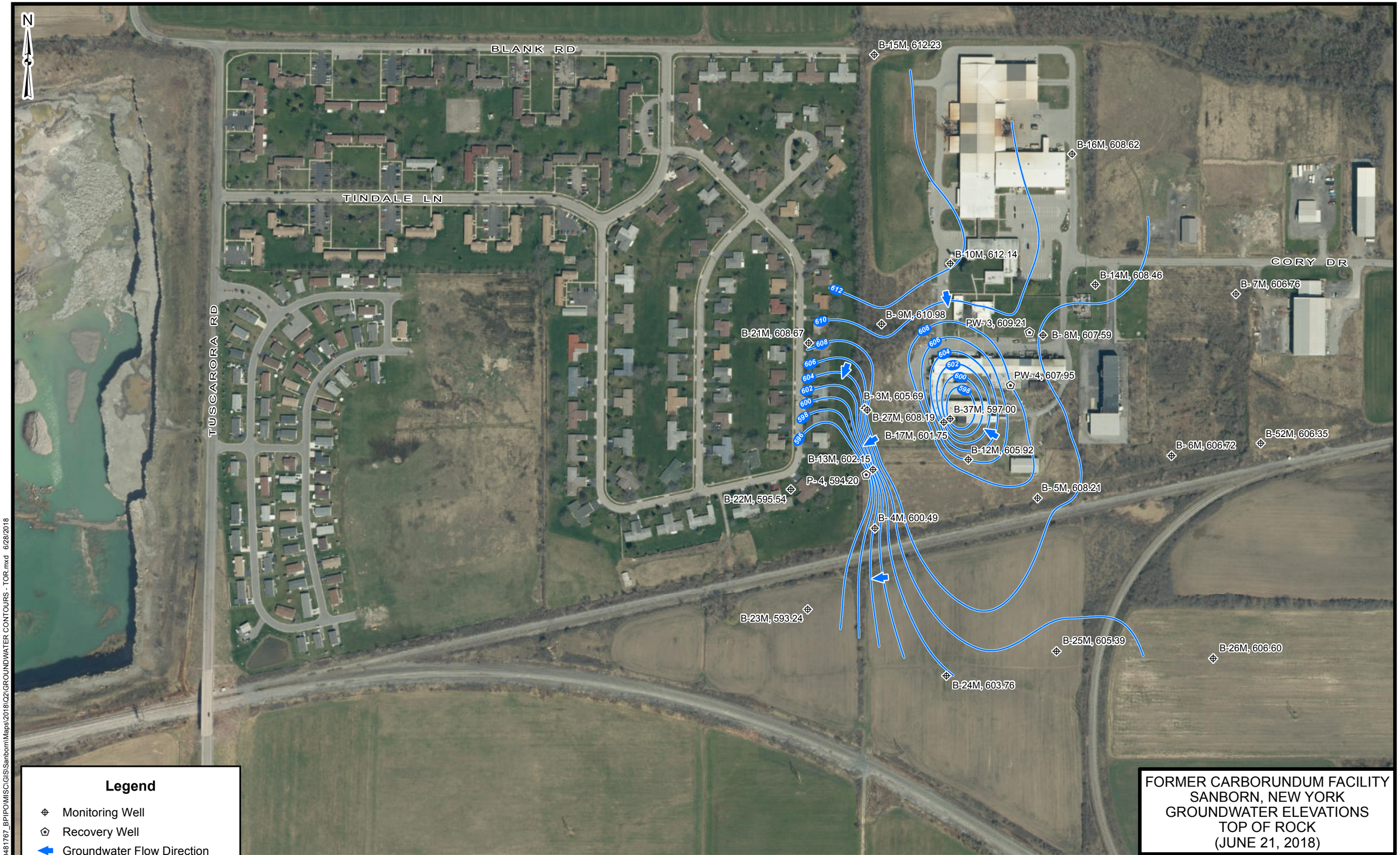
FIGURE 2

ATLANTIC RICHFIELD COMPANY
FORMER CARBORUNDUM FACILITY

SITE PLAN – UTILITIES

P:\Sanborn\\447601\Record Drawings\SK-442156-c17_Fig2.dwg
No XREFs

Attachment 2



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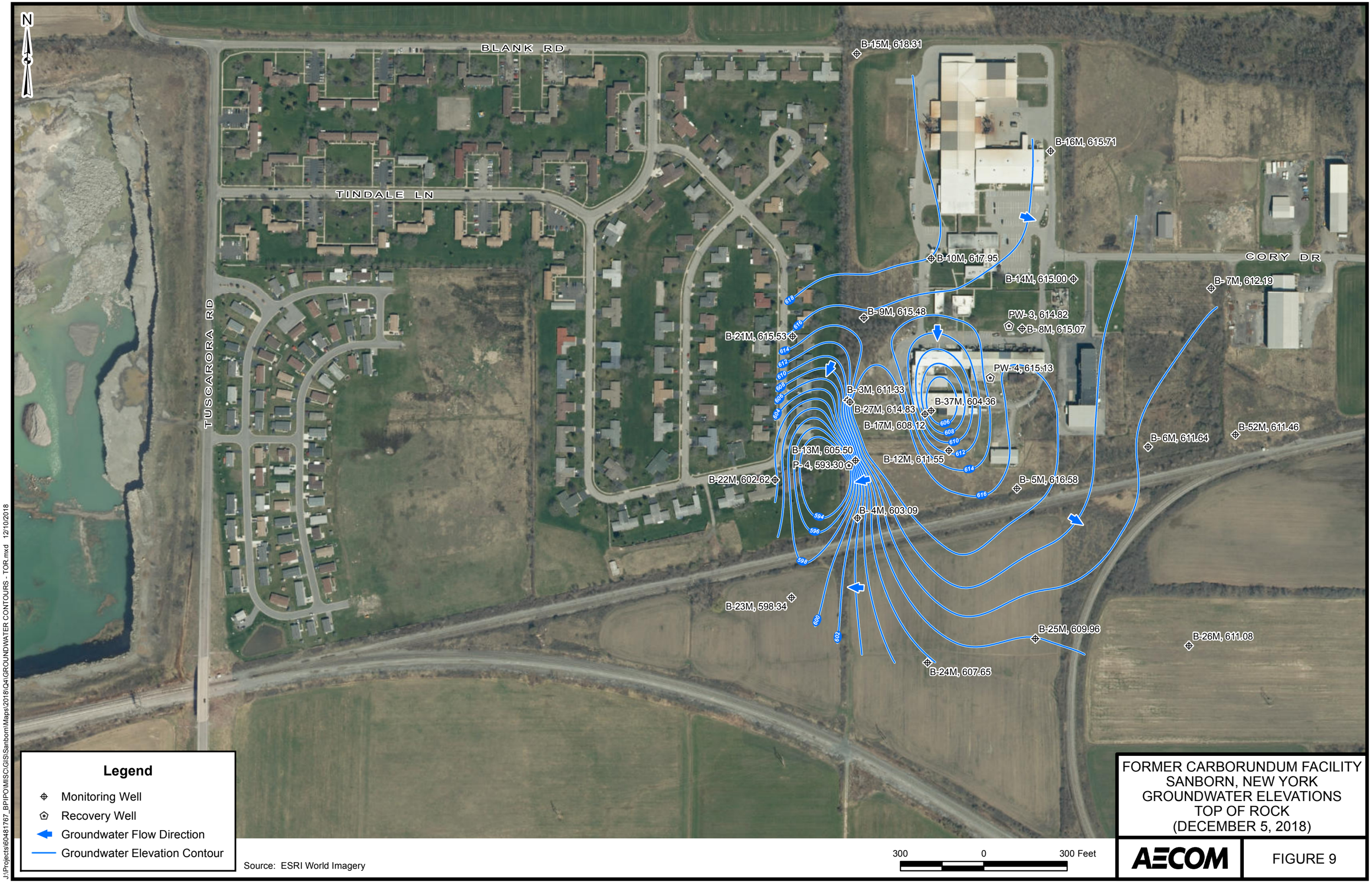
N
B-15M, 612.23
B-67M, 609.71
B-63M, 609.09
B-16M, 608.62
B-10M, 612.14
B-11M, 609.06
B- 8M, 607.59
B-21M, 608.67
PW- 4, 607.95
P- 2, 597.17
B-27M, 608.19
P- 3, 598.10
PW- 1, 597.88
B-17M, 601.75
B- 6M, 606.72
B-52M, 606.35
P- 4, 594.20
B-13M, 602.15
B-28M, 596.87
B-22M, 595.54
B-23M, 593.24
B-29M, 589.49
B-26M, 606.60
B-24M, 603.76
B-38M, 581.63
B-32M, 586.57
B-33M, 589.81
B-45M, 590.87
610
605
600
595
590
585
Legend
Monitoring Well
Recovery Well
Groundwater Flow Direction
Groundwater Elevation Contour
Source: ESRI World Imagery
300
0
300 Feet
FORMER CARBORUNDUM FACILITY
SANBORN, NEW YORK
GROUNDWATER ELEVATIONS
ZONE 1
(JUNE 21, 2018)
AECOM
FIGURE 6
J:\Projects\60481767_BP\PO\MISC\GIS\Sanborn\Maps\2018\Q2\GROUNDWATER CONTOURS - Z1.mxd 6/28/2018



FORMER CARBORUNDUM FACILITY
SANBORN, NEW YORK
GROUNDWATER ELEVATIONS
TOP OF ROCK
(DECEMBER 5, 2018)

AECOM

FIGURE 9

J:\Projects\60481767_BPIPO\MISC\GIS\Sanborn\Maps\2018\Q4\GROUNDWATER CONTOURS - TOR.mxd 12/10/2018

N

BLANK RD

TINDALE LN

TUSCARORA RD

CORY DR

B-15M, 618.31
B-67M, 616.58
B-63M, 616.09
B-16M, 615.71
B-10M, 617.95
B-11M, 615.37
B- 8M, 615.07
B-21M, 615.53
PW- 4, 615.13
P- 2, 616.31
B-27M, 614.83
P- 3, 600.89
PW- 1, 604.39
B-17M, 608.12
B-52M, 611.46
B- 6M, 611.64
P- 4, 593.30
B-13M, 605.50
B-28M, 601.20
B-22M, 602.62
B-23M, 598.34
B-29M, 594.95
B-26M, 611.08
B-24M, 607.65
B-38M, 582.91
B-32M, NM
B-33M, 594.63
B-45M, 596.07

615
610
605
600
595
590
585

Legend

- Monitoring Well
- Recovery Well
- Groundwater Flow Direction
- Groundwater Elevation Contour

Source: ESRI World Imagery

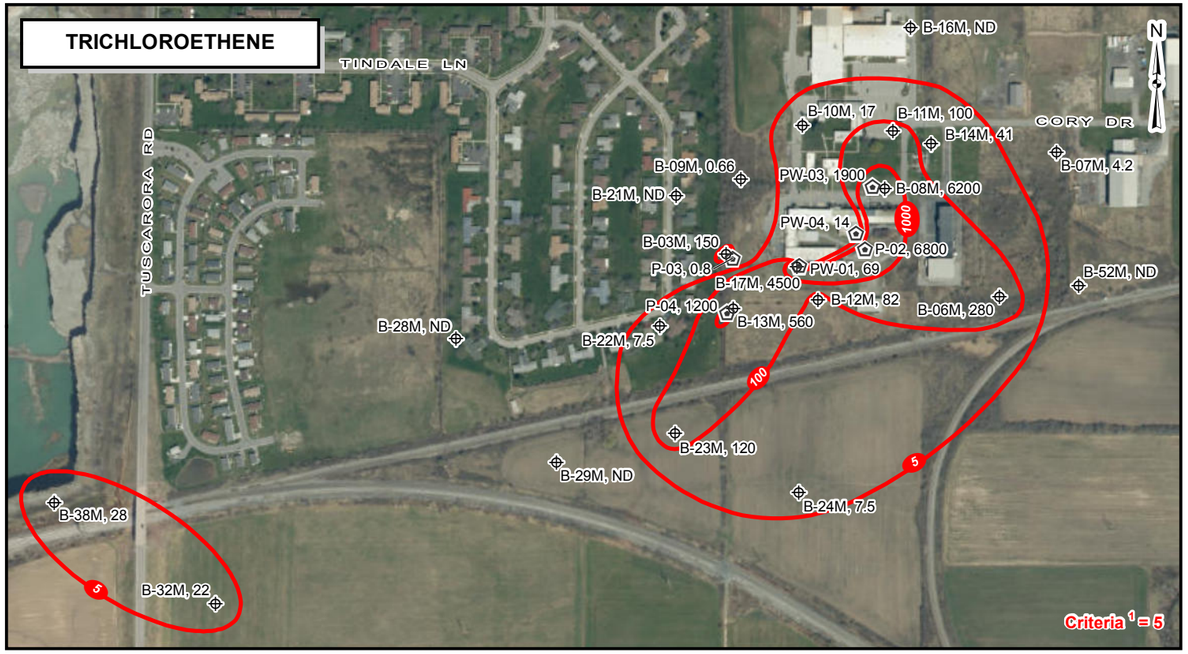
300 0 300 Feet

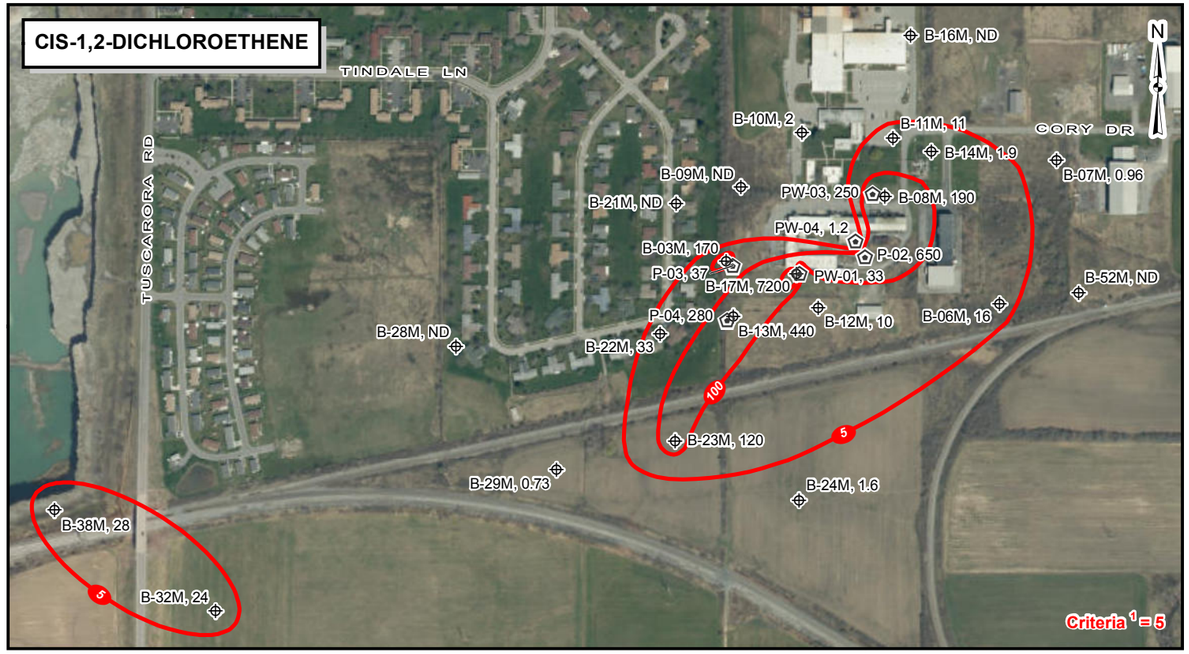
FORMER CARBORUNDUM FACILITY
SANBORN, NEW YORK
GROUNDWATER ELEVATIONS
ZONE 1
(DECEMBER 5, 2018)

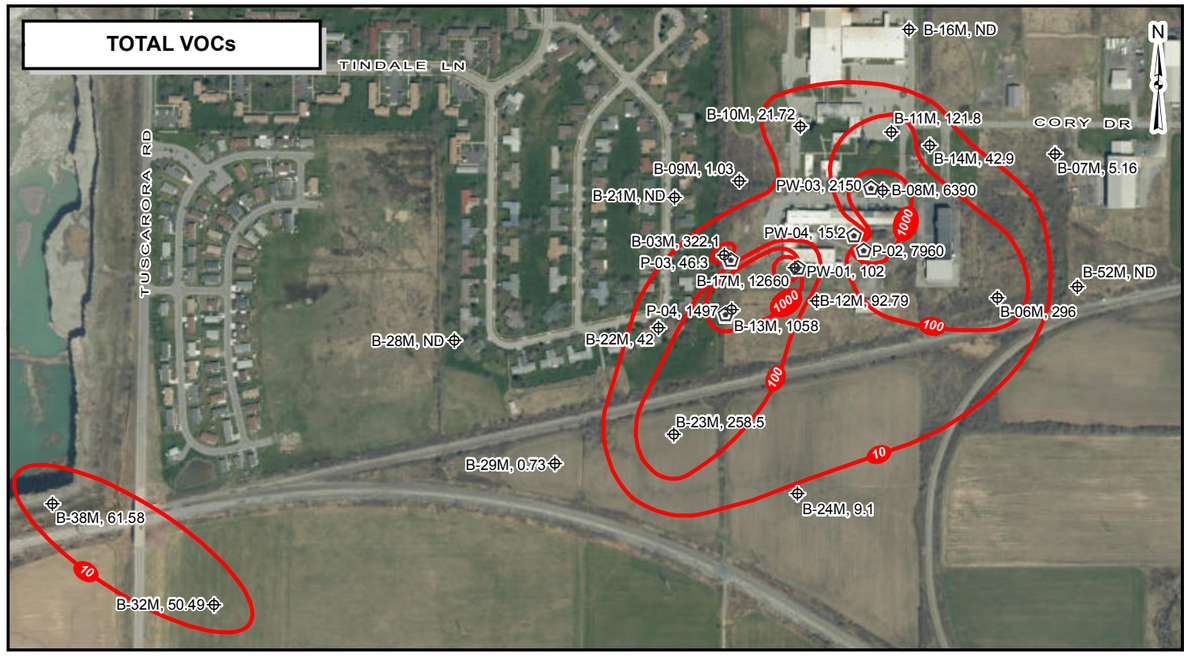
AECOM

FIGURE 10

J:\Projects\60481767_BPIPO\MISC\GIS\Sanborn\Maps\2018\Q4\GROUNDWATER CONTOURS - Z1.mxd 12/10/2018







Legend

- Monitoring Well
- Recovery Well
- Isoconcentration Contour

Notes:
1. Criteria = NYSDEC TOGS 1.1.1 Ambient Water Quality Standards, Class GA
2. Units are shown in µg/L
3. ND = Not Detected

Source:
ESRI World Imagery

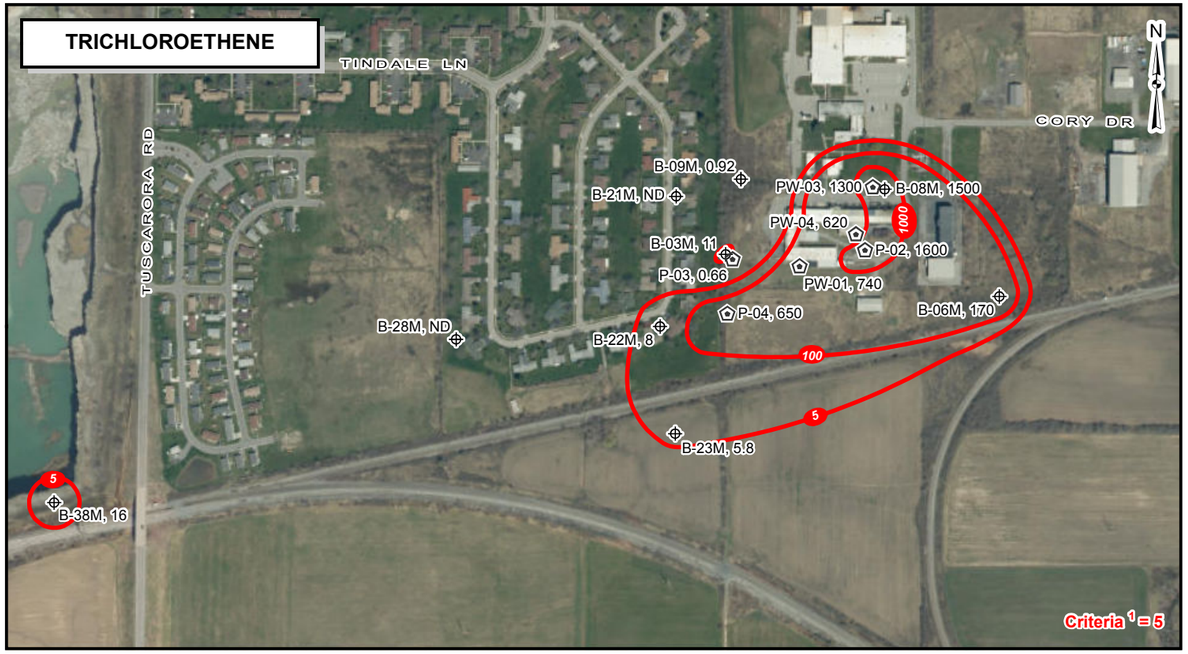
600 0 600 Feet

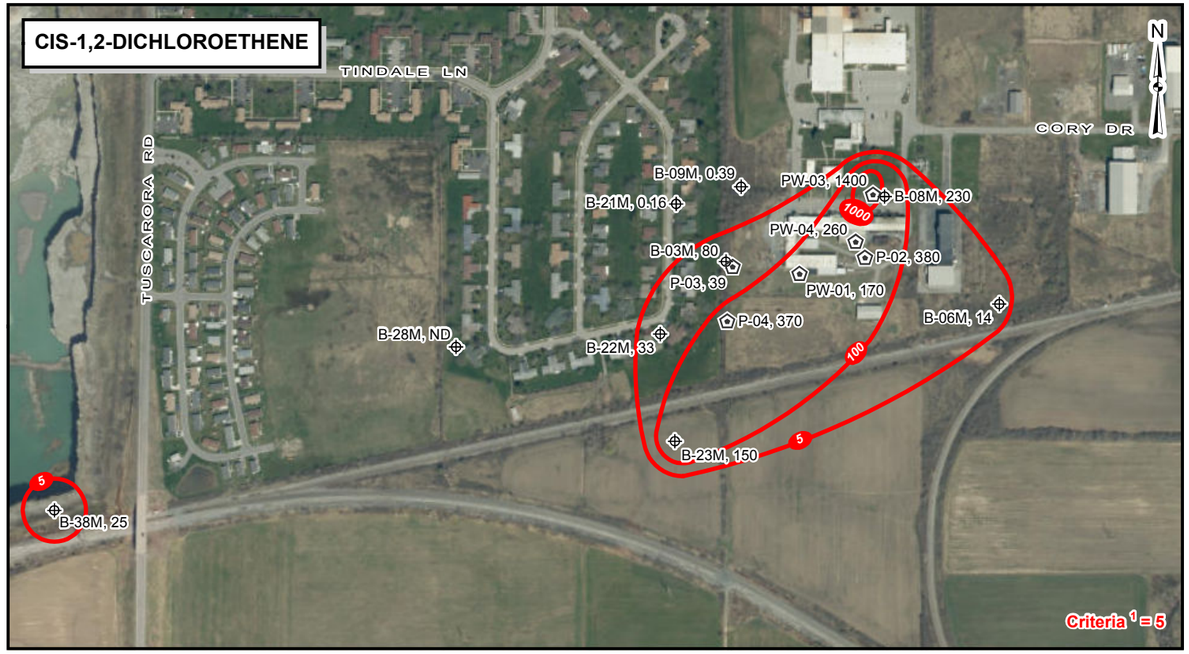
FORMER CARBORUNDUM FACILITY
SANBORN, NEW YORK
ISOCONTOURS IN TOP OF ROCK AND ZONE 1
(ANNUAL SAMPLING - SPRING 2018)

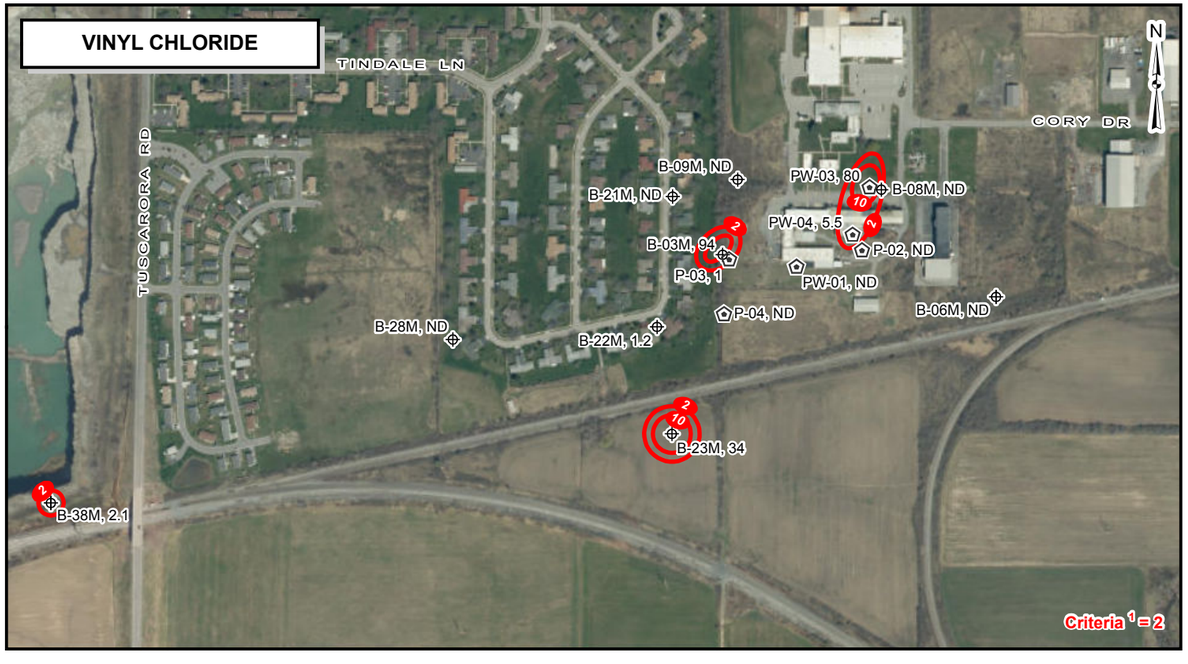
AECOM

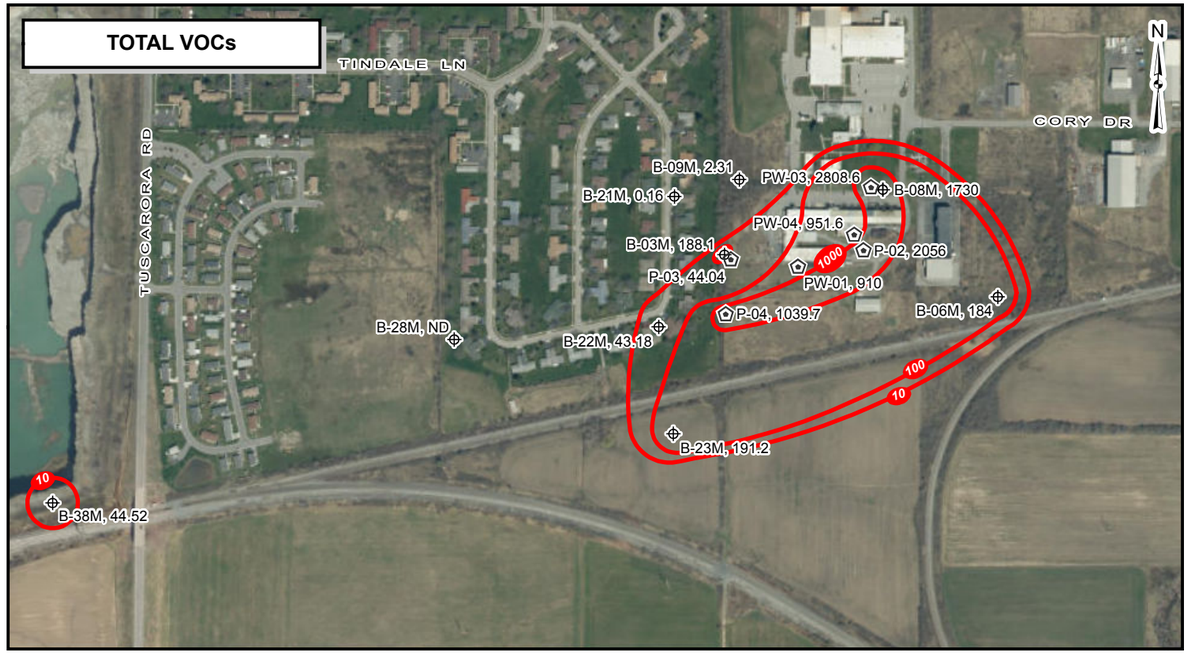
FIGURE 11

J:\Projects\60481767_BPIPO\MISC\GIS\Sanborn\Maps\2018\Q1\ISOPLETHS - TOR & Z1.mxd 5/17/2018









Legend

- Monitoring Well
- Recovery Well
- Isoconcentration Contour

Notes:
1. Criteria = NYSDEC TOGS 1.1.1 Ambient Water Quality Standards, Class GA
2. Units are shown in µg/L
3. ND = Not Detected

Source:
ESRI World Imagery

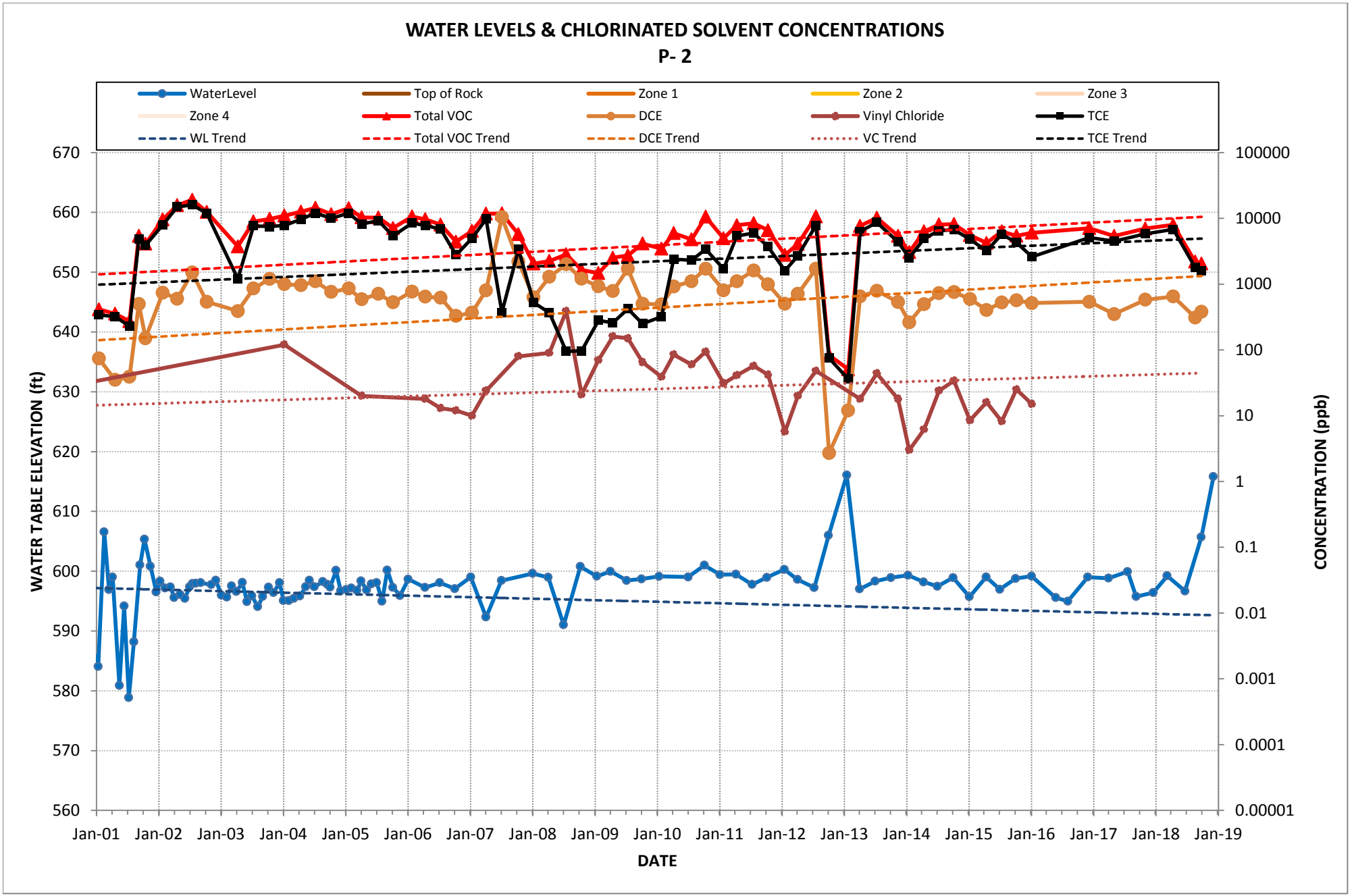
600 0 600 Feet

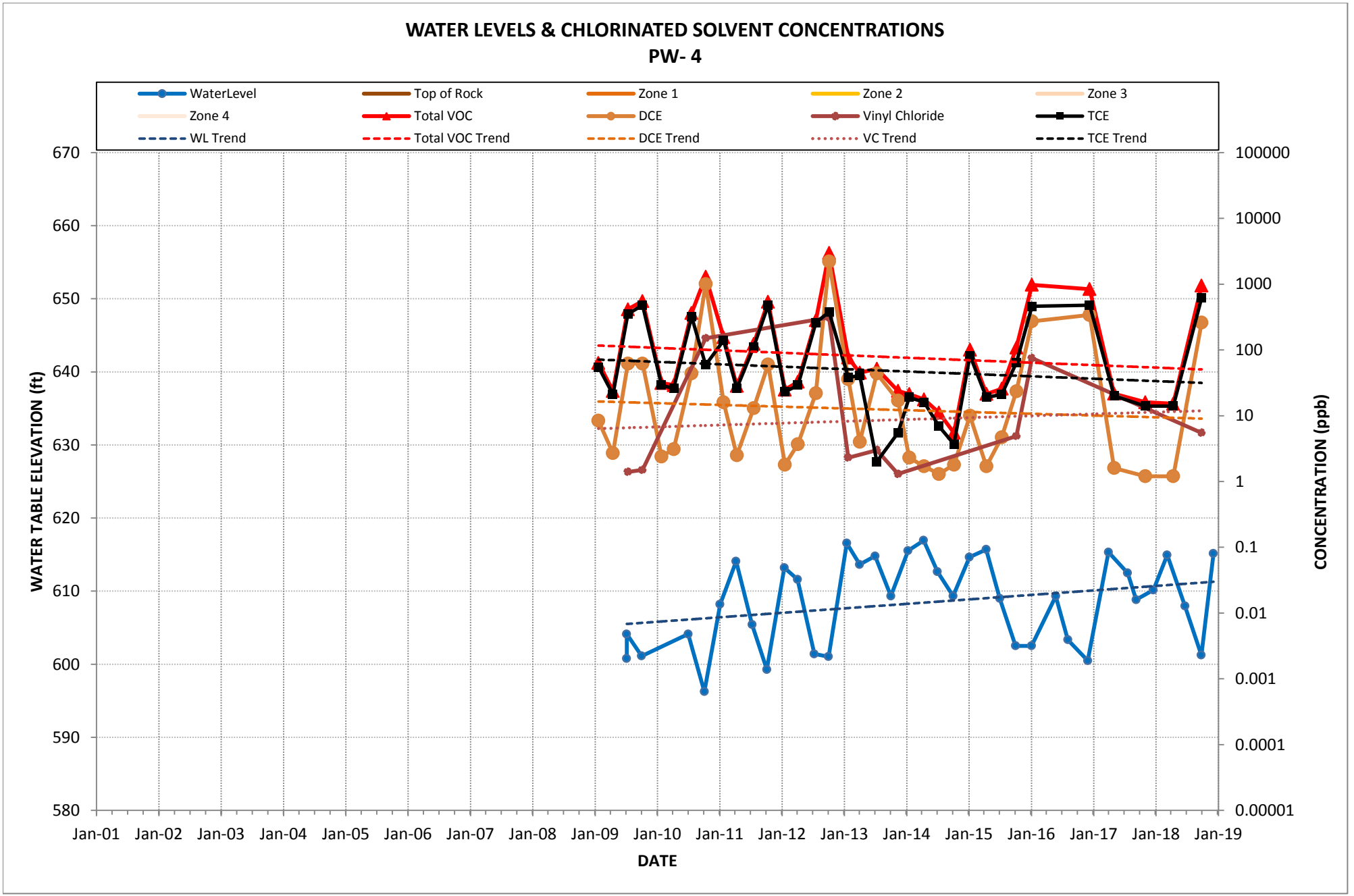
FORMER CARBORUNDUM FACILITY
SANBORN, NEW YORK
ISOCONTOURS IN TOP OF ROCK AND ZONE 1
(SEPTEMBER 2018)

AECOM

FIGURE 13

J:\Projects\60481767_BPIPO\MISC\GIS\Sanborn\Maps\2018\Q3\ISOPLETHS - TOR & Z1.mxd 2/6/2019


WATER LEVELS & CHLORINATED SOLVENT CONCENTRATIONS
P- 2
WaterLevel
Top of Rock
Zone 1
Zone 2
Zone 3
Zone 4
Total VOC
DCE
Vinyl Chloride
TCE
WL Trend
Total VOC Trend
DCE Trend
VC Trend
TCE Trend
WATER TABLE ELEVATION (ft)
CONCENTRATION (ppb)
DATE
670
660
650
640
630
620
610
600
590
580
570
560
100000
10000
1000
100
10
1
0.1
0.01
0.001
0.0001
0.00001
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19


WATER LEVELS & CHLORINATED SOLVENT CONCENTRATIONS
PW- 4
WaterLevel
Top of Rock
Zone 1
Zone 2
Zone 3
Zone 4
Total VOC
DCE
Vinyl Chloride
TCE
WL Trend
Total VOC Trend
DCE Trend
VC Trend
TCE Trend
WATER TABLE ELEVATION (ft)
670
660
650
640
630
620
610
600
590
580
CONCENTRATION (ppb)
100000
10000
1000
100
10
1
0.1
0.01
0.001
0.0001
0.00001
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
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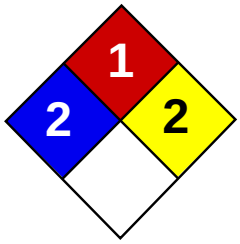
Jan-18
Jan-19
DATE

Attachment 3



Material Safety Data Sheet
Sodium permanganate monohydrate MSDS

Section 1: Chemical Product and Company Identification

Product Name: Sodium permanganate monohydrate

Catalog Codes: SLS4345

CAS#: 10101-50-5

RTECS: SD6650000

TSCA: TSCA 8(b) inventory: Sodium permanganate monohydrate

CI#: Not applicable.

Synonym: Permanganic acid, sodium salt

Chemical Name: Sodium permanganate monohydrate

Chemical Formula: NaMnO4.H2O

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call: 1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Sodium permanganate monohydrate	10101-50-5	100

Toxicological Data on Ingredients: Sodium permanganate monohydrate: ORAL (LD50): Acute: 9000 mg/kg [Rat].

Section 3: Hazards Identification

Potential Acute Health Effects:
Very hazardous in case of skin contact (irritant), of eye contact (irritant). Hazardous in case of skin contact (permeator), of ingestion, of inhalation. Prolonged exposure may result in skin burns and ulcerations. Over-exposure by inhalation may cause respiratory irritation. Inflammation of the eye is characterized by redness, watering, and itching. Skin inflammation is characterized by itching, scaling, reddening, or, occasionally, blistering.

Potential Chronic Health Effects:
CARCINOGENIC EFFECTS: Not available. MUTAGENIC EFFECTS: Not available. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Not available. Repeated or prolonged exposure is not known to aggravate medical condition.

Section 4: First Aid Measures

Eye Contact:

Check for and remove any contact lenses. Immediately flush eyes with running water for at least 15 minutes, keeping eyelids open. Cold water may be used. Do not use an eye ointment. Seek medical attention.

Skin Contact:
After contact with skin, wash immediately with plenty of water. Gently and thoroughly wash the contaminated skin with running water and non-abrasive soap. Be particularly careful to clean folds, crevices, creases and groin. Cold water may be used. Cover the irritated skin with an emollient. If irritation persists, seek medical attention. Wash contaminated clothing before reusing.

Serious Skin Contact:
Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek medical attention.

Inhalation: Allow the victim to rest in a well ventilated area. Seek immediate medical attention.

Serious Inhalation:
Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek medical attention.

Ingestion:
Do not induce vomiting. Loosen tight clothing such as a collar, tie, belt or waistband. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek immediate medical attention.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: May be combustible at high temperature.

Auto-Ignition Temperature: Not available.

Flash Points: Not available.

Flammable Limits: Not available.

Products of Combustion: Some metallic oxides.

Fire Hazards in Presence of Various Substances:
Highly flammable in presence of combustible materials. Flammable in presence of open flames and sparks, of heat.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available. Risks of explosion of the product in presence of static discharge: Not available.

Fire Fighting Media and Instructions:
Oxidizing material. Do not use water jet. Use flooding quantities of water. Avoid contact with organic materials.

Special Remarks on Fire Hazards: When heated to decomposition it emits toxic fumes.

Special Remarks on Explosion Hazards: Not available.

Section 6: Accidental Release Measures

Small Spill: Use appropriate tools to put the spilled solid in a convenient waste disposal container.

Large Spill:
Oxidizing material. Stop leak if without risk. Avoid contact with a combustible material (wood, paper, oil, clothing...). Keep substance damp using water spray. Do not touch spilled material. Prevent entry into sewers, basements or confined areas; dike if needed. Eliminate all ignition sources. Call for assistance on disposal. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Keep away from heat. Keep away from sources of ignition. Keep away from combustible material Empty containers pose a fire risk, evaporate the residue under a fume hood. Ground all equipment containing material. Do not ingest. Do not breathe dust. In case of insufficient ventilation, wear suitable respiratory equipment If ingested, seek medical advice immediately and show the container or the label. Avoid contact with skin and eyes Keep away from incompatibles such as reducing agents, organic materials, metals, acids, moisture.

Storage:
Keep container dry. Keep in a cool place. Ground all equipment containing material. Oxidizing materials should be stored in a separate safety storage cabinet or room.

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Use process enclosures, local exhaust ventilation, or other engineering controls to keep airborne levels below recommended exposure limits. If user operations generate dust, fume or mist, use ventilation to keep exposure to airborne contaminants below the exposure limit.

Personal Protection:
Splash goggles. Lab coat. Dust respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Dust respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
TWA: 5 (mg/m3) from ACGIH (TLV) [1995] Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Solid. (Powdered solid.)

Odor: Not available.

Taste: Not available.

Molecular Weight: 159.94 g/mole

Color: Red.

pH (1% soln/water): 7 [Neutral.]

Boiling Point: Not available.

Melting Point: Decomposes.

Critical Temperature: Not available.

Specific Gravity: 2.47 (Water = 1)

Vapor Pressure: Not applicable.

Vapor Density: Not available.

Volatility: Not available.

Odor Threshold: Not available.

Water/Oil Dist. Coeff.: Not available.

Ionicity (in Water): Not available.

Dispersion Properties: See solubility in water.

Solubility: Soluble in cold water, hot water.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Not available.

Incompatibility with various substances:
Highly reactive with reducing agents, organic materials, metals, acids. Reactive with moisture.

Corrosivity: Non-corrosive in presence of glass.

Special Remarks on Reactivity: Not available.

Special Remarks on Corrosivity: Not available.

Polymerization: No.

Section 11: Toxicological Information

Routes of Entry: Dermal contact. Eye contact. Inhalation. Ingestion.

Toxicity to Animals: Acute oral toxicity (LD50): 9000 mg/kg [Rat].

Chronic Effects on Humans: Not available.

Other Toxic Effects on Humans:
Very hazardous in case of skin contact (irritant). Hazardous in case of skin contact (permeator), of ingestion, of inhalation.

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans: Not available.

Special Remarks on other Toxic Effects on Humans: Exposure can cause nausea, headache and vomiting. Material is corrosive to the mucous membranes.

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The product itself and its products of degradation are not toxic.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:

Section 14: Transport Information

DOT Classification: CLASS 5.1: Oxidizing material.

Identification: : Sodium permanganate : UN1503 PG: II

Special Provisions for Transport: Not available.

Section 15: Other Regulatory Information

Federal and State Regulations:
Pennsylvania RTK: Sodium permanganate monohydrate Massachusetts RTK: Sodium permanganate monohydrate TSCA 8(b) inventory: Sodium permanganate monohydrate SARA 313 toxic chemical notification and release reporting: Sodium permanganate monohydrate

Other Regulations: OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200).

Other Classifications:

WHMIS (Canada):
CLASS C: Oxidizing material. CLASS D-2B: Material causing other toxic effects (TOXIC).

DSCL (EEC):
R38- Irritating to skin. R41- Risk of serious damage to eyes.

HMIS (U.S.A.):

Health Hazard: 2

Fire Hazard: 1

Reactivity: 2

Personal Protection: E

National Fire Protection Association (U.S.A.):

Health: 2

Flammability: 1

Reactivity: 2

Specific hazard:

Protective Equipment:
Gloves. Lab coat. Dust respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate. Splash goggles.

Section 16: Other Information

References:
-Hawley, G.G.. The Condensed Chemical Dictionary, 11e ed., New York N.Y., Van Nostrand Reinold, 1987. -Material safety data sheet emitted by: la Commission de la Santé et de la Sécurité du Travail du Québec. -SAX, N.I. Dangerous Properties of Indutrial Materials. Toronto, Van Nostrand Reinold, 6e ed. 1984. -Guide de la loi et du règlement sur le transport des marchandises dangeureuses au canada. Centre de conformité internatinal Ltée. 1986.

Other Special Considerations: Not available.

Created: 10/09/2005 06:34 PM

Last Updated: 05/21/2013 12:00 PM

Attachment 4

Type or print all information. See reverse for instructions. OMB No. 2040-0042 Approval Expires 12/31/2018

INVENTORY OF INJECTION WELLS

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
OFFICE OF GROUND WATER AND DRINKING WATER

(This information is collected under the authority of the Safe Drinking Water Act)

1. DATE PREPARED *(Year, Month, Day)*

2. FACILITY ID NUMBER

PAPERWORK REDUCTION ACT NOTICE

The public reporting burden for this collection of information is estimated at about 0.5 hour per response including time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding the burden estimate or any other aspect of this collection of information, includingsuggestions for reducing this burden, Director, Collection Strategies Division (2822), U.S. Environmental Protection Agency, 1200 Pennsylvania Avenue, NW, Washington, DC 20460, and to the Office of Management and Budget, Paperwork Reduction Project, Washington, DC20503.

3. TRANSACTION TYPE *(Please mark one of the following)*

☐ Deletion ☐ First Time Entry
☐ Entry Change ☐ Replacement

4. FACILITY NAME AND LOCATION

A. NAME *(last, first, and middle initial)*

B. STREET ADDRESS/ROUTE NUMBER

C. LATITUDE — DEG | MIN | SEC

D. LONGITUDE — DEG | MIN | SEC

E. TOWNSHIP/RANGE — TOWNSHIP | RANGE | SECT | 1/4 SECT

F. CITY/TOWN

G. STATE

H. ZIP CODE

I. NUMERIC COUNTY CODE

J. INDIAN LAND *(mark "x")* ☐ Yes ☐ No

5. LEGAL CONTACT:

A. TYPE *(mark "x")* ☐ Owner ☐ Operator

B. NAME *(last, first, and middle initial)*

C. PHONE *(area code and number)*

D. ORGANIZATION

E. STREET/P.O. BOX

F. CITY/TOWN

G. STATE

H. ZIP CODE

I. OWNERSHIP *(mark "x")* ☐ PRIVATE ☐ PUBLIC ☐ SPECIFY OTHER ☐ STATE ☐ FEDERAL

6. WELL INFORMATION:

A. CLASS AND TYPE		B. NUMBER OF WELLS COMM	B. NUMBER OF WELLS NON-COMM	C. TOTAL NUMBER OF WELLS	D. WELL OPERATION STATUS UC	AC	TA	PA	AN
				0					
				0					
				0					
				0					
				0					
				0					
				0					

COMMENTS *(Optional):*

KEY:

DEG = Degree
MIN = Minute
SEC = Second
SECT = Section
1/4 SECT = Quarter Section

COMM = Commercial
NON-COMM = Non-Commercial
AC = Active
UC = Under Construction
TA = Temporarily Abandoned
PA = Permanently Abandoned and Approved by State
AN = Permanently Abandoned and not Approved by State

INSTRUCTIONS AND DEFINITIONS

SECTION 1. DATE PREPARED: Enter date in order of year, month, and day.

SECTION 2. FACILITY ID NUMBER: In the first two spaces, insert the appropriate U.S. Postal Service State Code. In the third space, insert one of the following one letter alphabetic identifiers:

D - DUNS Number,
G - GSA Number, or
S - State Facility Number.

In the remaining spaces, insert the appropriate nine digit DUNS, GSA, or State Facility Number. For example, A Federal facility (GSA - 123456789) located in Virginia would be entered as : VAG123456789.

SECTION 3. TRANSACTION TYPE: Place an "x" in the applicable box. See below for further instructions.

Deletion. Fill in the Facility ID Number.
First Time Entry. Fill in all the appropriate information.
Entry Change. Fill in the Facility ID Number and the information that has changed.
Replacement.

SECTION 4. FACILITY NAME AND LOCATION:

A. Name. Fill in the facility's official or legal name.
B. Street Address. Self Explanatory.
C. Latitude. Enter the facility's latitude (all latitudes assume North Except for American Samoa).
D. Longitude. Enter the facility's longitude (all longitudes assume West except Guam).
E. Township/Range. Fill in the complete township and range. The first 3 spaces are numerical and the fourth is a letter (N,S,E,W) specifying a compass direction. A township is North or South of the baseline, and a range is East or West of the principal meridian (e.g., 132N, 343W).
F. City/Town. Self Explanatory.
G. State. Insert the U.S. Postal Service State abbreviation.
H. Zip Code. Insert the five digit zip code plus any extension.

SECTION 4. FACILITY NAME & LOCATION (CONT'D.):

I. Numeric County Code. Insert the numeric county code from the Federal Information Processing Standards Publication (FIPS Pub 6-1) June 15, 1970, U.S. Department of Commerce, National Bureau of Standards. For Alaska, use the Census Division Code developed by the U.S. Census Bureau.
J. Indian Land. Mark an "x" in the appropriate box (Yes or No) to indicate if the facility is located on Indian land.

SECTION 5. LEGAL CONTACT:

A. Type. Mark an "x" in the appropriate box to indicate the type of legal contact (Owner or Operator). For wells operated by lease, the operator is the legal contact.
B. Name. Self Explanatory.
C. Phone. Self Explanatory.
D. Organization. If the legal contact is an individual, give the name of the business organization to expedite mail distribution.
E. Street/P.O. Box. Self Explanatory.
F. City/Town. Self Explanatory.
G. State. Insert the U.S. Postal Service State abbreviation.
H. Zip Code. Insert the five digit zip code plus any extension.
I. Ownership. Place an "x" in the appropriate box to indicate ownership status.

SECTION 6. WELL INFORMATION:

A. Class and Type. Fill in the Class and Type of injection wells located at the listed facility. Use the most pertinent code (specified below) to accurately describe each type of injection well. For example, 2R for a Class II Enhanced Recovery Well, or 3M for a Class III Solution Mining Well, etc.
B. Number of Commercial and Non-Commercial Wells. Enter the total number of commercial and non-commercial wells for each Class/Type, as applicable.
C. Total Number of Wells. Enter the total number of injection wells for each specified Class/Type.
D. Well Operation Status. Enter the number of wells for each Class/Type under each operation status (see key on other side).

INJECTION WELL CLASS AND TYPE CODES

CLASS I Industrial, Municipal, and Radioactive Waste Disposal Wells used to inject waste below the lowermost Underground Source of Drinking Water (USDW).

TYPE	**1I**	Non-Hazardous Industrial Disposal Well.
	1M	Non-Hazardous Municipal Disposal Well.
	1H	Hazardous Waste Disposal Well injecting below the lowermost USDW.
	1R	Radioactive Waste Disposal Well.
	1X	Other Class I Wells.

CLASS II Oil and Gas Production and Storage Related Injection Wells.

TYPE	**2A**	Annular Disposal Well.
	2D	Produced Fluid Disposal Well.
	2H	Hydrocarbon Storage Well.
	2R	Enhanced Recovery Well.
	2X	Other Class II Wells.

CLASS III Special Process Injection Wells.

TYPE	**3G**	*In Situ* Gasification Well
	3M	Solution Mining Well.

CLASS III (CONT'D.)

TYPE	**3S**	Sulfur Mining Well by Frasch Process.
	3T	Geothermal Well.
	3U	Uranium Mining Well.
	3X	Other Class III Wells.

CLASS IV Wells that inject hazardous waste into/above USDWs.

TYPE	**4H**	Hazardous Facility Injection Well.
	4R	Remediation Well at RCRA or CERCLA site.

CLASS V Any Underground Injection Well not included in Classes I through IV.

TYPE	**5A**	Industrial Well.
	5B	Beneficial Use Well.
	5C	Fluid Return Well.
	5D	Sewage Treatment Effluent Well.
	5E	Cesspools (non-domestic).
	5F	Septic Systems.
	5G	Experimental Technology Well.
	5H	Drainage Well.
	5I	Mine Backfill Well.
	5J	Waste Discharge Well.

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Attachment 5

Injection Field Log

Project Name: _____ **Injection Logs Recorded By:** _____

Boring ID Number	Date	Start Time	End Time	Injection Interval (ft to ft)	Maximum PSI	Average PSI	Average Flow Rate (gpm)	Volume Per Interval (gal)	Volume per Boring Running Total (gal)	Check if Reagent Surfaced	Notes
IP1											

Total Volume Injected: _____

Boring ID Number	Date	Start Time	End Time	Injection Interval (ft to ft)	Maximum PSI	Average PSI	Average Flow Rate (gpm)	Volume Per Interval (gal)	Volume per Boring Running Total (gal)	Check if Reagent Surfaced	Notes
IP2											

Total Volume Injected: _____

Boring ID Number	Date	Start Time	End Time	Injection Interval (ft to ft)	Maximum PSI	Average PSI	Average Flow Rate (gpm)	Volume Per Interval (gal)	Volume per Boring Running Total (gal)	Check if Reagent Surfaced	Notes
IP3											

Total Volume Injected: _____