NEW YORK STATE OFFICE OF PEOPLE WITH DEVELOPMENTAL DISABILITIES

2015 IN-SITU CHEMICAL OXIDATION GROUNDWATER TREATMENT REPORT

Former Gowanda Day Habilitation Center
4 Industrial Place
Town of Gowanda, Cattaraugus County
Voluntary Cleanup Program Agreement V-00463-9

Prepared for:

Dormitory Authority & New York State Office of People with Developmental Disabilities

Bergmann Project No. 6974.80

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TABLE OF CONTENTS

LIST OF TABLE

LIST OF FIGURES

1.0 Introduction

Bergmann Associates (Bergmann) is submitting this In Situ Chemical Oxidation (ISCO) Groundwater Treatment report that documents the ISCO remediation completed at the former Gowanda Day Habilitation Center facility at 4 Industrial Place, Gowanda, New York (Site). This report has been prepared on behalf of the Dormitory Authority of the State of New York (DASNY) and the New York State Office of People with Developmental Disabilities (OPWDD). The OPWDD, as the volunteer, entered into a Voluntary Cleanup Agreement (VCA) on August 16, 2001 with the New York State Department of Environmental Conservation (NYSDEC) to conduct investigations and implement remedial measures in accordance with VCA Site No. V-00463-9.

OPWDD enhanced the remedial program at the Site by terminating the Groundwater Treatment System (GTS) and soil vapor extraction system that has mass removed the majority of the volatile organic compounds (VOCs) in the groundwater plume to the extent possible and implemented an In-Situ Chemical Oxidation (ISCO) treatment. ISCO treatment has further reduced residual concentrations of chlorinated solvents in the subsurface. Residual concentrations of chlorinated solvents remain in the source area (Treatment Area #1) located on the south side of building and also at a limited down gradient area (Treatment Area #2) along the property line with residential properties on Torrance Place. The nature and extent of contamination at the Gowanda Day Habilitation Center was documented as part of the 2003 Site Investigation and 2004 Supplemental Site Investigation reports. Trichloroethene (TCE) was the most commonly detected compound in the subsurface soil and groundwater samples during these previous investigations. The area of the Site is presented on Figure 1 – Site Vicinity Map. This Remedial Action Plan (RAP), dated March 29, 2014 was approved by NYSDEC and prepared based Bergmann's experience utilizing ISCO compounds for groundwater remediation, Regenesis® RegenOx™ product information, and groundwater quality data presented in the 2013 December Groundwater Characterization Report.

The elements of the scope of work detailed in the RAP were discussed with the NYSDEC Project Manager for the proposed ISCO groundwater treatment during a February 27, 2014 telephone conversation and previous written correspondence requesting proposed ISCO groundwater treatment in the 2012 PRR. The specific details and requirements for the methods and procedures to implement the proposed groundwater oxidation treatment are presented in the RAP dated April 2014. The ISCO groundwater treatment was conducted to reduce the residual concentrations of VOCs, specifically chlorinated solvents, in two treatment areas within the impacted groundwater plume that include the source area and the limited downgradient area along the property line. Total VOC concentrations range from approximately 1,740 to 880 µg/L in the source area and from 430 to 100 µg/L in the down gradient area along the property line. The groundwater results presented in the 2013 December Groundwater Characterization Report were used for ISCO planning and baseline levels to compare future groundwater quality results, see Table 1- Historic Groundwater Analysis Results Summary (December 2013).

1.1 Background

The Gowanda Day Habilitation Site consists of a 5.94 acre parcel located at 4 Industrial Place with a building previously used by a number of manufacturing operations during several time periods between circa 1948 and 1987 followed by renovations during 1987-1988. New York State agencies have occupied the building since 1982. New York State acquired the parcel in 1989. The building was most recently operated by the OPWDD as a Day Habilitation Center for mental health care clients from 1989 through 2001 and was formerly known as Western New York Developmental Disabilities Services Office. In April 2001, on-site operations ceased. The nature and extent of contamination at the Gowanda Day Habilitation Center was documented as part of the 2003 Site Investigation and 2004 Supplemental Site Investigation reports. Trichloroethene (TCE) was the most commonly detected compound in the subsurface soil and groundwater samples. TCE degradation products cis-1,2,-Dichloroethene (c-1,2-DCE), trans-1, 2-Dichloroethene (t-1,2-DCE) and Vinyl Chloride (VC) were also detected.

A Groundwater Treatment System (GTS) and Soil Vapor Extraction System (SVES) were activated on May 10, 2005 as Interim Remedial Measures (IRM). An additional groundwater recovery well, designated G-3, was installed outside the building and adjacent to MW-17 in November 2008. The GTS (pump and treat) consists of seven groundwater recovery wells, an air compressor, a network of controller-less pneumatic pumps and an air stripper treatment system to process recovered groundwater. Recovered groundwater is pumped to the equalization tank for settling of the sediment and discharged to the Village of Gowanda Sewage Treatment Plant (STP) via the sanitary sewer in accordance with a Gowanda Sewer Use Permit. The Village of Gowanda requires that an annual discharge report be submitted, detailing the volume of water collected, treated and discharged to the sewer. The air stripper unit was previously used to remove VOCs prior to discharge and the air discharged from the air stripper was routed to the SVES carbon vessels for treatment prior to atmospheric discharge.

In January 2008 the building was decommissioned. The GTS was winterized with the addition of heat tape and insulation to conveyance lines and the installation of an independently operated suspended heater in the treatment area for the GTS and SVES located in the former Machine Shop. The groundwater quality is monitored on a quarterly basis from monitoring wells and recovery wells shown on Figure 2 – Well Location Map. Groundwater Contour maps are generated from depth to water measurements collected during each monitoring event, see Figure 3 December 2013 Groundwater Contour Map and Figure 4 – March 2015 Groundwater Contour Map. The remedial program at the Site was modified by terminating the GTS and soil vapor extraction system, believed to have achieved the extent of it practical benefits in favor of ISCO treatment of the residual concentration of VOCs in Groundwater. The SVE and GTS equipment will remain on site in the event that re-activation is required in the future.

1.2 Summary of Groundwater Flow

A groundwater contour map of the water table surface was prepared and indicates the groundwater flow pattern for March 2015, the most recent sampling event before the ISCO treatment. The groundwater contour map is based on calculations of groundwater elevations from depth to water measurements in 20 monitoring wells. The March 2015 groundwater contour map shows a flow pattern similar to groundwater contours observed historically since 2002. Groundwater at the Site is flowing in a northerly direction. Torrance Place is hydraulically down-gradient from the Day Habilitation Center building. The March 2015 depths to groundwater range from 3.66 ft below top of casing (toc) at MW-1, located south of the building in the driveway to 11.94 ft toc at MW-7 located at the northern property line. The average depth to groundwater at the wells measured was 7.93 ft bgs.. The groundwater flow pattern did not change after the ISCO treatment of groundwater based on the most recent November 2015 monitoring event.

1.3 Subsurface Parameters

The following subsurface parameters were considered during the evaluation for ISCO groundwater treatment using RegenOx™. The data used to determine the parameters was selected from field measurements from monitoring well installations within the overburden groundwater system and with respect to the treatment areas.

- Average Thickness of Impacted Overburden 18.34 ft.
- Average Saturated Thickness in Overburden 9 ft.
- Average Depth to Groundwater in Overburden 8.89 ft.
- Shallowest Depth to Groundwater in Overburden 5.63 ft.
- Deepest Depth to Groundwater in Overburden 16.93 ft.
- Depth of Treatment Zone in Overburden (soil and groundwater) 7 ft. to 18 ft.
- Cubic yards of saturated and unsaturated soil in ISCO source injection area – 5,000 cubic yards
- Tons of soil in ISCO source injection area - 9,050 Tons
- Cubic yards of saturated and unsaturated soil in down gradient injection area – 2,930 cubic yards
- Tons of soil in down gradient injection area – 5,303 Tons
- Maximum concentration of TCE – 1,400 µg/L
- Maximum concentration of c-1,2-DCE – 340 µg/L

- Maximum concentration of Vinyl Chloride – 13 µg/L
- Average porosity 35%

The ISCO groundwater treatment included the unsaturated soil zone that is approximately 2 feet above the top of the groundwater table.

1.4 Groundwater Chemical Oxidation Treatment Using RegenOx™

Overall, the ISCO groundwater treatment further reduced VOC concentrations when compared to the December 2013 sampling event in the groundwater plume to levels that are approaching levels acceptable for NYSDEC closure criteria under the conditions of the OPWDD VCA. There have been some increases in VOC concentrations during subsequent sampling events. However, the long term trend for reduction is anticipated to continue in the majority of the plume area. The rebound after the 2nd ISCO may be attributable to the ISCO effecting residual VOCs in the soil through the oxidizing phase into the dissolved phase in groundwater where further reduction is possible from bioremediation from indigenous bacteria. The levels after the 2nd injection are close to the December 2013 levels.

Existing GTS and SVES equipment remains on-site in the event that in the future re-activation of the groundwater pump and treatment system is needed. RegenOx™ was used as the chemical oxidation compound for ISCO groundwater treatment of VOCs in the Source Injection Area (approximately 68 ft. by 110 ft. by 18 ft. deep). This area included the source area near monitoring wells MW-1/MW-11 and extends down gradient beyond DR-2 as presented on Figure 5 – December 2013 Distribution Groundwater Analytical Results in Monitoring Wells and Figure 6 – March 2015 Distribution Groundwater Analytical Results in Monitoring Wells. RegenOx™ was also used for treatment in the Down gradient injection Area to reduce groundwater impacts along the property line with residential homes on Torrance Place. This treatment area was approximately 36 ft. by 122 ft. by 18 ft. deep and is located near monitoring wells MW-6 and MW-17, shown on Figure 7 – Chemical Oxidation Injection Locations.

The operation of the GTS and SVES was shut down for approximately 18 months to allow for stabilization of groundwater prior to ISCO remediation and during post-injection groundwater monitoring for conformation of the completeness of ISCO remediation. Once the GTS & SVE system was shutdown, an initial increase (or rebound) in groundwater concentrations occurred at the beginning of the shutdown period at MW-1, MW-6, MW-11, MW-12, MW-14, MW-16 and MW-17 based on the data from the December 2013 sampling event. The groundwater concentrations were overall reduced during the shutdown stabilization period from October 2013 to March 2015 prior to the ISCO injections, see Table 1. Completeness of ISCO remediation will be based on future quarterly groundwater monitoring results during a nine month post-injection monitoring period that began on the November 2015 sampling event. Therefore, quarterly groundwater monitoring will continue as scheduled for corrective action throughout post ISCO remediation work. An initial groundwater sampling event, June 2015 quarterly monitoring event, was completed approximately four weeks after the ISCO injection to evaluate the initial short term effectiveness of the ISCO remediation in addition to subsequent quarterly monitoring events. Below is the scope of work elements that were completed to accomplish the ISCO groundwater remediation:

- Discussed the proposed groundwater chemical oxidation treatment with NYSDEC prior to preparation of the NYSDEC approved RAP and include class V injection inventory information for the proposed RegenOx™ treatment (injection) boreholes.
- Completed evaluation of subsurface parameters data and determine depth of treatment zone and injection borehole locations for the proposed application of RegenOx™ as detailed in the NYSDEC approved RAP.
- Reviewed subsurface utilities/structures and their compatibility with RegenOx™ as detailed in the NYSDEC approved RAP.
- RAP approved by NYSDEC / NYSDOH on June 19, 2014.
- Shut down GTS and SVES groundwater remediation and recovery network for to allow for an extended groundwater stabilization period of approximately 18 months.
- Field marked 44 initial RegenOx™ injection (treatment) borehole locations and contact underground utility stakeout.

- Re-developed the 7 existing pump wells to prepare as injection points.
- Installed 44 treatment boreholes for the first application of RegenOx™ on May 11th, 2015 through May 29th, 2015 and also injected into 7 existing pump wells. The treatment boreholes were installed by direct–push drilling methods on approximate 15-foot centers in each of the treatment areas to depths of approximately 18 feet as shown on Figure 7.
- Performed initial post-remediation groundwater sampling event during the June 2015 quarterly monitoring event to evaluate the short trem effectiveness of the initial ISCO application.
- Evaluated the need for a second ISCO application that was required based on the groundwater quality results and the first post-injection quarterly monitoring event results.
- Completed the second ISCO application on September 16th through September 18th 2015.
- Performed three quarters of routine groundwater monitoring were completed following the first ISCO injection and one quarter after the second injection.
- Prepared this summary report and submitted to NYSDEC that documents the project work completed with recommendations to continue quarterly groundwater monitoring.

2.0 Environmental Setting

The building and Site's physical setting is in a former industrial area adjacent to residential properties. The majority of the Site is occupied by a developed former industrial facility with parking lots, roadways, and some landscaped areas that are grass covered. The ground surface topography in the vicinity of the Site is generally flat and the overburden groundwater flow is generally north.

2.1 Geologic and Hydrogeologic Setting

Subsurface geologic units present at the Gowanda Day Habilitation Center site include the following in descending order:

- Flood plain deposits consisting of fine sand, silt, and clay.
- Alluvium deposits from a fluvial depositional regime, consisting of fine gravel, sand, and silt.
- Glacial till (lodgment or ablation-type glacial till).
- Bedrock, consisting of Devonian-age shale and siltstone deposits (not encountered).

A filled-in stream channel on the top of the glacial till surface also is apparent at the Site, as an elongated trough or depression. This feature may be a former stream channel that scoured into the relatively impermeable till surface, and was subsequently filled in with permeable alluvial deposits. This apparent trough is oriented in a southwest-to-northeast direction beneath the Gowanda Day Habilitation Center building.

Groundwater occurs in the alluvial sand and gravel unit under unconfined (water table) conditions with saturated thickness of the aquifer ranging from approximately 8.6 to 10.8 feet. The saturated thickness of the aquifer is greater at the southern portion of the Site, and thinner at the eastern and northern areas. Groundwater flow direction is in a generally northerly direction, corresponding with the decrease in the till surface. The water table aquifer likely discharges either into Cattaraugus Creek or into outwash and flood plain deposits approximately 2,400 feet north of the Site.

The 2002 SI report determined hydraulic conductivity for groundwater monitoring wells range from 1.001×10^{-3} to 1.403×10^{-3} cm/sec (2.838 to 3.978 ft/day). Groundwater seepage velocity in the direction of flow was estimated at 0.281 to 0.327 feet per day based on aquifer testing at the monitoring wells. Recharge to the water table aquifer at the Site occurs predominately from up-gradient sources to the south. Although local vertical infiltration of precipitation can occur, the presence of asphalt and the building footprint reduces such an effect.

2.2 Potential Receptors

Underground utilities that are below the groundwater table may be considered potential receptors. However, impact due to utilities in the source area has been limited by migration control from the source area that was contained through the use of the groundwater pump wells and groundwater recovery network during active corrective action during the last 9 years. The VOC plume is stabilized and the overall concentration of VOCs have been further reduced after the ISCO groundwater treatment.

3.0 ISOC Application of RegenOx™

Application of RegenOx™ in each treatment area was completed by injection of RegenOx™ into the groundwater plume to further reduce the concentration of VOCs in the groundwater plume to levels that meet NYSDEC closure criteria for commercial use. RegenOx™ was applied as a slurry into the injection zone in of each treatment borehole. The following sections present the methods and procedures completed for each phase of the ISCO groundwater treatment.

3.1 RegenOx™ Product Specifications and Applications

RegenOx™ maximizes performance using a solid alkaline oxidant that employs a sodium percarbonate complex with a multi-part catalytic formula and an activator complex (a composition of ferrous salt embedded in a micro-scale catalyst gel). RegenOx™ with its catalytic oxidizing compound is capable of treating a very broad range of soil and groundwater contaminants including both petroleum hydrocarbons and chlorinated solvents.

RegenOx™ application oxidized VOC contamination in impacted soil and groundwater and was applied using direct-injection techniques in uncased treatment boreholes. The application process involved combining RegenOx™ Part A oxidizer with Part B activator in a water solution that was injected into the treatment zone of the borehole under pressure. The treatment zone included the vertical zone of contamination of the lower portion of the unsaturated soils (2 foot capillary fringe zone) and the groundwater (saturated impacted zone 9 foot) that is from approximately 7 ft. to 18 ft. below the ground surface. The applied slurry (solution) of RegenOx™ moved out of the treatment zone and into the groundwater aquifer and was observed flowing from adjacent treatment boreholes that indicated communication of the slurry outward from injection locations in the subsurface. Upon direct contact with impacted soil and groundwater, RegenOx™ produced a series of efficient oxidation reactions by a number of mechanisms including: surface mediated oxidation, direct oxidation and free radical oxidation. These reactions destroy a wide range of petroleum and chlorinated solvent chemical compounds and reactions may be sustained for periods of up to 30 days from a single injection. RegenOx™ is safe for use in direct contact with underground utilities/infrastructure as it is non-corrosive and produces very low amounts of heat and pressure.

RegenOx™ Produces Beneficial Detergent-Like Contaminant Desorption Effects

The desorption-surfactant like effect of RegenOx™ draws the contaminant off the soil surface and or out of the groundwater and into solution like a detergent. Contaminants reach the catalytic surface where localized free-radical generation occurs leading to efficient contaminant destruction as RegenOx™ is released into the groundwater. The primary oxidation mechanisms destroy dissolved phase VOCs in the groundwater or in soils upon contact with the RegenOx™ solution.

Safety

Upon combining RegenOx™ Part A and Part B, a mild exothermic reaction begins. This reaction results in minimal heat and pressure generation, allowing field application of RegenOx™ to be accomplished safely and without the use of highly specialized equipment or specialty contractors. Bergmann's contractors, SJB Services, Inc., followed Regenesis® safety guidance information for use of RegenOx™.

RegenOx™Product Specifications and Benefits of Use

RegenOx™ is a two part product (Part A is the oxidizer powder, Part B is the liquid activator). The composition of Part A is a mixture of sodium percarbonate [$2Na_2CO_3$- $3H_2O_2$], sodium carbonate [Na_2CO_3], sodium silicate and silica gel. The composition of Part B is a mixture of sodium silicate solution, silica gel and ferrous sulfate. The benefits of use of RegenOx™ for groundwater oxidation treatment include:

- Rapid and sustained oxidation on petroleum and chlorinated solvents compounds
- Detergent-like, contaminant desorption effects
- Generates minimal heat and pressure
- Compatible with underground infrastructure, conduits, piping and tanks
- Easily applied with readily available equipment
- Destroys a broad range of contaminants
- Enhances subsequent bioremediation
- Avoids detrimental impacts to groundwater
- The action of oxidation lasts up to 30 days after each injection

3.2 Installation of RegenOx™ Treatment Boreholes

A total of 51 treatment boreholes are planned for the ISCO program. Installation of 44 treatment boreholes were drilled using direct push methods and existing pump wells DR-1 through DR-4 and G1 through G3 were used for treatment boreholes into the Source Injection Area and the Down Gradient Injection Area. A second injection of 15 treatment boreholes was required as further reduction was required after the quarterly monitoring results were reviewed. The second injection required the installation of 8 treatment boreholes and re-injection into the existing pump wells.

The treatment wells (injection wells) are considered Class V Injection Wells for the purpose of groundwater remediation and underground injection documentation is required in accordance with the EPA Region 2 underground injection control (UIC) program. The required well inventory forms will be submitted under separate cover to EPA Region 2. Each treatment borehole was advanced to create an approximate 3-inch diameter borehole from the ground surface to approximately 18 feet below ground surface or until refusal of the direct push drilling equipment. The treatment boreholes were installed on approximate 15-foot centers at the approximate locations shown on Figure 7. Treatment boreholes were installed using direct push drilling techniques by advancing steel rods and a steel drive point to advance the treatment borehole to the design depth that created an open (un-cased) soil borehole.

During the installation of the treatment boreholes, the soils removed from the boreholes was field screened with a photoionization detector (PID) for total organic vapors. The soils did not have elevated measurements above 10 ppm and were used as backfill in the same treatment borehole. Treatment boreholes were open for the time required to inject the RegenOx™ slurry and then the injection interval was backfilled with quartz sand followed by bentonite to approximately 1 foot below the ground surface. The ground surface was plugged with soil in the grass areas and with a concrete plug and pavement patch in parking lots and roadway locations.

The existing pump wells that were used as injection wells were developed to insure that the wells are adequate for injection of RegenOx™ slurry. After injection these wells were re-developed to remove sediments and allow of collection of groundwater samples.

3.3 RegenOx™ Slurry Application

RegenOx™ prepared in slurry was directly applied into the subsurface in each of the treatment boreholes throughout the treatment areas and at other selected locations within the impacted groundwater plume as shown in Figure 7. Approximately 20 lbs. of Part A RegenOx™ and 15 lbs. of Part B RegenOx™ per foot was mixed according to the manufacture specifications for injection into treatment borehole. The mixed batches varied at several locations based on field conditions in the subsurface. Therefore, some treatment boreholes took more or less volume of slurry and the slurry was also mixed to 3%, 4% and 5% depending on the flow of slurry into each borehole during injection. A total of approximately 8,530 lbs. of RegenOx™ Part A and 6,235 lbs. of Part B was used for the initial injection. The RegenOx™ slurry level was maintained in each treatment zone from 12 feet to approximately 18 feet below ground surface. The RegenOx™ mixture was also modified based on field conditions during the second injection as noted above.

- Prior to the injection of RegenOx™, any surface or overhead impediments were identified as well as the location of underground structures. The planned installation locations were within 5 feet of the actual locations to adjust for underground utilities and obstacles. All of the injection boreholes were marked in the field prior to installations.

- A direct push drill rig was located over treatment borehole locations and followed the installations by advancing drill steel to the design depth and pulling the steel back in the open borehole that removes the disposable steel drive tip. The depth of the treatment borehole was checked prior to injection of RegenOx™ slurry. The drill rod (casing) was lifted 6 inches so that the disposable tip detached from the drill rod. The slurry was injected through the drill rods as the steel was retracted towards the ground surface so that the slurry was injected into the entire length of the treatment zone. The treatment boreholes remained open and vertical during the injection timeframe.

- The RegenOx™ percent of the oxidizer in solution ranged between 3% to 5%.

- The appropriate quantity of RegenOx™ Oxidizer was measured for 9 vertical feet of injection into a mixing tank. The volume of water per injection treatment borehole was calculated from the following formulas:

  - 3% oxidant solution for every 10 lbs. of oxidant and 10 lbs. of activator (20 lbs. total RegenOx™) with 38 gallons of water.

  - 4% oxidant solution for every 10 lbs. of oxidant and 10 lbs. of activator (20 lbs. total RegenOx™) with 28 gallons of water.

  - 5% oxidant solution for every 10 lbs. of oxidant and 10 lbs. of activator (20 lbs. total RegenOx™) with 22 gallons of water.

- Pre-measured quantity of RegenOx™ Oxidizer was placed into the pre-measured volume of water to make the desired target % oxidant in a slurry solution. As a safety precaution the oxidizer was poured into water. The water and oxidant was mixed with a power drill and paint stirrer, to ensure that the Oxidizer dissolved in the water to from the RegenOx™ slurry.

- The RegenOx™ slurry was injected using a pump through a flexible rubber hose that was connected to the drill rods that extended from the ground surface to the bottom of the treatment borehole. The drill rods were raised from the bottom of the treatment zone (18 feet) to approximately 7 feet as the slurry was injected to maintain slurry level at approximately 7 to 5 feet below the ground surface. The majority of the treatment borehole took the required amount of RegenOx™ slurry. The contractor moved to other treatment locations and complete the injection at that location after the slurry level fell to the top of the groundwater table. Then the contractor returned to the previous location and injected the balance of slurry. Some treatment boreholes would not accept the design amount of slurry and other treatment boreholes accepted more than the design amount. Each batch of RegenOx™ slurry should was injected within 1 hour of mixing.

4.0 Backfilling of RegenOx™ Treatment Boreholes

Each treatment borehole was backfilled to the ground surface after the injection of RegenOx™ slurry was completed. The treatment zone from approximately 7 feet to 18 feet was backfilled with quartz sand and native soils. The backfill from approximately 7 feet to approximately 2 feet consisted of soils from the installation of the treatment borehole that did not indicate visual or elevated measurements above 10 part per million (ppm) with the PID. At several locations bentonite was used as backfill above the sand backfill when there was not enough native soils to backfill the boreholes. The backfill from approximately 2 feet to 0.5 feet consisted of concrete and a pavement patch that was placed at grade in roadway /parking lot locations. Bentonite was used as backfill to the ground surface in grass locations to a depth 6 inches below grade. In pavement areas, the interval from ground surface to 0.5 ft. was a pavement patch and from 0.5 ft. to 2.0 ft. concrete was backfilled. The borehole from the ground surface to approximately 0.5 feet was backfilled with a pavement patch to match the ground surface or topsoil to match the ground surface in grassy areas.

5.0 Evaluation of Chemical Oxidation

In general, the current residual concentrations and distribution of VOCs in the groundwater plume has been further reduced to levels that can be successfully remediated to levels that meet NYSDEC closure criteria. There have been some increases in VOC concentrations during subsequent sampling events after the ISCO injections. However, the long term trend for reduction is anticipated to continue in the majority of the plume area. The substantial source area reduction of VOCs is largely attributed to the operation and maintenance of the groundwater pump and treatment combined with soil vapor extraction technologies. The effectiveness of contaminant mass removal from operation of the GTS and SVES diminished and reached the approaching asymptotic conditions over approximately 9 years of operation. The success of the operation of the GTS and SVES has reduced VOCs to residual levels in the source area with substantial improvement to the groundwater quality throughout the extent of the groundwater plume.

The highest residual concentrations remain at two source area monitoring well locations MW-1 and MW-11 within the Source Injection Area and at monitoring well MW-17 within the proposed Down Gradient Injection Area. The distribution of VOCs detected in the groundwater during the December 2013 monitoring event is presented on Figure 5.

5.1 Summary of Groundwater Quality Pre-ISCO Treatment

The December 2013 groundwater monitoring event was conducted on December 16 – 17, 2013. Total VOCs were detected with concentrations from 1,740 µg/L and 880 µg/L in the groundwater samples collected from two source area monitoring wells MW-1 and MW-11, respectively. VOCs were detected in the down gradient property line area with concentrations of from 130 µg/L and 420 µg/L in monitoring wells MW-6 and MW-17, respectfully. These results were used as baseline levels for the development of the RAP and compared the overall effectiveness of post-ISCO groundwater sample results, see Table 1 - Historic Groundwater Analysis Results Summary (December 2013).

Residual concentrations of VOCs are distributed in the dissolved phase groundwater plume. The concentrations of VOCs throughout the majority of the groundwater plume down gradient of the source area and up gradient of the down gradient property line area range from approximately 6.8 µg/L (MW-15) to123 µg/L (DR-3).

The individual VOCs detected in the groundwater samples from the plume generally include the detection of TCE and c-1,2-DCE with a single detection of Vinyl Chloride. The sum of the detections of these VOCs is equal to the TVOCs in each sample. The distribution and concentrations for these VOCs is further discussed below.

<u>Trichloroethene</u>

Trichloroethene (TCE) was detected in eleven of the December 2013 groundwater samples from monitoring wells / pump wells with concentrations ranging from1, 400 µg/L (MW-1) to 6.8 µg/L (MW-15). Trichloroethene is the second most frequently detected VOC and was believed to the released chemical in the source area.

Cis – 1, 2 - Dichloroethene

C-1,2-DCE is the most frequently detected VOC and is a break down product of TCE. C-1,2-DCE was detected in thirteen of the December 2013 groundwater samples from monitoring wells / pump wells with concentrations ranging from 340 µg/L (MW-1) to 18 µg/L (DR-1).

Vinyl Chloride

Vinyl Chloride was detected in one of the December 2013 groundwater samples in pump will DR-2 with a concentration of 13 µg/L. The detection of Vinyl Chloride is the least frequent and is a break down product of Trichloroethene.

The current size of the groundwater plume and type of VOCs detected has substantially been reduced in extent and concentration from 9 years of active remediation. In general, the current detection of VOCs appears to be limited to persistent concentrations and distribution within the groundwater at the two ISCO treatment areas that include the Source Injection Area and Down Gradient Injection Area, see Figure 7 – Chemical Oxidation Injection Locations.

5.2 Groundwater Quality Trends

The trend for groundwater quality before and after the ISCO injections on May 11th through May 29th 2015 (First ISCO injection) and September 16th through September 18th 2015 (second injection) is best compared to the groundwater results for total VOC concentrations in monitoring wells / recovery wells that have historically exhibited elevated concentrations from both treatment areas as noted below. The results listed below are expressed in parts per billion (ppb) and indicate an overall decrease after the 1st ISCO injection and increasing concentration after the 2nd ISCO treatment. The rebound after the 2nd ISCO may be attributable to the ISCO effecting residual VOCs in the soil through the oxidizing phase into the dissolved phase in groundwater where further reduction is possible from bioremediation from indigenous bacteria. The levels after the 2nd injection are close to the December 2013 levels.

Well ID	December 2013 Groundwater Monitoring Event (Baseline)	March 2015 Groundwater Monitoring Event	May 2015 1st ISCO Injection	June 2015 Groundwater Monitoring Event	August 2015 Groundwater Monitoring Event	September 2015 2nd ISCO Injection	November 2015 Groundwater Monitoring Event
MW-1	1,740	430	**1st ISCO**	350	1,470	**2nd ISCO**	1,530
MW-11	880	500	**1st ISCO**	444	630	**2nd ISCO**	1,060
DR-1	87	21.7	**1st ISCO**	No Sample	160	**2nd ISCO**	319
DR-2	302	259	**1st ISCO**	291	187	**2nd ISCO**	199
MW-12	173	120	**1st ISCO**	97	52	**2nd ISCO**	28.8
MW-17	420	336	**1st ISCO**	No Sample	410	**2nd ISCO**	460

The timeframes of the groundwater monitoring events noted above are in accordance with scheduled quarterly monitoring requirements for compliance monitoring. The 1st ISCO injection date was planned after:

- groundwater stabilization period;
- RAP approval:
- December and March quarterly monitoring events; and
- after freezing weather conditions ended to allow of mixing and injecting RegenOx™ slurry.

The increase of total VOCs detected in the groundwater samples from source area wells is likely due to VOCs bound to soils below the water table and have been released into the dissolved phase in the groundwater system by desorption caused by the ISCO treatment. The most recent levels are compared above and as shown on Figure 8 - November 2015 Distribution of Total Volatile Organic Compounds in Groundwater. VOCs may be further reduced by natural attenuation as dissolved phase in groundwater.

A second possible reason for the increased concentration of VOCs is that there is an on-site source in the subsurface that is actively increasing the dissolved phase from impacted soils above the water table or from an off-site source contributing to the groundwater plume. A third reason for this increase may be attributable to false concentration in groundwater during sample collection from the well's sand pack. These monitoring wells were installed when the concentrations were much higher residual impacts may remain in the sand pack of the wells that is impacting the quality of samples. Several wells were fouled with sediments and RegenOx slurry after the injections and it's possible that re-development did not remove all of the fines that were entrained into the wells sand pack and the condition of the sand packs is causing the elevated groundwater sample concentrations.

6.0 Anticipated Schedule for Closure

The following is the approximate timeframe for the remaining project work to evaluate post-ISCO groundwater quality period of nine months (November 2015 through August 2016) after the second ISCO injection.

Project Task	Duration
Quarterly groundwater monitoring	June 2016
Quarterly Groundwater Monitoring	August 2016
Final Evaluation of ISCO Effectiveness	October 2016
Meeting with NYSDEC to review groundwater quality and requirements for closure	November 2016
Request for NYSDEC closure	1.5 years

7.0 Recommendations

Bergmann recommends continuation of the compliance quarterly groundwater monitoring schedule to the end of the post-ISCO remediation evaluation period. Then complete the evaluation of the effectiveness of the ISCO groundwater treatment.

TABLES

Table 1 Historic Groundwater Analysis Results Summary
Gowanda Day Habilitation Center
4 Industrial Place, Gowanda, New York
VCA # V-00463-9

MONITORING WELLS

Monitoring Well Number	Total VOCs Nov 2015 (ppb)	Total VOCs Aug 2015 (ppb)	Total VOCs Jun 2015 (ppb)	Total VOCs Mar 2015 (ppb)	Total VOCs Nov 2014 (ppb)	Total VOCs Sep 2014 (ppb)	Total VOCs Jun 2014 (ppb)	Total VOCs Mar 2014 (ppb)	Total VOCs Dec 2013 (ppb)	Total VOCs Jul 2013 (ppb)	Total VOCs Apr 2013 (ppb)	Total VOCs Dec 2012 (ppb)	Total VOCs Jun 2012 (ppb)	Total VOCs Mar 2012 (ppb)	Total VOCs Sep 2011 (ppb)	Total VOCs Jun 2011 (ppb)	Total VOCs Mar 2011 (ppb)	Total VOCs Dec 2010 (ppb)	Total VOCs Sep 2010 (ppb)	Total VOCs Jun 2010 (ppb)	Total VOCs Jul 2009 (ppb)	Total VOCs Feb 2009 (ppb)	Total VOCs Sep 2008 (ppb)	Total VOCs Jun 2008 (ppb)	Total VOCs Mar 2008 (ppb)	Total VOCs Sep 2007 (ppb)	Total VOCs May 2007 (ppb)	Total VOCs Oct 2006 (ppb)	Total VOCs Nov 2005 (ppb)	Total VOCs Oct 2004 (ppb)	Total VOCs Jul 2003 (ppb)	Total VOCs Aug 2002 (ppb)
MW-1	1.530	1.470	350	430	300	420	990	990	1.740	830	910	1.440	528	889	442	1.318.1	583	564	649	778	1107.16	677	860	705	1.463	1.481	2.046	1.769	1.128	1.250	2.879	768
MW-2	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	ND	NS	NS	ND	ND	ND	ND	ND	7.1	23
MW-3	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	ND	2.4	ND	ND	8.42	5.6	3.1	15
MW-4	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NS	ND	ND	ND	ND	ND	1.8	3.8
MW-5	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	ND	3.41	ND	ND	5.13	6.7	7.3	14
MW-6	120	96	86	81	110	110	96	94	130	99	93	99	86.7	85.7	101	79	73.2	81.8	107	96	92.8	87.8	113	123	105	171	151	173	233	280	333	406
MW-7	49	130	58	ND	180	190	29	ND	ND	18	ND	ND	151.56	30.5	209.16	70.9	22.3	58.2	160.5	114.46	213	92.34	347.8	244	196.7	360	330.5	420	455.7	508	534	450
MW-8	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	ND	NS	ND	ND	ND	ND	1.4
MW-9	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	ND	NS	ND	ND	ND	ND	4.2
MW-10	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	ND	NS	ND	ND	ND	ND	2.6
MW-11	1.060	630	444	500	451	375	450	710	880	510	570	790	498	617	508.7	722	623	588	630.7	765	625.9	790	437.3	564.9	1.023	398.6	1.189	2.600	1.101	2.355	34.169	4.647
MW-12	28.8	52	97	120	126	136	200	212	173	149.3	186.6	142	86.5	148.22	92.8	162.9	90.82	90.4	100	159.8	82	279.01	65.8	159	165.6	196.9	429	1,082	4,776	6,900	12,100	12,643
MW-13	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	ND	NS	ND	2.02	ND	ND	ND	ND	31	315
MW-14	81	96	52	99	68	68	54	73	94	49	71	47	39.7	76.6	77.3	104.98	31.9	24.33	38.93	65.22	40.72	34.9	17.8	38.15	29.3	103.2	106.8	293.9	139.9	67	140	315
MW-15	9.9	14	8.1	9.8	32	31	6.1	ND	6.8	7	ND	12.9	26.26	6.25	32.46	16.18	6.92	16.85	62	22.93	64.8	4.9	113.3	77.3	18.2	149.6	60.4	149.9	271	320	258	730
MW-16	31	13	6.8	ND	5.2	9.4	21	24	20	8.4	24	18	4.36	12.2	6.07	23.1	28.9	7.21	2.53	ND	22	22.2	16.2	21.3	8.56	24.7	60.0	51.2	65.4	82	38	NA
MW-17	460	410	NS	336	394	410	339	167	420	400	21.3	430	381	260.1	449	225.2	26.7	48.1	312.3	232.1	228.8	4.41	728	599	610	903.0	777	1.011	1.006	1.154	810	NA
MW-18	ND	ND	ND	ND	ND	ND	ND	ND	NS	ND	ND	ND	16.6	2.33	28.7	13.9	6.43	17.9	40.77	27.5	196	13.07	238.6	115.2	56.0	719	442	392	375	460	159	NA
MW-19R	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	2.5	ND	ND	ND	ND	ND	ND	2.67	ND	4.27	ND	13.7	10.57	ND	22.1	2.64	11.4	20.2	14	10*	NA
MW-20	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	17	NA	NA
MW-21	20	20	10	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	141.8	NS	14.3	533	318	29	495.6	436	NA	NA
MW-X (DUP)	1.720	410	360	407	300	400	870	990	1.850	540	186.8	1.450	521	913	457	1.022.2	Sample loss*	588	611	264	598	678	902	648	12.41	888	437	1.350	1031.49	540.6	7.1	133.63
EB	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NS	ND	NS	NS	ND	ND	NS	ND	0.001

RECOVERY WELLS

Recovery Well Number	Total VOCs Nov 2015 (ppb)	Total VOCs Aug 2015 (ppb)	Total VOCs Jun 2015 (ppb)	Total VOCs Mar 2015 (ppb)	Total VOCs Nov 2014 (ppb)	Total VOCs Sep 2014 (ppb)	Total VOCs Jun 2014 (ppb)	Total VOCs Mar 2014 (ppb)	Total VOCs Dec 2013 (ppb)	Total VOCs Jul 2013 (ppb)	Total VOCs Apr 2013 (ppb)	Total VOCs Dec 2012 (ppb)	Total VOCs Jun 2012 (ppb)	Total VOCs Mar 2012 (ppb)	Total VOCs Sep 2011 (ppb)	Total VOCs Jun 2011 (ppb)	Total VOCs Mar 2011 (ppb)	Total VOCs Dec 2010 (ppb)	Total VOCs Sep 2010 (ppb)	Total VOCs Jun 2010 (ppb)	Total VOCs Jul 2009 (ppb)	Total VOCs Feb 2009 (ppb)	Total VOCs Sep 2008 (ppb)	Total VOCs Jun 2008 (ppb)	Total VOCs Mar 2008 (ppb)	Total VOCs Sep 2007 (ppb)	Total VOCs May 2007 (ppb)	Total VOCs Oct 2006 (ppb)	Total VOCs Feb 2005 (ppb)	Total VOCs Oct 2004 (ppb)	Total VOCs Jul 2003 (ppb)	Total VOCs Aug 2002 (ppb)
DR-1	319	160	NS	21.7	63	55	75	132	87	73	82	43	29.38	673	166.5	154.5	250.1	355.5	442.5	60.3	392.28	260	724	864	530	2,043.5	1,106	573.4	8,000	NA	NA	NA
DR-2	199	187	291	259	162	224	231	207	302	256	293	19	229.9	305.3	206.1	240.93	267.75	152.3	213.52	255.2	198.24	223.79	206.6	284.3	154.4	288.1	350.1	549.2	2,003	NA	NA	NA
DR-3	45	76	83	55	181	210	83	89	123	62	73	42	116.96	24.9	74.3	67.7	25.3	30.1	38.1	79.7	125.96	167.34	75.4	123.2	171.7	387.5	183	152.5	1,467	NA	NA	NA
DR-4	94	110	71	147	156	148	96	64	68	79	37	90	122.6	ND	191.03	128.4	101.4	71.7	230.58	155.04	80.3	66.3	129.1	40.2	42.1	217.0	15.21	859.0	1,760	NA	NA	NA
G-1	80.3	ND	68	146	101	105	90	78	96.2	69.1	55.8	52.6	68.55	65.58	67.52	55.81	67.02	48.8	30.5	108.3	164	126.6	120.4	170.5	186	225.0	153.3	200.8	544	NA	NA	NA
G-2	NS	28	NS	48	34	37	52	14	68	81	50	132.2	75.3	41.9	29.8	65.6	47.2	51.8	6.02	8.37	56.2	231	28.3	39.1	80.92	59.3	174.92	283.4	385	NA	NA	NA
G-3	262	370	NS	NS	NS	NS	NS	82	NS	11	25	41.6	147.3	44.2	296.2	224.7	209.8	159.3	233.2	277.8	344	403	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

NS: This well not included in this sampling event.
ND = Not Detected, results less than Method Detection Limit.
Impacted north property line wells: MW-5, MW-6, MW-7, MW-16, MW-17, MW-21
All compounds are measured in parts per billion (ppb).
VOC - Volatile Organic Compounds.
DUP - Duplicate Sample

Monitoring Well Number	Sampling Order Jun 2014	Sampling Order Mar 2014	Sampling Order Dec 2013	Sampling Order Jul 2013
MW-1	12	12	8	12
MW-17	13	13	7	13
MW-18	6	6	NS	6
MW-7	7	7	5	7
MW-11	11	11	12	11
MW-12	10	10	11	10
MW-14	5	5	10	5
MW-2	NS	NS	NS	NS
MW-15	4	4	9	4
MW-20	2	2	2	2
MW-6	9	9	6	9
MW-16	8	8	4	8
MW-19R	3	3	3	3
MW-21	NS	NS	NS	NS
MW-5	NS	NS	NS	NS
MW-3	NS	NS	NS	NS
MW-13	NS	NS	NS	NS
MW-4	1	1	1	1
MW-8	NS	NS	NS	NS
MW-9	NS	NS	NS	NS
MW-10	NS	NS	NS	NS

Recovery Well Number	Sampling Order Jun 2014	Sampling Order Mar 2014	Sampling Order Dec 2013	Sampling Order Jul 2013
G-3	NS	20	NS	20
G-2	19	19	18	19
G-1	18	18	17	18
DR-4	17	17	16	17
DR-3	16	16	15	16
DR-1	15	15	13	15
DR-2	14	14	14	14

Sampling Order Apr 2013	Sampling Order Dec 2012	Sampling Order Jun 2012	Sampling Order Mar 2012	Sampling Order Sep 2012
12	13	13	13	13
13	11	10	7	11
6	6	6	4	4
7	7	8	5	7
11	12	12	12	12
10	10	11	11	10
5	5	5	9	9
NS	NS	NS	NS	NS
4	4	4	8	5
2	2	2	2	2
9	9	9	10	8
8	8	7	6	6
3	3	3	3	3
NS	NS	NS	NS	NS
NS	NS	NS	NS	NS
NS	NS	NS	NS	NS
NS	NS	NS	NS	NS
1	1	1	1	1
NS	NS	NS	NS	NS
NS	NS	NS	NS	NS
NS	NS	NS	NS	NS

Sampling Order Apr 2013	Sampling Order Dec 2012	Sampling Order Jun 2012	Sampling Order Mar 2012	Sampling Order Sep 2011
20	20	20	20	20
19	19	19	19	19
18	18	18	18	18
17	17	17	17	17
16	16	16	16	16
15	15	15	15	14
14	14	14	14	15

FIGURES

DASNY

Gowanda Day Habilitation Center

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Gowanda, NY

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Figure 1

Site Vicinity Map

0 340 680 1,020 1,360
Feet
N

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Figure 2

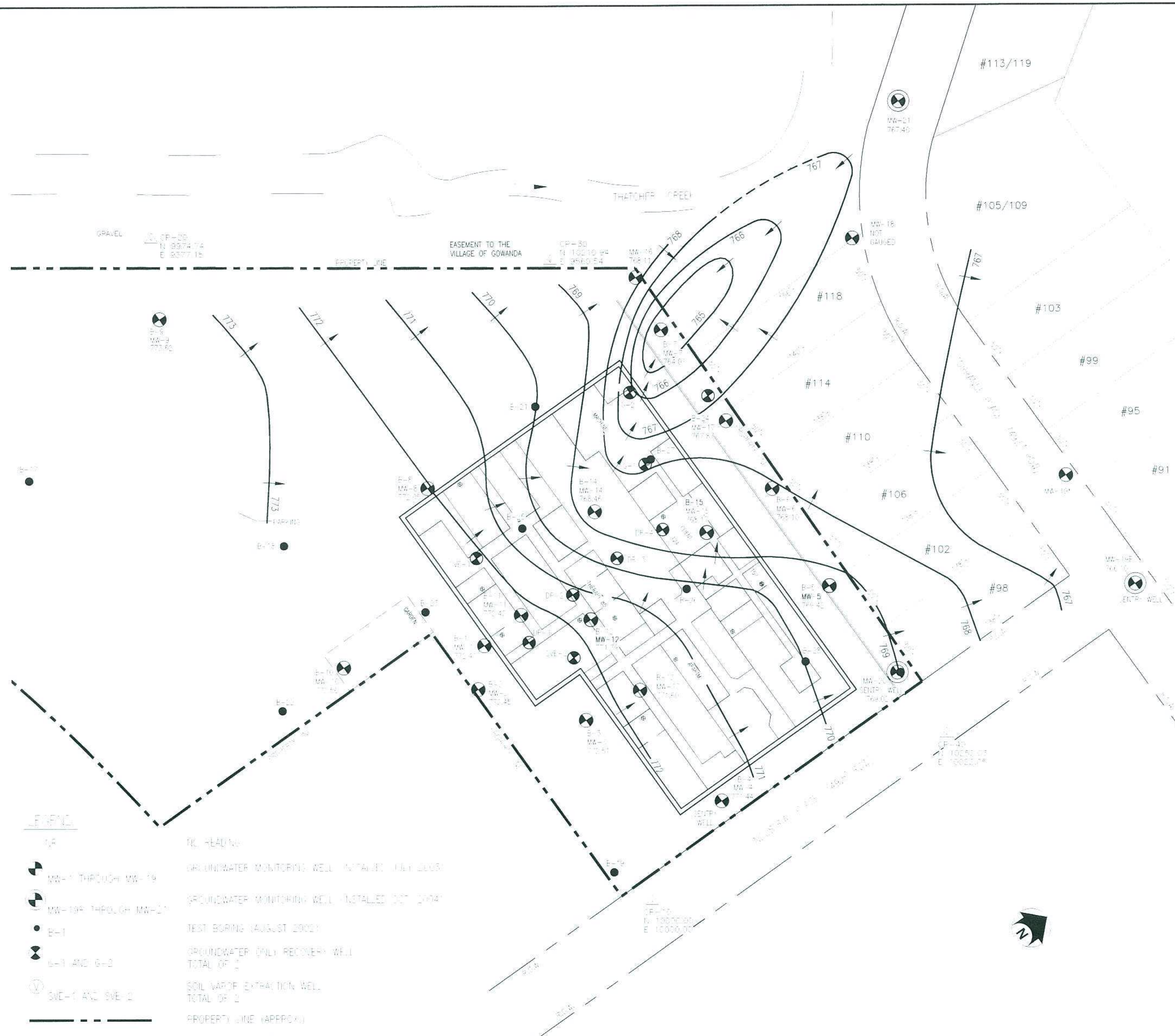
Well Location Map

MONITORING WELLS & BORING LOCATIONS

SAMPLE	NORTH	EAST	ELEVATION	DESCRIPTION
MW-1	10005.75	9770.81	778.51 778.52 778.23	ASPH RIM PVC
MW-2	9983.26	9795.25	778.38 778.38 778.08	ASPH RIM PVC
MW-3	10036.20	9853.98	778.59 778.61 778.38	ASPH RIM PVC
MW-4	10085.20	9967.62	778.66 778.77 778.43	GRD RIM PVC
MW-5	10246.03	9880.34	778.80 778.85 778.61	ASPH RIM PVC
MW-6	10249.86	9795.88	778.[illegible] 781.36 781.10	GRD CASE PVC
MW-7	10249.65	9650.[illegible]4	778.[illegible] 781.[illegible] 780.94	GRD CASE PVC
MW-8	10058.09	9649.08	778.49 781.75 781.[illegible]	GRD CASE PVC
MW-9	9945.36	9450.[illegible]	780.56 782.84 782.61	GRD CASE PVC
MW-10	9909.63	9724.56	[illegible].46 783.10 780.0[illegible]	GRD CASE PVC
MW-11	10041.23	9767.54	778.82 778.81 778.58	FLOOR RIM PVC
MW-12	10082.02	9799.74	778.84 778.85 778.50	FLOOR RIM PVC
MW-13	10080.09	9864.35	778.88 778.87 778.[illegible]	FLOOR RIM PVC
MW-14	10130.64	9734.67	778.80 778.82 778.43	FLOOR RIM PVC
MW-15	10120.80	9795.30	778.78 778.[illegible] 778.08	FLOOR RIM PVC
MW-16	10256.48	9607.06	778.[illegible] 781.05 780.43	GRD CASE PVC
MW-17	10256.56	9734.36	778.[illegible] 781.[illegible] 778.85	GRD CASE PVC
MW-18	10406.65	9675.18	776.73 776.65 776.29	GRD RIM PVC
MW-19*	10436.32	9912.63	775.04 775.[illegible] 774.80	GRD RIM PVC
MW-19R	10430.70	10009.16	774.56 774.[illegible] 774.32	ASPH RIM PVC
MW-20	10248.05	9962.73	778.47 778.46 778.04	ASPH RIM PVC
MW-21	10490.58	9609.30	775.47 775.46 774.76	ASPH RIM PVC
B-16	9730.69	9324.99	781.07	GRD
B-17	9706.66	9475.17	780.40	GRD
B-18	9975.09	9623.76	778.55	ASPH
B-19	9988.66	9965.14	778.30	ASPH
B-20	10240.88	9964.02	778.37	ASPH
B-21	10139.45	9644.71	774.51	GRAV
B-22	9871.[illegible]	9725.31	778.60	GRD
B-23	9983.6[illegible]	9724.67	778.59	ASPH
B-24	10048.[illegible]	9732.76	778.88	GRD
B-25	10079.30	9714.32	778.79	FLOOR
B-26	10154.36	9821.64	778.84	FLOOR
B-27	10187.79	9726.14	778.80	FLOOR
B-28	10194.30	9917.16	778.83	FLOOR

RECOVERY WELL LOCATIONS

SAMPLE	NORTH	EAST	ELEVATION	DESCRIPTION
DF-1	10034.24	9767.60	778.81 779.66 779.60	FLOOR PVC RISER PVC CAP
DF-2	10091.63	9776.90	778.87 779.92 779.91	FLOOR PVC RISER PVC CAP
DF-3	10124.45	9778.02	778.83 779.79 779.81	FLOOR PVC RISER PVC CAP
DF-4	10164.98	9774.65	778.80 779.64 779.67	FLOOR PVC RISER PVC CAP
G-1	10182.25	9726.78	778.85 779.83 779.86	FLOOR PVC RISER PVC CAP
G-2	10203.60	9675.79	778.86 779.70 779.70	FLOOR PVC RISER PVC CAP
SVE-1	10038.31	9716.39	778.77 779.66 N/A	FLOOR PVC RISER PVC CAP
SVE-2	10055.47	9816.17	778.86 779.81 N/A	FLOOR PVC RISER PVC CAP



LEGEND

MW-1 THROUGH MW-19 — GROUNDWATER MONITORING WELL INSTALLED JULY 2003

MW-19R THROUGH MW-21 — GROUNDWATER MONITORING WELL INSTALLED OCT 2004

B-1 — TEST BORING (AUGUST 2002)

G-1 AND G-2 — GROUNDWATER ONLY RECOVERY WELL TOTAL OF 2

SVE-1 AND SVE-2 — SOIL VAPOR EXTRACTION WELL TOTAL OF 2

PROPERTY LINE (APPROX)

775 — GROUNDWATER EQUIPOTENTIAL CONTOUR, FEET RELATIVE TO MEAN SEA LEVEL MEASURED DECEMBER 16-17, 2013

GROUNDWATER FLOW DIRECTION

*: MW-19 DECOMMISSIONED & REMOVED ON JULY 23, 2007

NOTE:
BASEMAP INFORMATION FROM MAP ENTITLED "SURVEY OF PART OF LOT 27, TOWNSHIP 6, RANGE 8-VILLAGE OF GOWANDA, CATTARAUGUS COUNTY, NEW YORK" PREPARED BY KREHEIEL ASSOCIATES, DWG# D-2097, DATED 6-16-92

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GOWANDA DAY HABILITATION CENTER

4 INDUSTRIAL PLACE
GOWANDA, NY

BERGMANN associates
Engineers / Architects / Surveyors
200 First Federal Plaza
28 East Main Street, Rochester, New York 14614
585.232.5135 / 585.232.4652 fax

REVISIONS

NO	DATE	DESCRIPTION	REV	CKD

NOTE

SCALE BAR: 0 — 80 — 160 — 240 FT

DECEMBER 2013 GROUNDWATER CONTOUR MAP

Project Manager: G. FLISNIK
Designed by:
Drawn by: C. WOOD
Checked by: S. DEMEO
Date Issued: MARCH 2014
Scale: 1"=80'
Project Number: 6974.76
File Name: I:\DASNY\006974.76\3.0\3.6\2013 Sampling Events\December 2013\Figures\Dec2013 FIG1.dwg
Drawing Number:

FIGURE 3

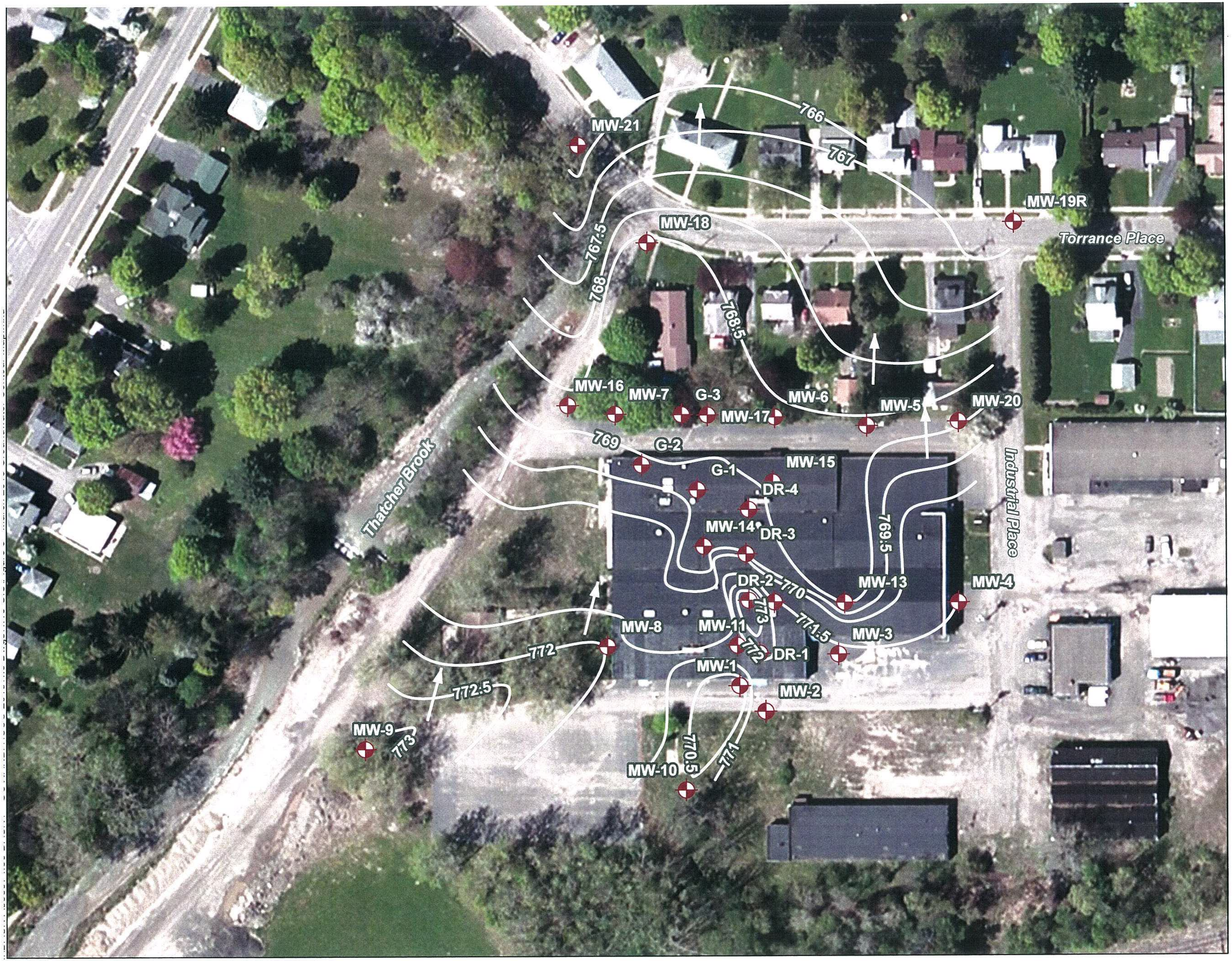

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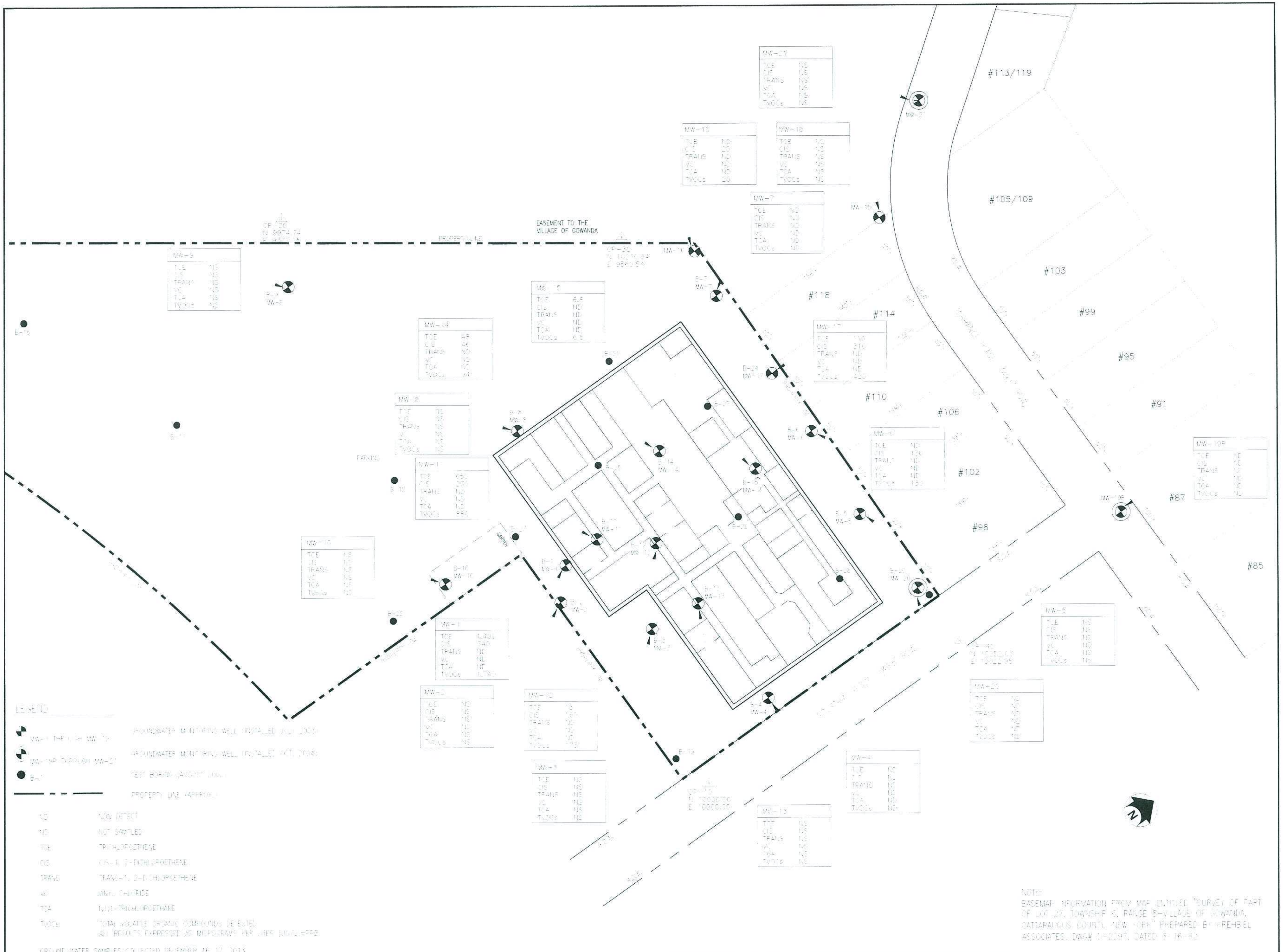
FIGURE 4

March 2015 Groundwater Contour Map



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585.232.5135 / 585.232.4652 fax

REVISIONS				
NO.	DATE	DESCRIPTION	REV	CKD

NOTE
Unauthorized alteration or addition to this drawing is a violation of the New York State Education Law Article 145, Section 7209.

0 80 160 240 FT
SCALE BAR

DECEMBER 2013 DISTRIBUTION OF GROUNDWATER ANALYTICAL RESULTS IN MONITORING WELLS

Project Manager: G. FLISNIK
Designed by:
Drawn by: C. WOOD
Checked by: S. DEMEO
Date Issued: MARCH 2014
Scale: 1"=80'
Project Number: 6974.76

FIGURE 5

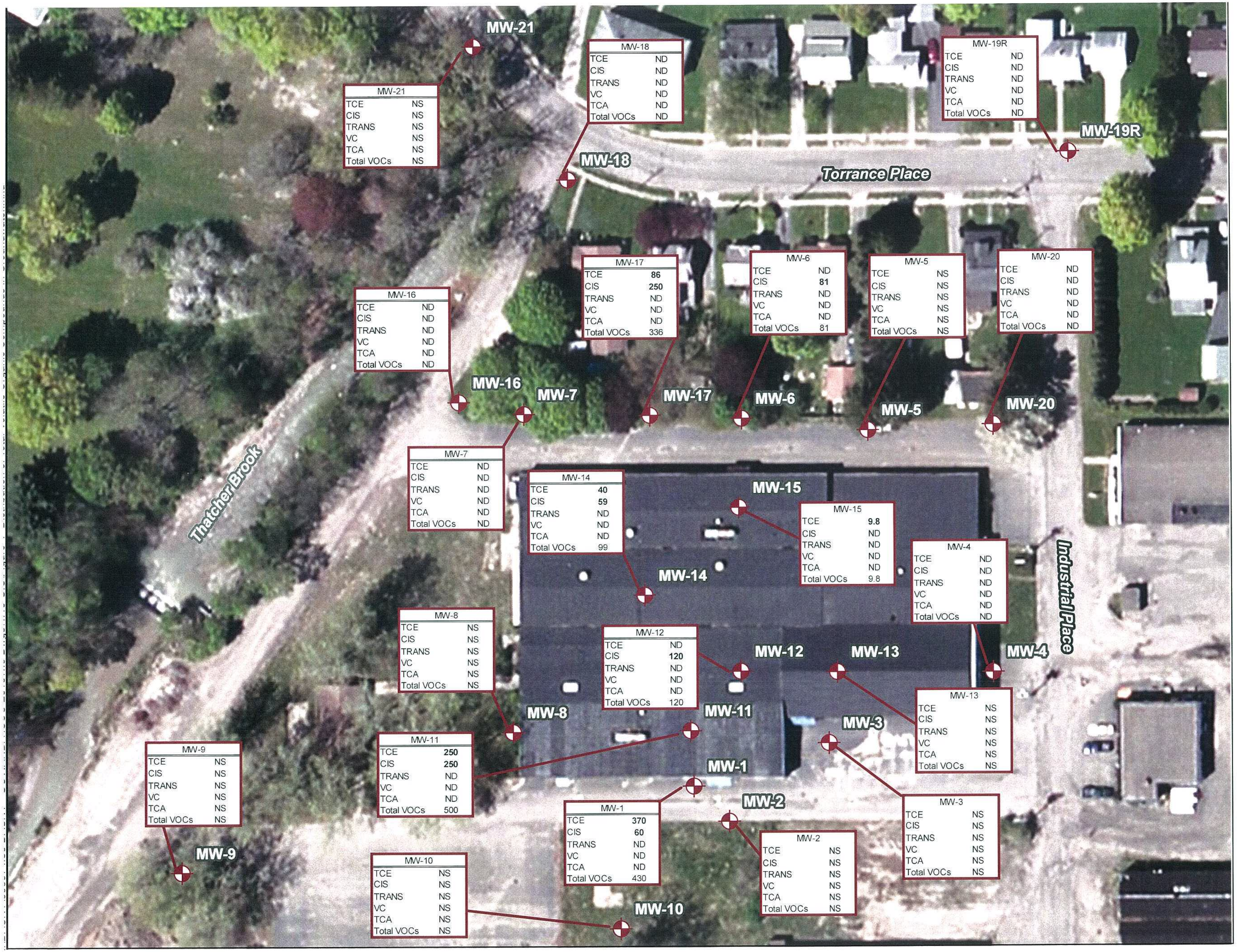

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FIGURE 6

March 2015 Distribution of Groundwater Analytical Results: Monitoring Wells

0 25 50 75 100
Feet

N

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FIGURE 7

Chemical Oxidation Injection Locations

0 30 60 90 120
Feet

N

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FIGURE 8

November 2015 Distribution of Groundwater Analytical Results: Monitoring Wells

0 25 50 75 100
Feet
N

I:\DASNY\006974.76 DASNY-GOWANDA 2013 O & M\4.0 Dwgs\5.0 GIS\Figure_2_2015_Q4.mxd