DRAFT ALTERNATIVES ANALYSIS REPORT
FORMER DENNISON/MONARCH SYSTEMS SITE
OPERABLE UNIT 02

Former Dennison/Monarch Systems Site – OU02
15-21 Ruscitti Road
New Windsor, New York 12553

NYSDEC Site No. 336090

Prepared for:

Avery Dennison Corporation
8080 Norton Parkway
Mentor, Ohio 44060

58300.00

July 2019

Prepared by:
VHB Engineering, Survey, Landscape and Geology, P.C.
100 Great Oaks Boulevard, Suite 118
Albany, NY 12203

Revision 1

DRAFT ALTERNATIVES ANALYSIS REPORT

Former Dennison/Monarch Systems Site
Operable Unit 02
New Windsor, New York
NYSDEC Site No. 336090
Revision 1

CERTIFICATION STATEMENT

I, George William Lester, certify that I am currently a New York State registered Professional Engineer as defined in 6 NYCRR Part 375 and that this Alternatives Analysis Report was prepared in accordance with all applicable statutes and regulations and in substantial conformance with the DER Technical Guidance for Site Investigation and Remediation (DER-10).

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DRAFT ALTERNATIVES ANALYSIS REPORT

Former Dennison/Monarch Systems Site – OU02, Revision 1
New Windsor, New York 12553

EXECUTIVE SUMMARY

Pursuant to the Administrative Order executed by Avery Dennison Corporation (ADC) and NYSDEC on September 17, 2018, this Alternatives Analysis Report (AAR) presents and evaluates remedial alternatives and provides a recommended Remedial Action (RA) for Operable Unit 2 (OU02) of the Former Dennison/Monarch System Site, NYSDEC Site No. 336090 (Site). OU02 is the downgradient and remnant portion of the Facility groundwater plume (Facility Plume) resulting from a source area within Operable Unit 01 (OU01). Ongoing monitored natural attenuation (MNA) and effective source isolation accomplished by the OU01 RA in 2015/2016 has resulted in considerable attenuation of primary constituents of concern (COCs) in groundwater, as shown in **Figures ES-1** through **ES-4**. NYSDEC approved the Engineer's certification of the performance of the OU01 RA in 2016 and 2017. Accelerated reduction of COC concentrations in the Facility Plume following implementation of the OU01 RA has already been observed in OU02 as much as 300 feet downgradient from OU01.

The NYSDEC-approved PDI Report presented Baseline Human Health and Screening Level Ecological Risk Assessments (BHHRA/SLERA) performed using a comprehensive dataset that included soil, sediment, groundwater and surface water data collected from OU02 in 2006/2007. The BHHRA concluded that estimated excess human cancer risks from the Site at that time were below, or within the range of risks considered acceptable by government agencies. The factors driving the risks in OU02, which were within and at the low-end of the range that is generally acceptable to regulatory agencies, were based on the presence of TCE and vinyl chloride in surface water, sediment, and shallow groundwater. Since the BHHRA was performed, significant attenuation of COCs, including TCE and vinyl chloride, has occurred in surface water and groundwater. The BHRRA determined estimated non-cancer hazard indices were all well below the level of concern (hazard index=1). The SLERA concluded no ecological risks were identified for plants, soil invertebrates, fish, amphibians, and wildlife in OU02 and risks to benthic life from COCs in OU02 were restricted to a small area in which concentrations of COCs in underlying groundwater have significantly attenuated since the SLERA was performed.

There is one Remedial Action Objective (RAO) for OU02: restore the groundwater aquifer to pre-disposal/pre-release conditions, to the extent practicable. In addition to institutional controls (ICs), four remedial alternatives were considered: no action; continued implementation of MNA, which has already demonstrated effectiveness for reducing concentrations of COCs in the Facility Plume over time; enhanced in-situ bioremediation (EISB) by biostimulation; and, as specifically requested by NYSDEC for comparative evaluation, excavation and removal of overburden soil within the Facility Plume footprint in OU02.

As a remedial alternative for OU02, the purpose of EISB would be to attempt to accelerate the MNA that is already occurring in an area for which the BHHRA and SLERA did not identify an unacceptable risk and in an area that is affected by two other plumes (South Plume #1 and South Plume #2) migrating from sources not associated with the Site. The excavation and disposal alternative requested by NYSDEC for evaluation would have significant challenges to its implementation including: destruction of habitat for a considerable time period, prolonged noise and nuisance due to construction equipment and truck traffic, and influx of contamination from South Plume #1 and South Plume #2 if not previously addressed.

MNA is selected as the remedial alternative for OU02 to attain the RAO in conjunction with applied ICs that will maintain protectiveness of human health and the environment. MNA has already been implemented in OU02 as a component of the OU01 Site Management Plan (SMP); it is protective of human health and the environment, is attenuating the Facility Plume and does not have any known adverse impacts from its continued implementation.

LEGEND

- Pre-Design Investigation Monitoring Well Location
- Abandoned Well Location
- Drivepoint Groundwater Profiling Location (2006)
- 130 — Water Table Interpolated Potentiometric Isocontour (2 ft. interval, dashed where inferred) - Dec. 2006 & May 2018
- Approximate Parcel Boundary from Town of New Windsor, New York Tax Maps
- Sealed Sheet Pile Wall (Waterloo Barrier)

- 1 µg/L < [TCA] < 10 µg/L
- 10 µg/L < [TCA] < 50 µg/L
- 50 µg/L < [TCA] < 500 µg/L
- 500 µg/L < [TCA] < 1000 µg/L
- 1000 µg/L < [TCA]

N

0 80 160 320

SCALE IN FEET

Notes:

(1) TCA concentrations for monitoring well locations are sourced from either Fall 2006 or Spring 2018 data. Drivepoint groundwater profiling data from 2006 and 2012 were considered for the estimated contours where other data is unavailable.

(2) The data shown represent the maximum concentration at any depth in the vertical profile.

(3) TCA = 1,1,1-Trichloroethane

Base Map: USDA Farm Service Agency - NAIP (August 2017)

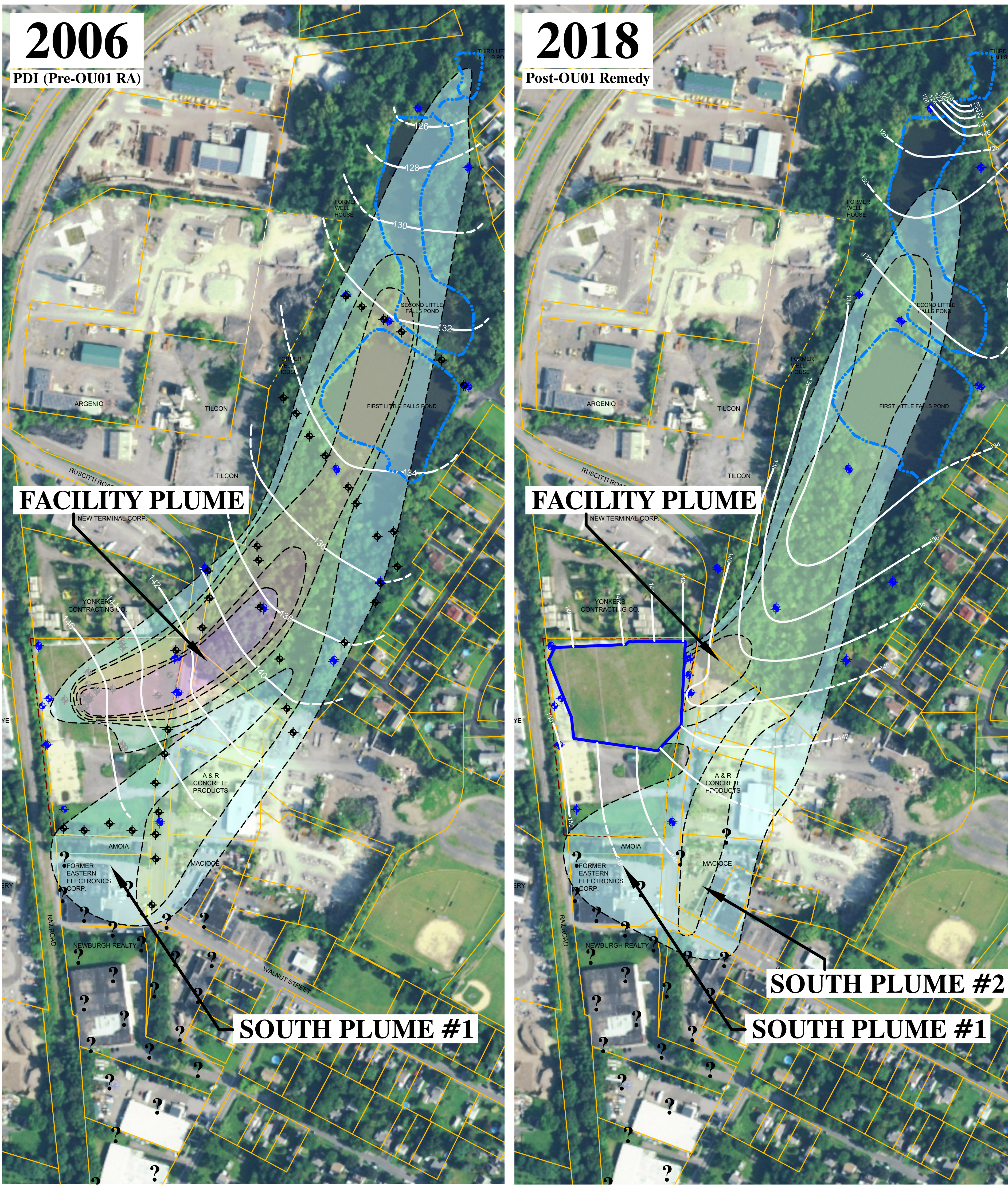

FIGURE ES-1: TCA GROUNDWATER CONCENTRATIONS IN UNCONSOLIDATED DEPOSITS: 2006 & 2018
FORMER DENNISON/MONARCH SYSTEMS SITE
NEW WINDSOR, NEW YORK

VHB Engineering, Surveying Landscape and Geology, P.C.
100 Great Oaks Blvd, Ste 118, Albany, NY

Drawn by: TEH Date: 01/02/19
Chk'd by: GWL Date: 06/26/19
Scale: As Shown Project: 58300.00

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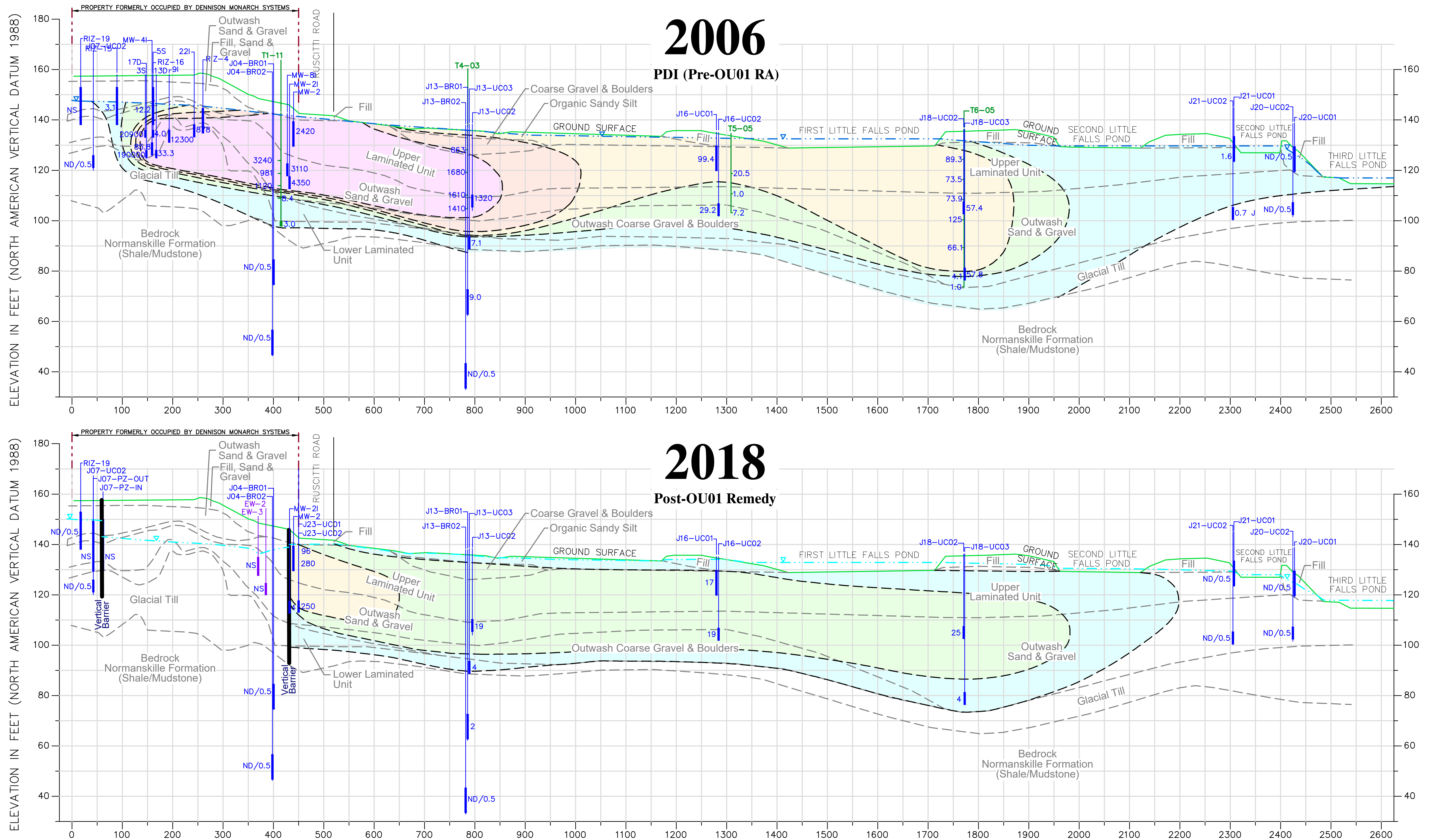
CROSS SECTION A-A': 1,1,1-TRICHLOROETHANE (TCA) CONCENTRATIONS IN GROUNDWATER (μg/L)

WEST–SOUTHWEST **A** — NORTHEAST **A'**



DISTANCE IN FEET
VERTICAL EXAGGERATION 5:1

KEY

- 1 μg/L < [TCA] < 10 μg/L
- 10 μg/L < [TCA] < 50 μg/L
- 50 μg/L < [TCA] < 500 μg/L
- 500 μg/L < [TCA] < 1000 μg/L
- 1000 μg/L < [TCA]

ND/0.5 = Non Detect/Detection Limit; NS = Not Sampled

\\vhb\gbl\proj\Montpelier\58300.00 ADC New Windsor NY\JCOdata\CAD\AAR 2018\Cross section A-A' 20181204.dwg

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100 Great Oaks Blvd. Ste 118, Albany, NY

Drawn by: TEH	Date: 01/07/19
Chk'd by: GAK	Date: 01/07/19
Scale: As Shown	Project: 58300.00

FIGURE ES-2: TCA GROUNDWATER CONCENTRATIONS ALONG CROSS-SECTION A-A': 2006 & 2018
FORMER DENNISON/MONARCH SYSTEMS SITE
NEW WINDSOR, NEW YORK

LEGEND

- Pre-Design Investigation Monitoring Well Location
- Abandoned Well Location
- Drivepoint Groundwater Profiling Location (2006)
- 130 — Water Table Interpolated Potentiometric Isocontour (2 ft. interval, dashed where inferred) - Dec. 2006 & May 2018
- Approximate Parcel Boundary from Town of New Windsor, New York Tax Maps
- Sealed Sheet Pile Wall (Waterloo Barrier)

- 1 µg/L < [TCE] < 10 µg/L
- 10 µg/L < [TCE] < 50 µg/L
- 50 µg/L < [TCE] < 500 µg/L
- 500 µg/L < [TCE] < 1000 µg/L
- 1000 µg/L < [TCE]

N

0 80 160 320

SCALE IN FEET

Notes:

(1) TCE concentrations for monitoring well locations are sourced from either Fall 2006 or Spring 2018 data. Drivepoint groundwater profiling data from 2006 and 2012 were considered for the estimated contours where other data is unavailable.

(2) The data shown represent the maximum concentration at any depth in the vertical profile.

(3) TCE = Trichloroethene

Base Map: USDA Farm Service Agency - NAIP (August 2017)

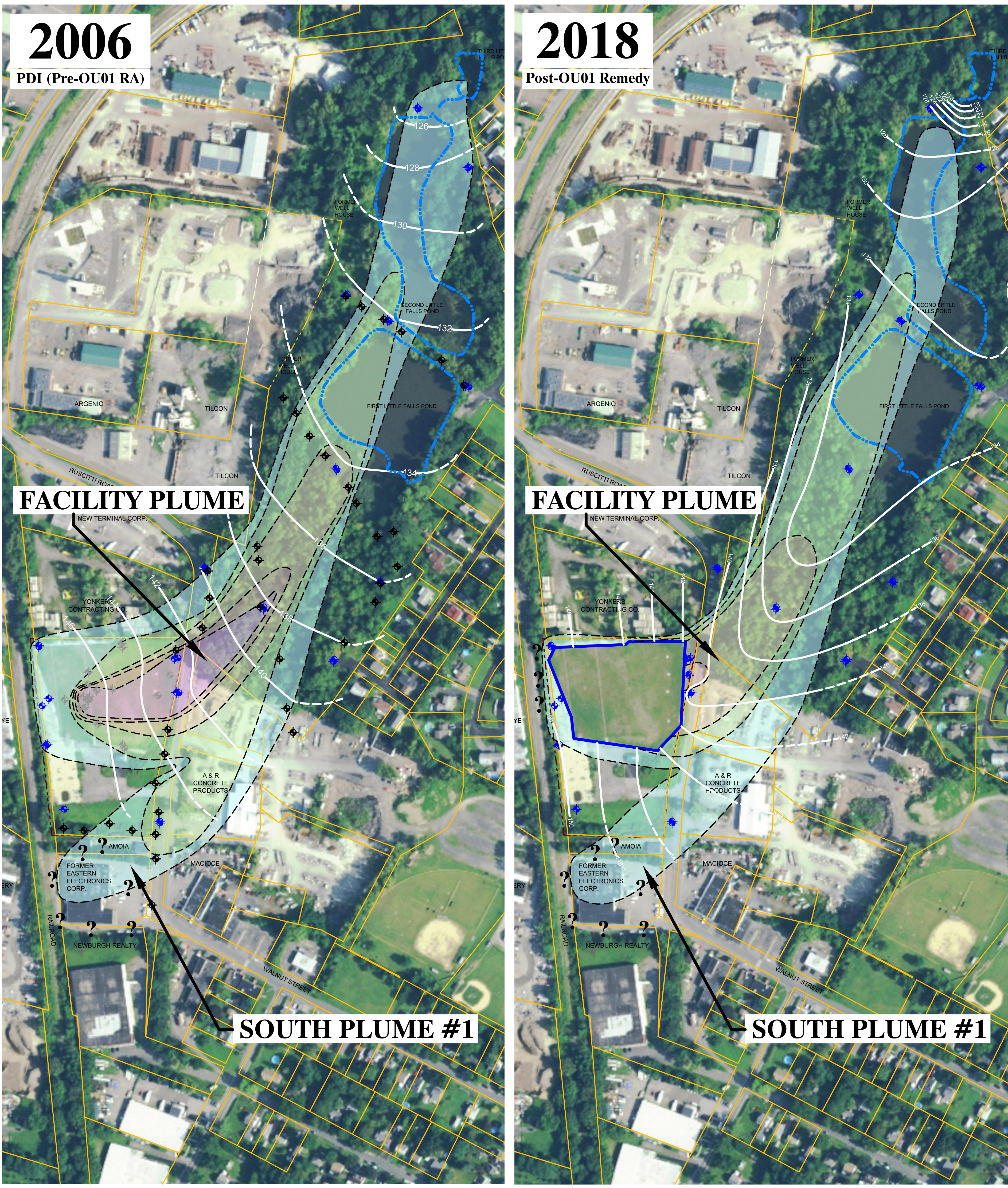

FIGURE ES-3: TCE GROUNDWATER CONCENTRATIONS IN UNCONSOLIDATED DEPOSITS: 2006 & 2018
FORMER DENNISON/MONARCH SYSTEMS SITE
NEW WINDSOR, NEW YORK

vhb

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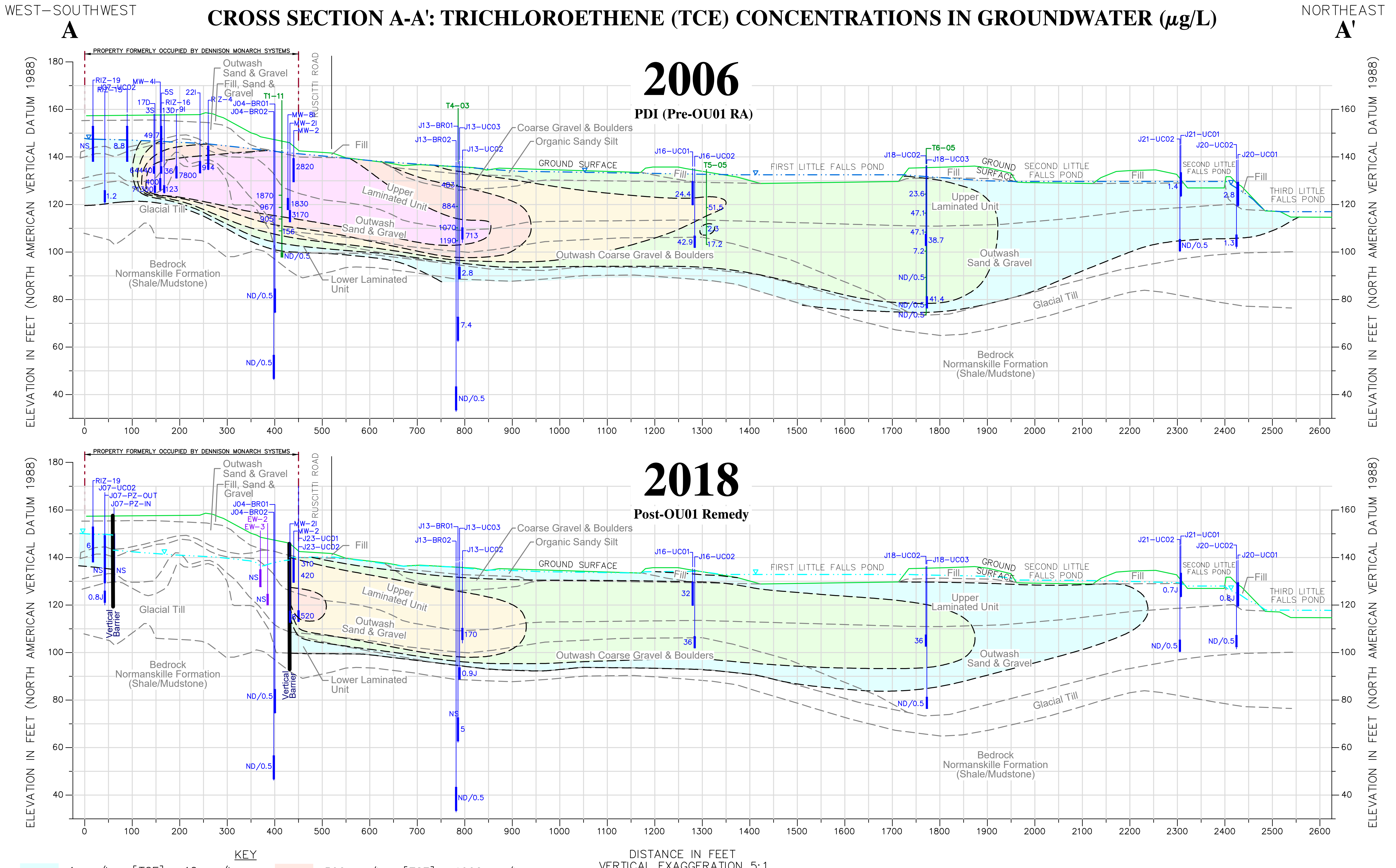
CROSS SECTION A-A': TRICHLOROETHENE (TCE) CONCENTRATIONS IN GROUNDWATER (μg/L)



KEY

1 μg/L < [TCE] < 10 μg/L

10 μg/L < [TCE] < 50 μg/L

50 μg/L < [TCE] < 500 μg/L

500 μg/L < [TCE] < 1000 μg/L

1000 μg/L < [TCE]

ND/0.5 = Non Detect/Detection Limit; NS = Not Sampled

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Scale: As Shown	Project: 58300.00

FIGURE ES-4: TCE GROUNDWATER CONCENTRATIONS ALONG CROSS-SECTION A-A': 2006 & 2018
FORMER DENNISON/MONARCH SYSTEMS SITE
NEW WINDSOR, NEW YORK

1.0 INTRODUCTION

Pursuant to the Order on Consent and Administrative Settlement (the Order) executed by Avery Dennison Corporation (ADC) and the New York State Department of Environmental Conservation (NYSDEC) on September 17, 2018, this Alternatives Analysis Report (AAR) presents and evaluates remedial alternatives and provides a recommended Remedial Action (RA) for Operable Unit 2 (OU02) of the Former Dennison/Monarch System Site, NYSDEC Site No. 336090 (Site). OU02 is located to the northeast of 15-21 Ruscitti Road in New Windsor, New York – see general location in **Figure 1-1**.

The Order[1] and the March 2014 Operable Unit 1 (OU01) Decision Document (DD) (NYSDEC, 2014) define OU02 as the downgradient and off-Property (i.e., outside of OU01) portion of the Facility groundwater plume (Facility Plume) resulting from the Constituents of Concern (COC) source area within OU01. The Order defines the COC for OU02 as 1,1,1-trichloroethane (TCA), trichloroethene (TCE), and their associated degradation products. Known degradation products of TCA and TCE include 1,1-dichloroethene (1,1-DCE), 1,1-dichloroethane (1,1-DCA), 1,2-dichloroethane (1,2-DCA), cis-1,2-dichloroethene (cis-1,2-DCE), trans-1,2-dichloroethene (trans-1,2-DCE), and vinyl chloride (Kueper, et al. 2014).

Figure 1-2 presents the OU02 boundary as presented in the DD, which was established in March 2014 based on the delineation of the Facility Plume presented in the NYSDEC-approved May 2013 Alternatives Analysis Report/Remedial Action Workplan (OU01 AAR/RAWP; JCO, 2013).[2] Since then, natural plume attenuation and effective source isolation accomplished by the OU01 Remedial Action (OU01 RA) in 2015/2016 has resulted in shrinkage of the OU02 boundary, as determined by routine semi-annual monitoring of groundwater and surface water in OU02, which is described herein. The revised OU02 boundary, as of May 2018, is shown in **Figure 1-3**.

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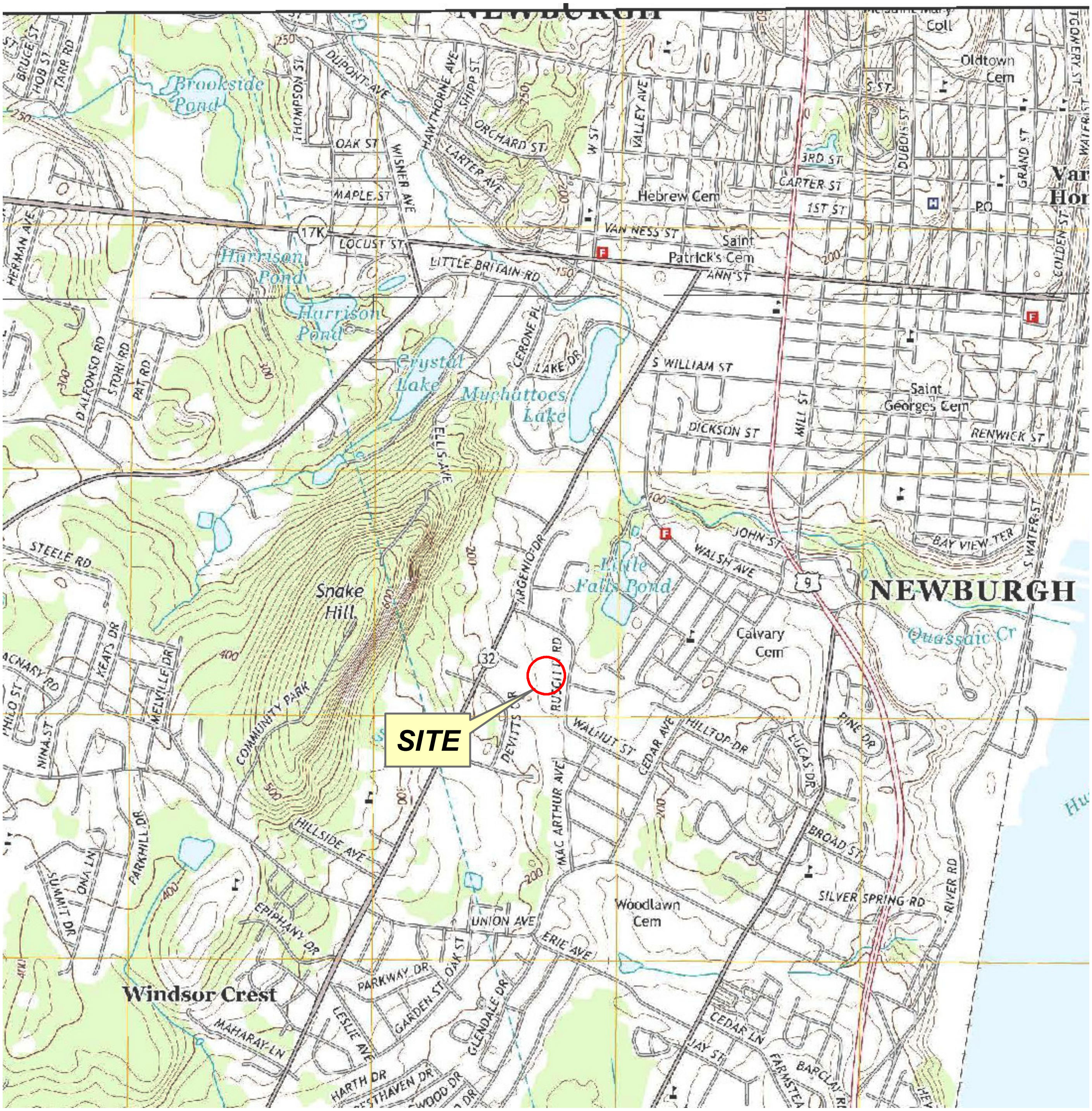
[1] ADC contacted NYSDEC regarding what is now OU01 on or about January 1997 and was accepted into the NYSDEC Voluntary Cleanup Program (VCP) on or about March 4, 1998. A Voluntary Cleanup Agreement (VCA) was executed by Dennison Monarch Systems, Inc. and NYSDEC on or about September 23, 1999. Following execution of the VCA, and prior to execution of the Order, all investigation and remediation activities at the Site proceeded pursuant to the terms of the VCA and under the auspices of the NYSDEC.

[2] The Facility groundwater plume was defined at the time of the OU01 DD as the union of the delineated boundaries of the 1 ug/L isoconcentration contours for TCE, TCA and DCA established in the NYSDEC-approved OU01 AAR/RAWP.



N

1 0.5 0 1

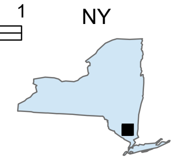
MILES

1,000 0 1,000 2,000 3,000 4,000 5,000 6,000 7,000

FEET

CONTOUR INTERVAL: 20 FEET

NY



MAP LOCATION

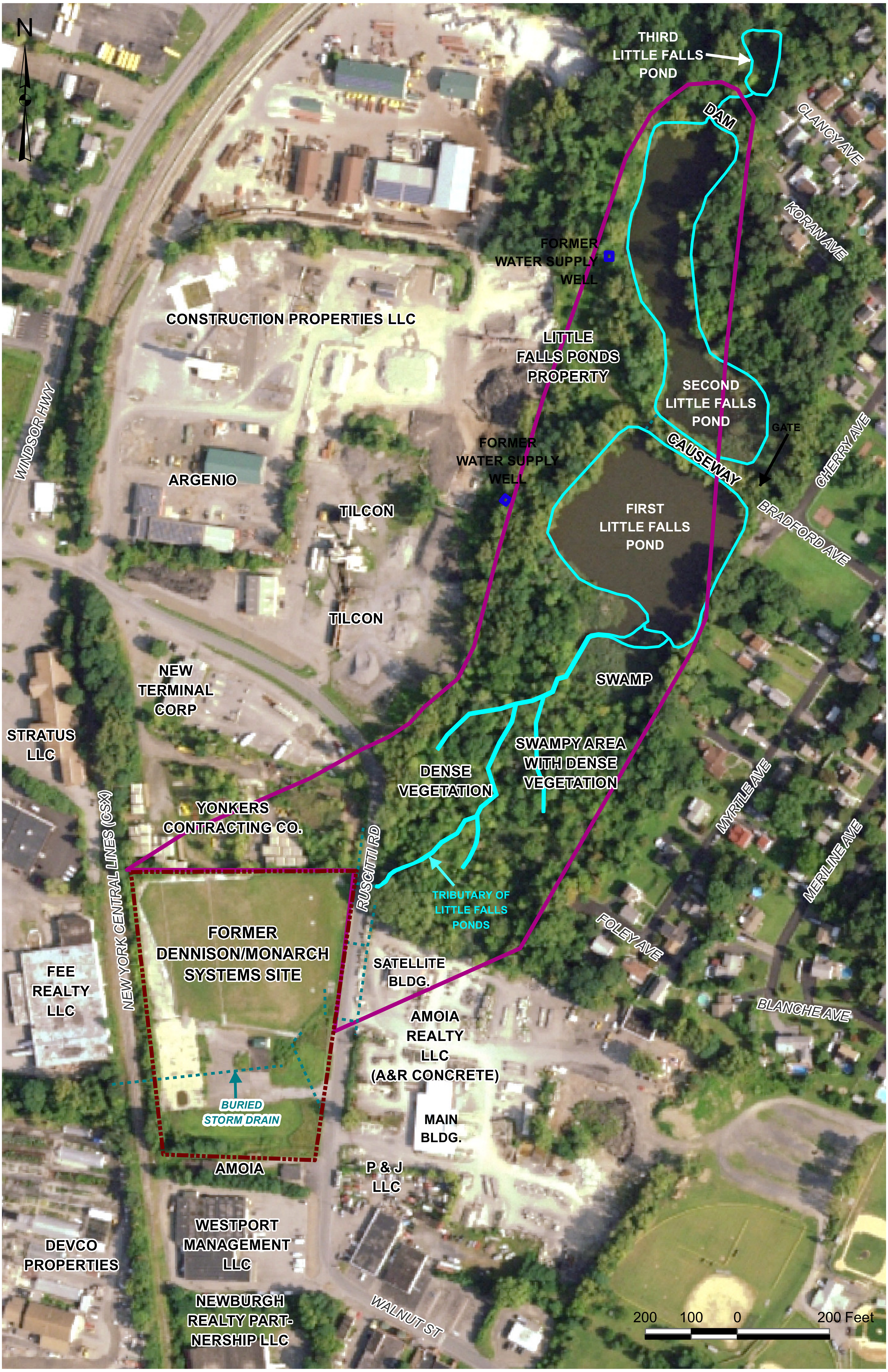
BASE MAP: USGS 7.5 Minute Topographic Quadrangles Cornwall-on-Hudson and Newburgh, 2013

FIGURE 1-1: SITE LOCATION MAP
FORMER DENNISON/MONARCH SYSTEMS SITE
NEW WINDSOR, NEW YORK

VHB Engineering, Surveying, Landscape and Geology, P.C.
100 Great Oaks Boulevard, Suite 118
Albany, New York 12203

Drawn by: DEB Date: 12/20/18
Reviewed by: GAK Date: 01/11/19

Scale: 1:24,000 Project: 58300.00



LEGEND

Operable Unit 1 (Site Property Boundary)

Operable Unit 2 Approximate Boundary per 2014 Decision Document

Sources: Parcel Boundaries from Town of New Windsor Tax Map, 2017;
Aerial photo taken in August 2017 (USDA Farm Service Agency - NAIP).

FIGURE 1-2: OU01 AND OU02 BOUNDARIES AS DEFINED IN MARCH 2014 OU01 DECISION DOCUMENT
FORMER DENNISON/MONARCH SYSTEMS SITE
NEW WINDSOR, NEW YORK

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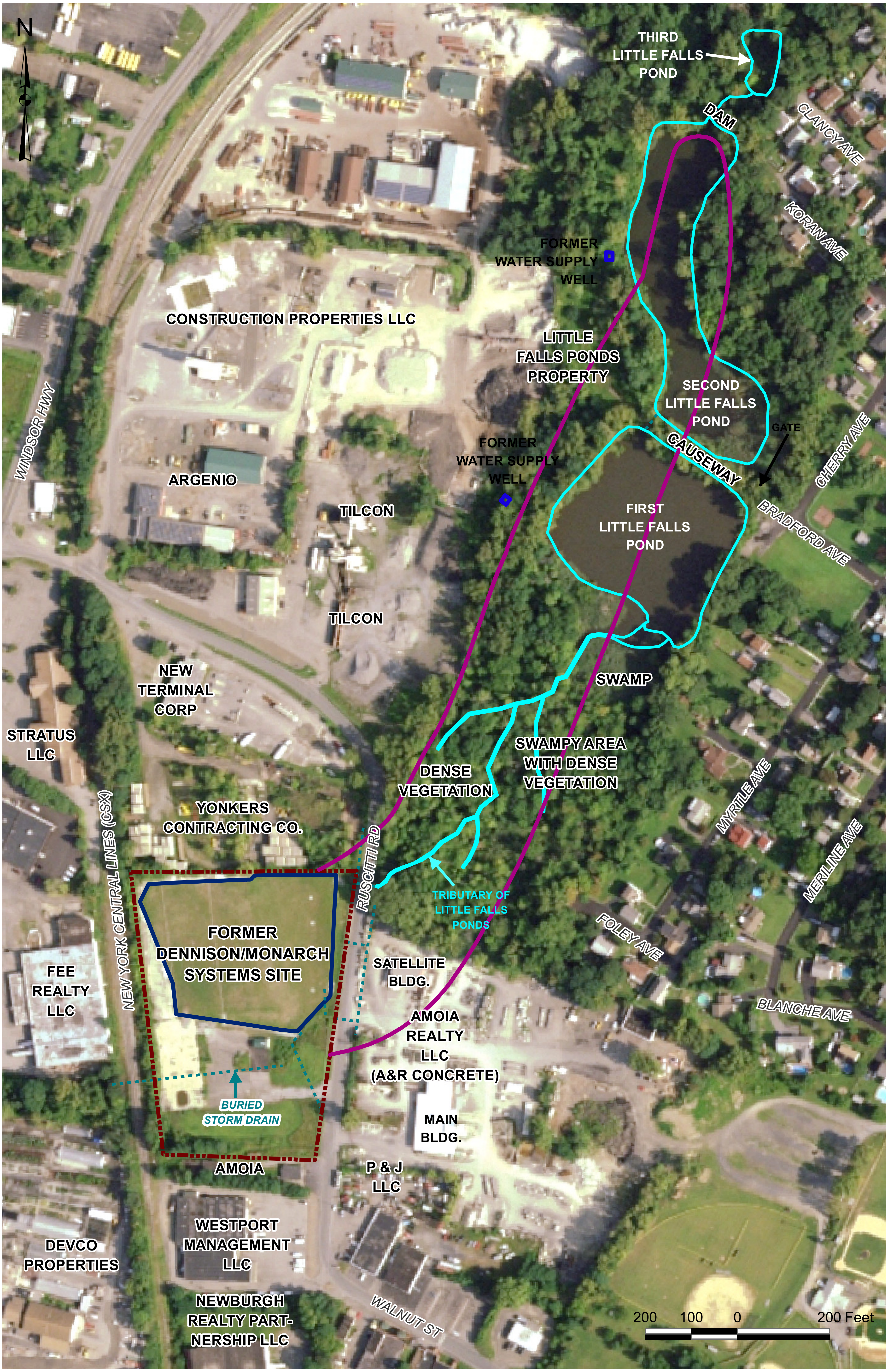
Scale: As Shown Project: 58300.00

\\vhb\gis\proj\Montpelier\58300.00 ADC New Windsor NY\gis\MXDs\OU2 AAR Figures\Figure 1-2 - Operable Units - Decision Document.mxd



LEGEND

- Operable Unit 1 (Site Property Boundary)
- Operable Unit 2 Approximate Boundary
- Sealed Sheet Pile Wall (OU01 RA)

Sources: Parcel Boundaries from Town of New Windsor Tax Map, 2017;
Aerial photo taken in August 2017 (USDA Farm Service Agency - NAIP).

FIGURE 1-3: UPDATED OU02 BASED ON CURRENT MONITORING DATA (SPRING 2018)
FORMER DENNISON/MONARCH SYSTEMS SITE
NEW WINDSOR, NEW YORK

vhb

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\\vhb\gis\proj\Montpelier\58300.00 ADC New Windsor NY\gis\MXDs\OU2 AAR Figures\Figure 1-3 - Operable Units - Current.mxd

2.0 CURRENT SETTING OF OU02 AND SURROUNDING LOCAL AREA

OU02 currently consists of portions of the following three properties, as shown on **Figure 1-3**:

- Amoia Realty, LLC property, which is occupied by A&R Concrete Products and is located to the east of OU01, across Ruscitti Road;
- Yonkers Contracting Co. located to the north of OU01; and
- Undeveloped land to the northeast of OU01 that is owned by the Town of New Windsor (the Little Falls Ponds (LFP) property), which contains approximately 85 percent of the current footprint of OU02.

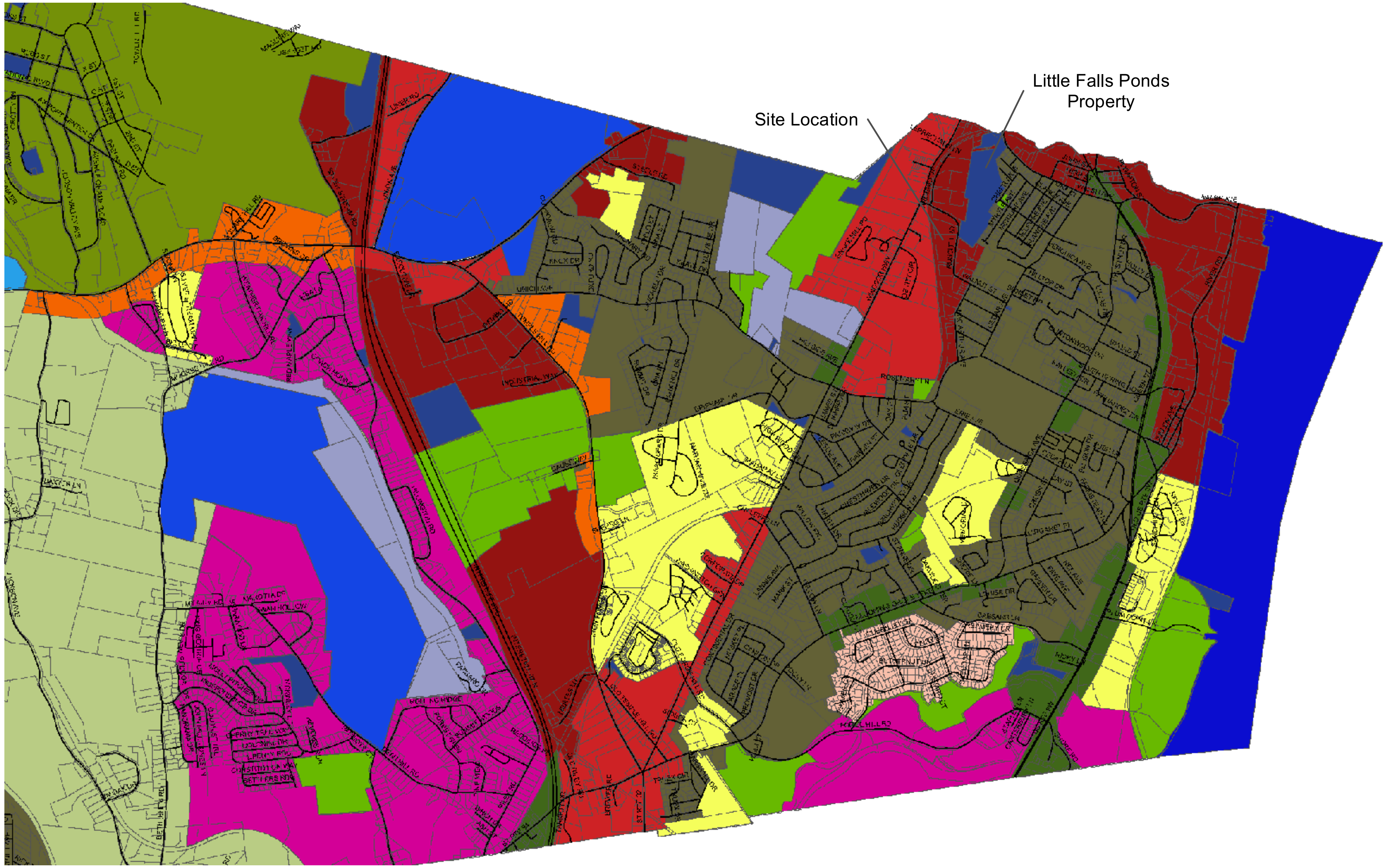
The portions of the parcels occupied by A&R Concrete Products and Yonkers Contracting Co. that are within OU02 are zoned for Planned Industrial Use – see **Figure 2-1**. The satellite building on the Amoia Realty, LLC property is the only occupied building within 100 feet of OU02 – see **Figure 1-3**. The portion of the Yonkers Contracting Co. property within OU02 consists of scrub vegetation and a drainage ditch and appears to be unused; much of the rest of that property appears to be used for road construction equipment and supplies storage.

The LFP property within OU02 is zoned for Municipal Use – see **Figure 2-1** - and consists of densely vegetated areas, two shallow ponds, a causeway between the ponds, and a swampy area containing tributaries to the ponds – see **Figure 1-3**. Photos of the ponds and surrounding area of the LFP property are included in **Appendix A**. No New York State regulated wetlands are mapped within the LFP property or the boundaries of OU02 (NYSDEC, 2019). The waters within the LFP ponds are designated by the State as Class C Surface Waters; however, when the Town of New Windsor adopted an updated and revised zoning code in 2012, the LFP property and the surrounding area was *not* designated as a "Watershed Overlay District."[1]

Remnants of two former pumphouses for former municipal water supply wells, which have now been out-of-service for 30 or more years, are located on the western side of the LFP property, but outside of the OU02 boundary (see **Figure 1-3**). First developed in the mid-1960s, these wells, and a third located northwest of OU02, were reportedly refurbished in 1976 and used in 1980 during a period of drought (McGoey, 2001). Historically, the Town previously claimed an interest in keeping the wells serviceable as an emergency water supply (McGoey; 2001, 2008). Now fully abandoned, the unmaintained pump houses and associated piping have been observed to be in an open and unlocked condition. Trash and burned-out automobiles have been observed in the vicinity adjacent to the pump houses, and waste or raw materials used by the neighboring asphalt batch plants have been observed encroaching on the LFP property and within close proximity of the pump houses – see **Figure 1-3**, and photos in **Appendix A**.

A residential area is located to the east of the LFP property and to the northeast of the A&R Concrete property. The nearest residence is located more than 100 feet from the boundary of OU02, and most are located at least 200 feet from the boundary – see **Figure 1-3**. The extent of OU02 is decreasing, thereby increasing the separation from the residences to the east – compare **Figures 1-2 and 1-3** and see Section 4.2.2.

[1] The Watershed Overlay District designation is intended to promote the health, safety and welfare of the community by protecting and preserving the surface and groundwater resources of the Town from any use of land or buildings which may reduce the quality of its water resources (Town of New Windsor, 2018b).



Legend

- (AP) Airport
- (CL-1) Cluster -1
- (HC) Highway Commercial
- Hudson River
- (LC) Limited Commercial
- (MU) Municipal Use
- (NC) Neighborhood Commercial
- (OLI) Office and Light Industrial
- (PI) Planned Industrial
- New York State Forest Preserve
- Parks
- (R-1) Rural Residential
- (R-2) Open Space Residental
- (R-3) Suburban Residential (Including two family)
- (R-4) Suburban Residential (Excluding two family)
- (R-5) Multiple Residential
- Watershed Overlay District
- Historic District Overlay

Town of New Windsor

555 Union Avenue, New Windsor, New York 12553
Telephone: (845) 565-8800
Town Website: http://town.new-windsor.ny.us

ELECTED OFFICIALS

George A. Green, Town Supervisor

Patricia Mullarkey, Councilwoman
Eric Lundstrom, Councilwoman
Andrew Regenbaum, Councilman
Steve Moreau, Councilman

Deborah Green, Town Clerk
Anthony Fayn, Superintendent of Highways
Susan Scheible, Receiver of Taxes

OFFICIAL TOWN OF NEW WINDSOR ZONING DISTRICTS MAP

Deborah Green, Town Clerk

Date

DISCLAIMER: This map is a product of the Town of New Windsor Information Technology Department. The data depicted here has been developed with extensive cooperation from other Town of New Windsor departments, as well as other Federal, State and County government agencies. The Town of New Windsor and the Town of New Windsor Information Technology Department make no representation as to the accuracy of the information in the mapping data, but rather provide said information as is. The Town of New Windsor and the Town of New Windsor Information Technology Department expressly disclaim responsibility for damages or liability that may arise from the use of this map.

N W E S

1 inch = 1,325 feet

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Drawn by: DEB Date: 06/28/18
Reviewed by: GAK Date: 01/11/19
Scale: As Shown Project: 58300.00

FIGURE 2-1:
TOWN OF NEW WINDSOR ZONING DISTRICTS
FORMER DENNISON/MONARCH SYSTEMS SITE
NEW WINDSOR, NEW YORK

Retrieved from Town of New Windsor website June 28, 2018.

3.0 SUMMARY OF REMEDIAL INVESTIGATION AND OU01 REMEDIAL ACTION ACTIVITIES

Multiple stages of environmental site investigation and one remediation pilot study were conducted in what is now defined as OU01 between 1992 and 2003. In 2006, NYSDEC approved a comprehensive Pre-Design Investigation (PDI) Work Plan by The Johnson Company, Inc. (JCO) intended to address data gaps in the prior investigations, develop an updated and more comprehensive Site Conceptual Model, and evaluate remedial alternatives. The PDI utilized an adaptive, stage-wise approach to delineate the nature and extent of contamination arising from a presumed singular source of Site constituents, which from the prior investigations was reported to be the former vapor phase degreasers and distillation unit that operated in OU01 – see location in **Figure 3-1**. The PDI also investigated adjacent and neighboring properties outside of OU01 that were owned by A&R Concrete[1] and the Town of New Windsor, respectively, and plumes of groundwater contamination in the Site vicinity that do not originate on OU01, as presented herein. The resultant NYSDEC-approved PDI Report (JCO, 2008; see **Appendix B**) provides a detailed presentation of the results of the PDI, as well as a detailed description of the history of operations and land use in OU01. The coverage of data collection for the PDI in OU01 and in OU02 and vicinity was comprehensive (**see Figures 3-1 and 3-2**, respectively), and the summary dataset of soil, sediment, groundwater and surface water assembled for the PDI was used to conduct Baseline Human Health and Screening Level Ecological Risk Assessments (BHHRA/SLERA) included in the NYSDEC-approved PDI Report (**Appendix B**; JCO, 2008).

In 2009 and subsequent years, ADC and its consultants continued semi-annual groundwater and surface water monitoring in OU01 and OU02, installed additional bedrock monitoring wells in OU02, and also investigated portions of the neighboring Amoia/A&R Concrete, Inc. properties in 2011. Results from those activities are presented in the NYSDEC-approved OU01 AAR/RAWP (JCO, 2013) – see **Appendix C**. The OU01 AAR/RAWP concluded *"comprehensive groundwater data collected semi-annually for several years [as of 2012] shows the extent of the groundwater plume of Site constituents has attained a steady-state condition and concentrations at its core are declining. Therefore, the PDI dataset used as a basis for the BHHRA and SLERA is a conservative approach for purposes of risk assessment."*

The NYSDEC-approved OU01 AAR/RAWP identified and confirmed the existence of South Plume #1 and South Plume #2, which are groundwater contaminant plumes that originate off-Site and/or up-gradient/cross-gradient of OU01 and migrate into the LFP property and comingle with a portion of the Facility Plume. **Figures 3-3, 3-4 and 3-5** show the delineation of the Facility Plume and South Plume #1 and South Plume #2 in unconsolidated deposits groundwater for tetrachloroethene (PCE – not a Site COC, but a primary constituent of South Plume #1), and TCE and TCA, respectively, as presented in the AAR/RAWP. As stated in the Order, *"[ADC] is <u>not</u> (emphasis added) responsible to take action with respect to the two off-Site releases and/or the subject groundwater plumes identified in the [AAR/RAWP]."* The respective sources of South Plume #1 and South Plume #2 have not yet been reported to ADC by NYSDEC or the responsible parties and do not appear to have been remediated or isolated.

The NYSDEC-approved OU01 AAR/RAWP evaluated alternatives and recommended the OU01 RA approach to address the source of COCs in the Facility Plume and to isolate or remediate the COCs in OU01 that were above the NYSDEC soil cleanup objectives (SCOs) for protection of groundwater. The OU01 RA, which primarily consists of a Waterloo Barrier® containment cell with groundwater extraction and treatment, was implemented in accordance with the OU01 Remedial Design Report (RDR) approved by the NYSDEC on May 12, 2015 (JCO, 2015), and physically and hydraulically isolates the COCs that are above the NYSDEC

[1] The A&R Concrete property is now owned by Amoia Realty, LLC, but remains occupied by A&R Concrete.

SCOs for protection of groundwater in OU01. The NYSDEC-approved OU01 Construction Completion Report (CCR; JCO, 2017a) documents the construction of the OU01 RA.

The OU01 groundwater extraction and treatment system began operation in December 2015, and the sealing of the Waterloo Barrier® was completed in April 2016, effectively completing the physical isolation of the source area of the Facility Plume. Semi-annual monitoring of groundwater and surface water of OU01 and OU02 continued during and after construction of the OU01 RA, in accordance with the requirements of the draft OU01 Site Management Plan[1] (OU01 SMP; JCO, 2017b) and its associated subdocuments: the Operation, Maintenance and Monitoring Plan (OMMP) and the Sampling and Analysis Plan (SAP). **Figure 3-6** shows the monitoring locations included in the on-going semi-annual monitoring events, which have been performed since 2009.[2] The Target Analyte List (TAL) includes all COC as well as 13 other VOCs requested by NYSDEC based on historic groundwater analytical results from the Site, and 1-4 dioxane – see **Table 3-1**.[3,4]

NYSDEC-approved OU01 Remedial Action Reports (OU01 RARs) for 2016 (JCO, 2017c – see **Appendix E**) and 2017 (JCO, 2018 - see **Appendix F**) provided certification of the performance of the OU01 RAR, and concluded "*given the OU01 RA is performing as designed, any on-going contribution of OU01 constituents to groundwater in OU02 will continue to decline, and relative contributions to OU02 by South Plume #1 and South Plume #2, as defined in the NYSDEC-approved AAR/RAWP, will continue to increase*." As discussed herein, the 2017 RAR noted decreasing concentrations were already observed at the OU02 shallow monitoring well that is most proximate to the OU01 RA (J13-UC02 – see **Figure 3-6)**.

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[1] NYSDEC provided comments on those draft documents on November 6, 2017, to which ADC responded on January 2, 2018; NYSDEC responded to those responses on January 31, 2018. Then, following the schedule required by the September 20, 2018 Order, ADC submitted the revised OU01 SMP to NYSDEC on November 20, 2018.

[2] The 2013 AAR/RAWP stated semi-annual monitoring in OU01 and OU02 would continue during and for a period of five years post-remedy implementation (i.e., until April 2021), after which the frequency and duration of monitoring will be reevaluated and discussed with NYSDEC.

[3] Pursuant to the October 26, 2017-Addendum 1 to the June 2017 Sampling and Analysis Plan, which is a component of the June 2017 draft Site Management Plan, analysis of 1,4-dioxane by EPA Method 8260C using isotope dilution with selective ion monitoring (SIM) was added to the monitoring plan for the November 2017 and April 2018 monitoring events. 1,4-dioxane is not a COC. Resultant data is presented in figures provided in Appendix D.

[4] Pursuant to the July 23, 2018 Addendum 2 to the June 2017 Sampling and Analysis Plan, which is a component of the June 2017 draft Site Management Plan, analysis of per- and polyfluoroalkyl substances (PFAS) was performed for groundwater samples collected from nine Site monitoring wells in fall 2018. Validated results were not available by the OU02 AAR Due Date specified by the Order, and are thus not presented herein. Results will be provided in the upcoming OU01 Remedial Action Report for 2018.

Table 3-1: Target Analyte List
Former Dennison/Monarch Systems Site
Operable Unit 02
New Windsor, New York

Compound	Groundwater	Surface Water	Soil						
	Class GA Standard (ug/L)	Class C Surface Water Standard	Unrestricted Use (ppb)	Residential Use (ppb)	Restricted-Residential (ppb)	Commercial (ppb)	Industrial (ppb)	Protection of Ecological Resources (ppb)	Protection of Groundwater (ppb)
OU02 Constituents of Concern									
1,1,1-Trichloroethane	5	NA	680	100000	100000	500000	1000000	NS	680
Trichloroethene	5	40	470	10000	21000	200000	400000	2000	470
1,1-Dichloroethane	5	NA	270	19000	26000	240000	480000	NS	270
1,2-Dichloroethane	0.6	NA	20	2300	3100	30000	60000	10000	20
1,1-Dichloroethene	5	NA	330	100000	100000	500000	1000000	NS	330
cis-1,2-Dichloroethene	5	NA	250	59000	100000	500000	1000000	NS	250
trans-1,2-Dichloroethene	5	NA	190	100000	100000	500000	1000000	NS	190
Vinyl chloride	2	NA	20	210	900	13000	27000	NS	20
Other Target Analyte List Compounds									
Acetone	50	NA	50	100000	100000	500000	1000000	2200	50
Benzene	1	10	60	2900	4800	44000	89000	70000	60
2-Butanone	50	NA	120	100000	100000	500000	1000000	100000	120
Carbon Disulfide	60	NA	NA	NA	NA	NA	NA	NA	NA
Chloroform	7	NA	370	10000	49000	350000	700000	12000	370
1,2-Dichlorobenzene	3	NA	1100	100000	100000	500000	1000000	NS	1100
1,4-Dioxane	NA	NA	100	9800	13000	130000	250000	100	100
Ethylbenzene	5	NA	1000	30000	41000	390000	780000	NS	1000
Freon 113	5	NA	NA	NA	NA	NA	NA	NA	NA
Methylene Chloride	5	200	50	51000	100000	500000	1000000	12000	50
Naphthalene	10	NA	12000	100000	100000	500000	1000000	NS	12000
Tetrachloroethene	5	1	1300	5500	19000	150000	300000	2000	1300
Toluene	5	6000	700	100000	100000	500000	1000000	36000	700
Xylenes (each isomer)	5	NA	260	100000	100000	500000	1000000	260	1600

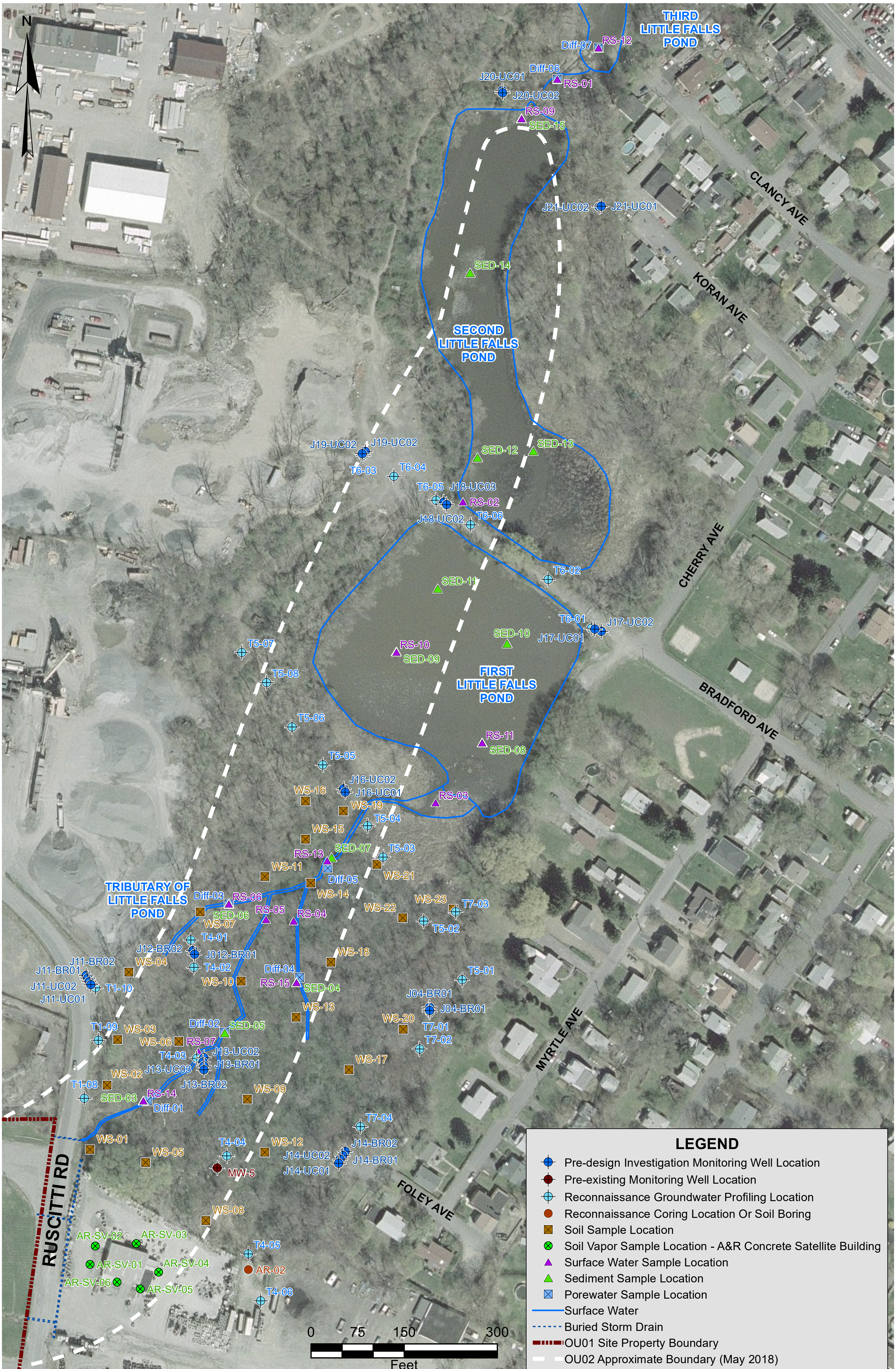
Notes:
NS: No Standard
NS: Not specified
ug/l: micrograms per liter
ppb: parts per billion

Sources:
Aerial photo referenced from N.Y, Digital Orthoimagery Program, Spring 2004.

FIGURE 3-1: INVESTIGATION LOCATIONS IN OU01 FOR THE 2008 PDI REPORT
FORMER DENNISON/MONARCH SYSTEMS SITE
NEW WINDSOR, NEW YORK

VHB Engineering, Surveying, Landscape and Geology, P.C.
100 Great Oaks Boulevard, Suite 118, Albany, NY 12203

Drawn by: TEH Date: 01/11/19
Reviewed by: GAK Date: 01/11/19
Scale: As Shown Project: 58300.00



Sources:
Aerial photo referenced from N.Y, Digital Orthoimagery Program, Spring 2004.

FIGURE 3-2: INVESTIGATION LOCATIONS IN OU02 FOR THE 2008 PDI REPORT
FORMER DENNISON/MONARCH SYSTEMS SITE
NEW WINDSOR, NEW YORK

VHB Engineering, Surveying, Landscape and Geology, P.C.
100 Great Oaks Boulevard, Suite 118, Albany, NY 12203

Drawn by: TEH Date: 01/11/19
Reviewed by: GAK Date: 01/11/19
Scale: As Shown Project: 58300.00

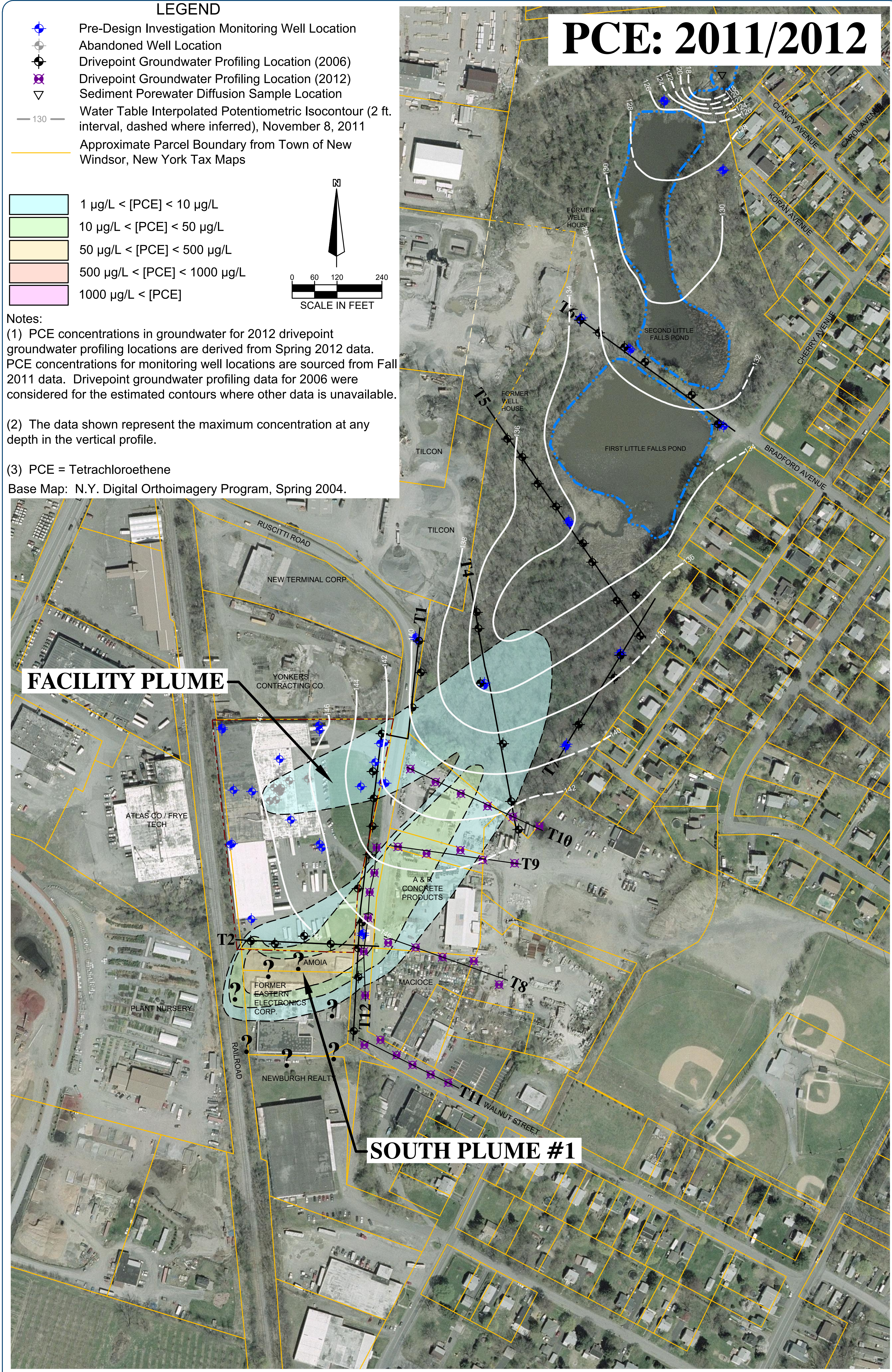
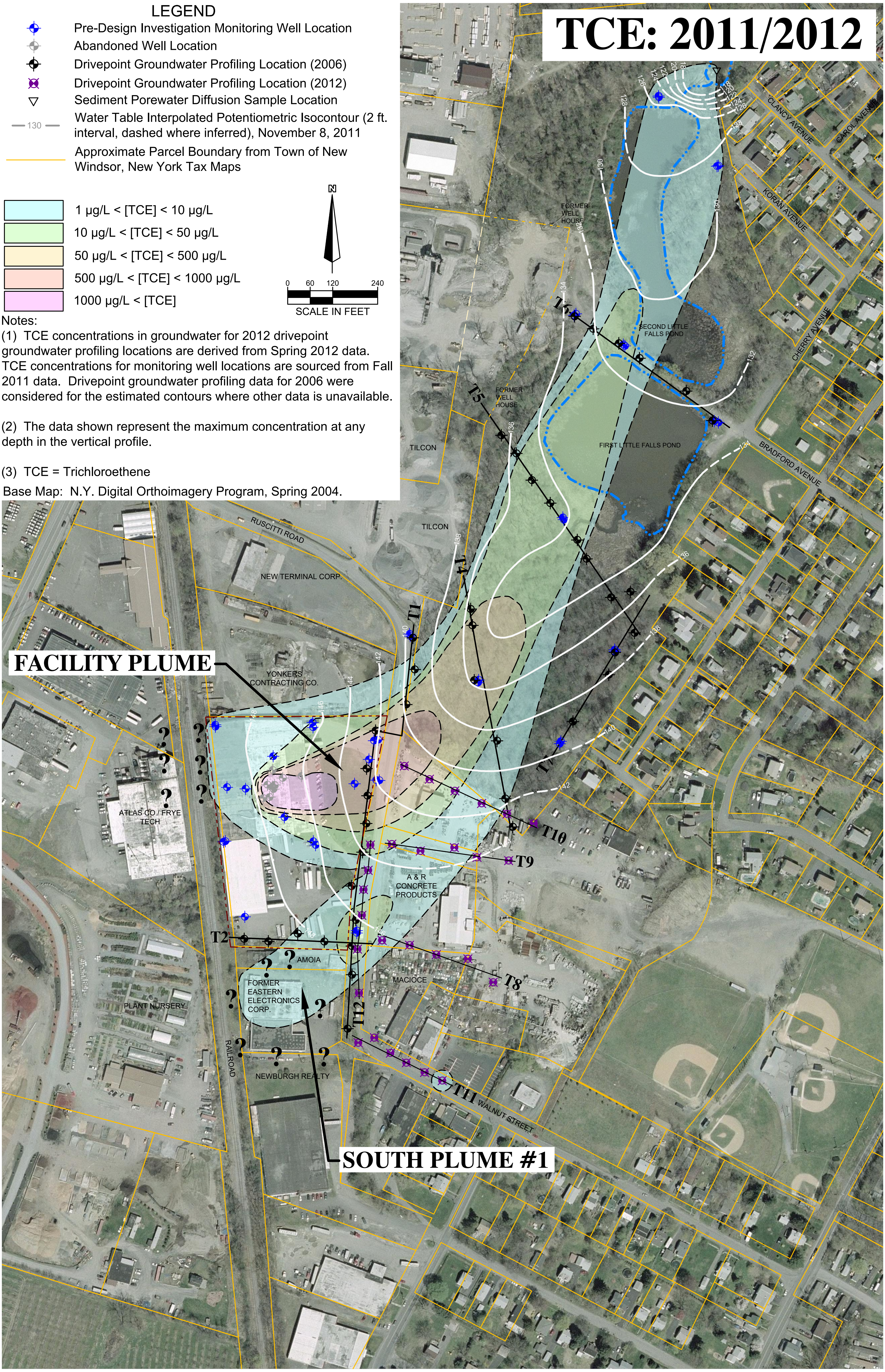


FIGURE 3-3: FALL 2011/WINTER 2012 PCE CONCENTRATIONS IN UNCONSOLIDATED DEPOSITS GROUNDWATER (µg/L)
FORMER DENNISON/MONARCH SYSTEMS SITE
NEW WINDSOR, NEW YORK

VHB Engineering, Surveying Landscape and Geology, P.C.
100 Great Oaks Blvd, Ste 118, Albany, NY

Drawn by: TJK Date: 07/17/12
Chk'd by: GAK Date: 04/23/13
Scale: As Shown Project: 58300.00

\\vhb\gbl\proj\Montpelier\58300.00 ADC New Windsor NY\JCOdata\CAD\AAR 2018\VOC 2012.dwg



LEGEND

- Pre-Design Investigation Monitoring Well Location
- Abandoned Well Location
- Drivepoint Groundwater Profiling Location (2006)
- Drivepoint Groundwater Profiling Location (2012)
- Sediment Porewater Diffusion Sample Location
- 130 Water Table Interpolated Potentiometric Isocontour (2 ft. interval, dashed where inferred), November 8, 2011
- Approximate Parcel Boundary from Town of New Windsor, New York Tax Maps

- 1 μg/L < [TCE] < 10 μg/L
- 10 μg/L < [TCE] < 50 μg/L
- 50 μg/L < [TCE] < 500 μg/L
- 500 μg/L < [TCE] < 1000 μg/L
- 1000 μg/L < [TCE]

N

0 60 120 240

SCALE IN FEET

Notes:

(1) TCE concentrations in groundwater for 2012 drivepoint groundwater profiling locations are derived from Spring 2012 data. TCE concentrations for monitoring well locations are sourced from Fall 2011 data. Drivepoint groundwater profiling data for 2006 were considered for the estimated contours where other data is unavailable.

(2) The data shown represent the maximum concentration at any depth in the vertical profile.

(3) TCE = Trichloroethene

Base Map: N.Y. Digital Orthoimagery Program, Spring 2004.

FIGURE 3-4: FALL 2011/WINTER 2012 TCE CONCENTRATIONS IN UNCONSOLIDATED DEPOSITS GROUNDWATER (μg/L)
FORMER DENNISON/MONARCH SYSTEMS SITE
NEW WINDSOR, NEW YORK

VHB Engineering, Surveying Landscape and Geology, P.C.
100 Great Oaks Blvd, Ste 118, Albany, NY

Drawn by: TJK	Date: 07/17/12
Chk'd by: GAK	Date: 04/23/13
Scale: As Shown	Project: 58300.00

\\vhb\gbl\proj\Montpelier\58300.00 ADC New Windsor NY\JCOdata\CAD\AAR 2018\VOC 2012.dwg

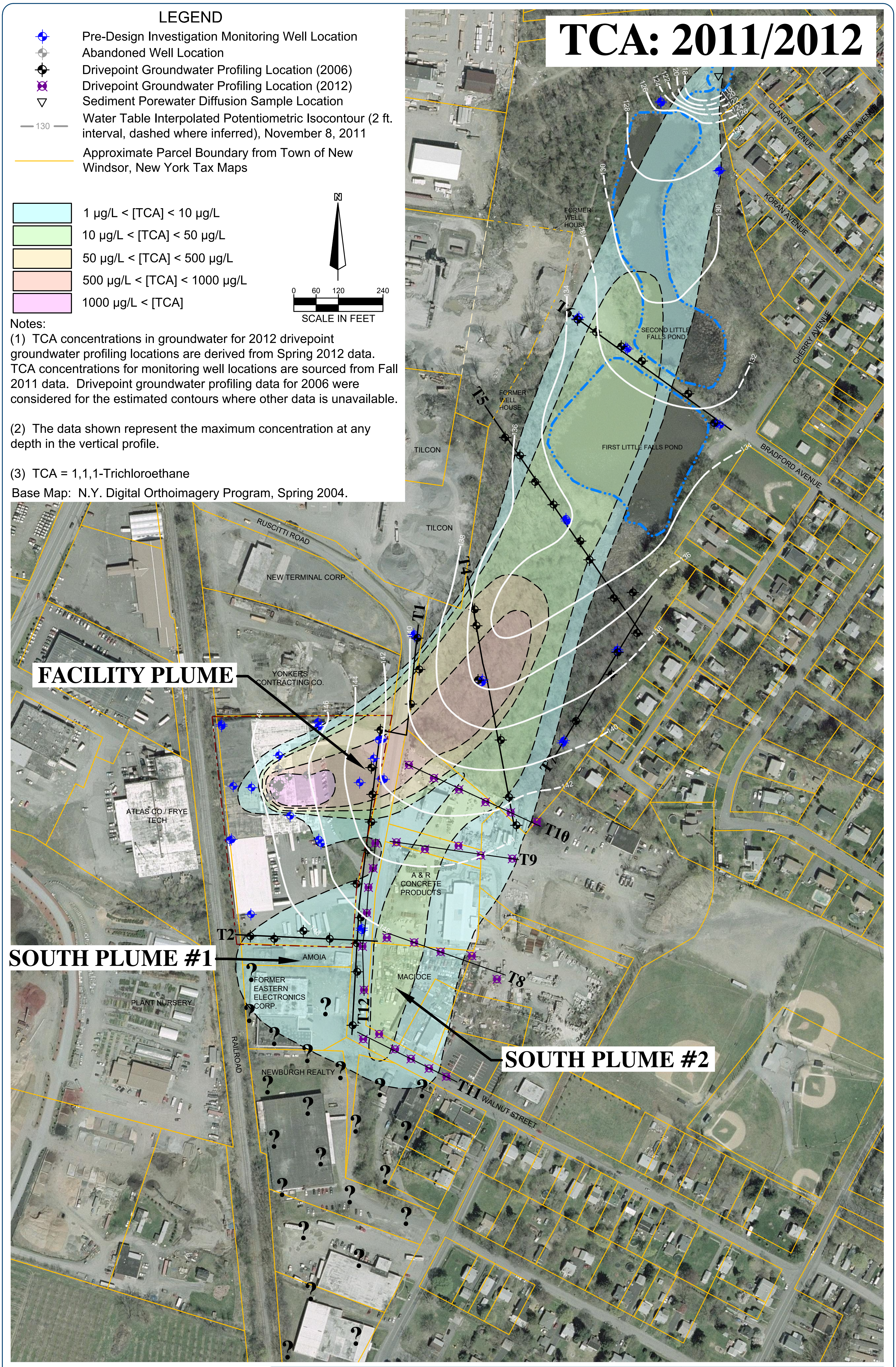
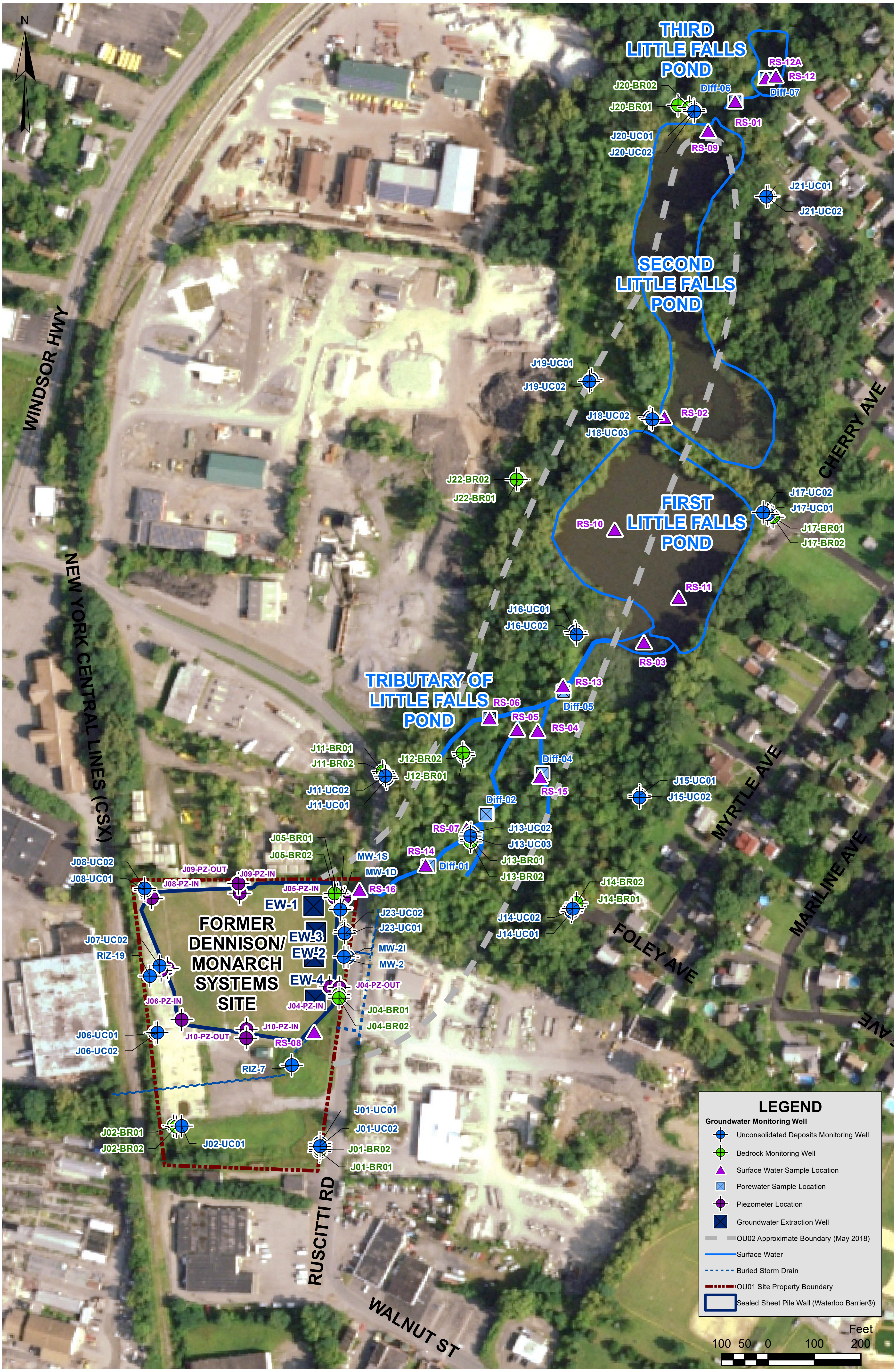


FIGURE 3-5: FALL 2011/WINTER 2012 TCA CONCENTRATIONS IN UNCONSOLIDATED DEPOSITS GROUNDWATER (µg/L)
FORMER DENNISON/MONARCH SYSTEMS SITE
NEW WINDSOR, NEW YORK

VHB Engineering, Surveying Landscape and Geology, P.C.
100 Great Oaks Blvd, Ste 118, Albany, NY

Drawn by: TJK Date: 07/17/12
Chk'd by: GAK Date: 04/23/13
Scale: As Shown Project: 58300.00

\\vhb\gbl\proj\Montpelier\58300.00 ADC New Windsor NY\JCOdata\CAD\AAR 2018\VOC 2012.dwg



Sources:
Aerial photo taken in August 2017 (USDA Farm Service Agency - NAIP).

FIGURE 3-6: MONITORING LOCATIONS FOR CURRENT SEMI-ANNUAL GROUNDWATER AND SURFACE WATER MONITORING PROGRAM
FORMER DENNISON/MONARCH SYSTEMS SITE
NEW WINDSOR, NEW YORK

VHB Engineering, Surveying, Landscape and Geology, P.C.
100 Great Oaks Boulevard, Suite 118, Albany, NY 12203

Drawn by: TEH Date: 12/08/18
Reviewed by: GWL Date: 06/26/19
Scale: As Shown Project: 58300.00

4.0 REMEDIAL INVESTIGATION AND RISK ASSESSMENT RESULTS: OU02

The NYSDEC-approved PDI Report (JCO, 2008 – see **Appendix B**) and the NYSDEC-approved OU01 AAR/RAWP (JCO, 2013 – see **Appendix C**) provide a detailed presentation of remedial investigation findings for OU01 and OU02 from 2006 to 2012. The PDI Report included the results of the BHHRA and SLERA performed for OU02 in 2008 using the comprehensive PDI dataset available at the time. Results of subsequent semi-annual groundwater and surface water monitoring performed to date were provided to NYSDEC in written submittals, and associated data was uploaded to the NYSDEC EQuIS database following each respective event. This compendium of data is the basis for the assessment presented below.

4.1 Site Geology and Hydrogeology

4.1.1 Local and Regional Drainage

The Site is located approximately 1.1 to 1.3 miles west of the Hudson River atop a prominent terrace at an elevation of 157-159 feet National Geodetic Vertical Datum (NGVD), as shown in **Figure 1-1.** Regional topography generally grades from a high point atop Snake Hill (elevation 690 feet NGVD), which is directly west of the Site, to the Hudson River (near sea level). The local topography generally slopes downward to the northeast, with a decline in elevation following the incised erosional channel of a relic stream that was dammed, presumably for stormwater control, to create the LFP. The former building slab on OU01 is at an approximate elevation of 158 feet, and the Third (and most downstream) LFP is at an elevation of 117 feet, resulting in an overall drop in grade from OU01 to the Third LFP of 41 feet over a distance of approximately 2,400 feet, or 1.7 percent. The outlet of the Third LFP is a tributary to the Quassaick Creek that discharges to the Hudson River approximately 1.3 miles east of the Site. A residential area rests on the glacially-modified western berm that is immediately east of the topographic depression occupied by the Little Falls Ponds.

Surface drainage from the OU01 and vicinity along Ruscitti Road, as well as treated groundwater from the OU01 RA system, is conveyed through a series of culverts and drainage swales from OU01 and Ruscitti Road that discharge to a swampy area of OU02, east of Ruscitti Road. The swampy area drains through considerable vegetative cover into a dendritic stream network that enters the First LFP (**see Figure 1-3**). A pipe inlet located at the north end of First LFP drains through an earthen dam and culvert to Second LFP, dropping approximately two feet. At the end of Second LFP, a dam with visible cracks and local failures allows water to short-circuit the culvert drainage into Third LFP; nevertheless, the elevation difference between Second LFP and Third LFP is significant, falling 11 feet over a distance of about 40 feet. In addition to receiving stormwater from the Site, the LFP receive stormwater runoff and inflow from adjacent properties to the west and east. The relatively low topography of the LFP system also serves to draw groundwater discharge from surrounding areas.

4.1.2 Geology

The NYSDEC-approved 2013 AAR/RAWP (JCO, 2013) and 2008 PDI Report (JCO, 2008) provide a thorough description of the general geology in the vicinity of the Site and present cross-sections based on borings performed during the remedial investigation. A summary description is presented herein. **Figure 4-1** shows the location of a summary geologic cross-section extending from OU01 and along the approximate axis of OU02 – the cross-section is shown in **Figure 4-2**.

The bedrock in OU02 consists of Ordovician period Normanskill or Snake Hill shales and siltstones/mudstones. The presence of these units at the Site was confirmed by geologic logs from eight bedrock borings described in the PDI Report (JCO, 2008), as well as the subsequently installed additional bedrock monitoring wells in OU02 (JCO, 2013). The bedrock logs indicate calcite veining and several zones of post-emplacement movement, as shown by displacements in vein structure. Fractures were noted along the nearly horizontal bedding and at angles of up to 90 degrees from the bedding plane. The top five to eight feet of the bedrock cores collected on the Site were more competent than the lower eight to 50 feet.

The overburden is composed of materials deposited during the retreat of the most recent continental glacier, which reached a maximum extent at Long Island approximately 22,000 years ago, and which scraped off pre-existing soils from the bedrock surface. The glacier formed glacial till – see **Figure 4-2** -, which is a dense compacted mixture of rock flour, sand, gravel, pebbles, cobbles and boulders, as it was deposited beneath the ice onto the rock. Testing of till samples during the PDI indicated vertical hydraulic conductivities (K) ranging between 4.1E-06 to 8.2E-08 cm/s (JCO, 2008), which is consistent with ranges of K for glacial till presented by Freeze and Cherry (1979), and confirms the till is of low permeability. The till is estimated to be continuous throughout OU02, ranging in thickness, as shown on **Figure 4-2**.

As the continental glacier melted, mountainous areas were the first to be exposed as nunataks. In the valleys, the ice either stagnated and wasted down in-place, or actively retreated. The Hudson Glacial Lobe retreated northwards up-valley and uncovered the area of the Site between 17,000 and 18,000 years ago. Episodic retreat and stagnation of the Hudson Ice Lobe resulted in coarse-grained outwash and ice-contact deposits close to the glacier, which were later covered by finer-grained delta and lake deposits that were placed after additional retreat of the glacier had occurred. In the area of OU2, observations of soil cores indicate a generally fining upward sequence above the till, with outwash sand and gravel upon the till in the northern portion, and a course gravel outwash upon the till in the southern portion – see **Figure 4-2**. A laminated unit including fine and very fine sand, laminated clay and silt layers overlays the outwash. Organic silty sand and/or fill is present above the laminated unit – see **Figure 4-2**.

4.1.3 Physical Hydrogeology

An extensive description of the physical hydrogeology at the Site, including OU02, is presented in the NYSDEC-approved 2008 PDI Report (JCO, 2008 – see **Appendix B**) and the 2013 OU01 AAR/RAWP (JCO, 2013 – see **Appendix C**). Mapped potentiometric surfaces for each of the validated semi-annual monitoring events performed since submittal of the 2013 OU01 AAR/RAWP have been provided to NYSDEC in prior submittals, with the exception of May 2018, which is presented herein.

Figures 4-3 through 4-6 present isocontour maps of potentiometric surfaces established for the OU01/OU02 groundwater monitoring event performed in May 2018 for the water table, deep unconsolidated deposits, shallow bedrock, and deep bedrock geologic units, respectively. Vertical gradient directions at locations of co-located monitoring wells of multiple geologic units are also indicated on the figures. Supporting summary tables of the May 2018 potentiometric data are provided in **Table 4-1**.

The water-table gradient (see **Figure 4-3**) slopes from OU01 and nearby areas toward the LFP and their tributaries. The water-table declines across the series of Ponds, dropping steeply between the Second and Third LFP. Surrounding topography sloping to the Ponds from the residential area to the east and the industrial area to the west supports that groundwater flow occurs toward the Ponds and/or the stream connecting and discharging from the Ponds. The Third LFP represents a considerable topographic low with respect to the Second Pond, which is held back by a dam. A considerable drop in ground elevation toward the Third LFP from the residential area to east and the wooded area immediately to the west results in a sloping water table and convergence of groundwater flow toward a narrow swath that is occupied by the Third LFP and its outlet that discharges toward the Quassaick Creek.

The potentiometric surface within deep unconsolidated deposits (see **Figure 4-4**) follows the same general trend in flow directions observed for shallow unconsolidated deposits (water table): that is, it reflects groundwater flow convergence toward the tributaries of the ponds and the general flow path of the overlying surface water. Also, as is generally reflected by the direction of vertical gradients, the deep unconsolidated deposits recharge the shallow unconsolidated deposits with groundwater in the portion of OU02 that is between OU01 and the First LFP.

The bedrock hydrogeology at the Site is characterized by at least ten clusters of two wells each; shallow and deep. The potentiometric surface within shallow and deep bedrock (see **Figures 4-5 and 4-6**, respectively) supports the same general trend in groundwater flow directions observed for unconsolidated deposits: groundwater flow convergence toward the tributaries to the LFP. As discussed above, vertical gradients to deep unconsolidated deposits are upward throughout much of OU02, supporting migration of groundwater from bedrock to unconsolidated deposits within the operable unit. This is further emphasized by flowing artesian conditions (if wells are left uncapped) observed at bedrock monitoring well locations J04 and J13 – see **Figures 4-5 and 4-6**.

By design, construction of the OU01 RA modified the hydraulic gradients in the area of the Waterloo Barrier® containment cell in OU01. The groundwater extraction and treatment system within the containment cell lowers the groundwater elevation within the cell and creates inward horizontal hydraulic gradients across the barrier wall, and upward vertical hydraulic gradients into the barrier enclosure, to prevent groundwater from leaving the containment cell. The OU01 RA is operating effectively, as presented in the NYSDEC-approved 2017 OU01 RAR, and is inducing the designed local inward hydraulic gradients to the barrier (JCO, 2018 - **see Appendix F**). As expected, hydraulic head patterns in OU02 have remained similar pre- and post-OU01 RA; variations in hydraulic head patterns outside of the Waterloo Barrier® containment cell pre- and post-OU01 RA are primarily observed in the south and southeast area of OU01, and not in OU02.

Estimated groundwater velocities were calculated and presented in the NYSDEC-approved PDI Report for the shallow unconsolidated deposits, the deep unconsolidated deposits, and the bedrock (JCO, 2008 – **see Appendix B**). A summary of the estimated average groundwater velocities, which were developed based on slug testing performed in several of the monitoring wells (JCO, 2008) and the November 2017 and May 2018 potentiometric data, is presented in **Table 4-2**. Average horizontal groundwater velocities were estimated to be approximately 65 to 130 feet per year in shallow unconsolidated deposits, and 12 to 24 feet per year in deep unconsolidated deposits.

4.2 Nature and Extent of Contamination

4.2.1 Soil

The NYSDEC-approved PDI Report (JCO, 2008; **Appendix A**) provides a description of the scope and results of the soil investigation performed in the LFP property. A total of 23 surface soil samples were collected from the surface (0 to 6 inches) of unconsolidated deposits within the upland and swampy areas on the portion of the LFP property located to the southwest of the First LFP - see **Figure 3-2** for the locations of sample collection. Unrestricted use Soil Cleanup Objectives per 6 NYCRR Part 375 Subpart 6.3 were not exceeded in any of the soil samples from the LFP Property.[1]

[1] The only COC detection was at one location, it was a low concentration of a single TCA daughter product (1,1-DCA at 5.9 µg/kg at location WS-12), otherwise, COCs were not detected in any of the LFP area surface soils.

4.2.2 Unconsolidated Deposits Groundwater

Figure 4-7 compares, in plan view, the nature and extent of TCE in unconsolidated deposits groundwater in 2006, as mapped during the PDI, to the nature and extent of TCE in unconsolidated deposits groundwater in 2012, as determined by post-PDI Site monitoring and additional characterization activities. **Figure 4-8** provides a similar comparison, but in cross-section along the axis of OU02. As is evident from the figures, concentrations within the core of the TCE plume emanating from OU01 naturally attenuated substantially between 2006 and 2012, prior to implementation of the OU01 RA. An even more substantial attenuation is observed for the other primary COC in groundwater, TCA, in that same time period, before implementation of the OU01 RA – see **Figure 4-9 and Figure 4-10.**

The NYSDEC-approved PDI Report (JCO, 2008) included an assessment with Molecular Biological Tools (MBT) to determine if bioremediation, as one form of natural attenuation, is taking place to convert COCs to the various degradation products. The PDI Report concluded *"there is ample evidence that the necessary key organisms are present as of the time of this study; therefore, addition of microorganisms (bioaugmentation) for bioremediation is probably not necessary for current conditions [in OU02]. The key organisms express dechlorinating enzymes with acceptable frequency, and the key genes are present."* (JCO, 2008). Biodegradation is likely one of the current components of the natural attenuation mechanism that is effectively reducing concentrations of COCs in the Facility Plume in OU02. As discussed in Section 6.2.2, biostimulation by addition of substrate to the subsurface is a feasible approach to stimulate biodegradation, but only if needed.

As described in Section 3.0, the OU01 groundwater extraction and treatment system began operation in December 2015, and the sealing of the Waterloo Barrier® was completed in April 2016, effectively completing the physical isolation of the source area of the Facility Plume. The NYSDEC-approved OU01 RARs for 2016 (see **Appendix E**) and 2017 (see **Appendix F**) provided NYSDEC with the semi-annual groundwater and surface water monitoring results and associated data usability summary reports (DUSRs) for each respective year. Results for the May 2018 groundwater monitoring event, the most recent event for which validated data are available, are provided herein. Laboratory analytical reports and the associated DUSR for analyses of groundwater are provided in **Appendix G**. **Table 4-3** provides a summary of the May 2018 laboratory analytical data for groundwater.

Figure 4-11 compares, in plan view, the nature and extent of TCE in unconsolidated deposits groundwater in 2012, as presented in the OU01 AAR/RAWP, with the most recent dataset from May 2018. **Figure 4-12** provides a similar comparison, but in cross-section along the axis of OU02. As is evident from the figures, concentrations within the core of the TCE plume emanating from OU01 have attenuated as a result of monitored natural attenuation and the OU01 RA. An even more substantial attenuation is observed for the other primary COC in groundwater: TCA – see **Figure 4-13 and Figure 4-14**. **Figures 4-15 through 4-18** show the comparison of the concentrations of TCE and TCA in unconsolidated deposits groundwater over the time period of 2006 and 2018; the attenuation of primary COCs in OU02 groundwater is clearly evident.

Two COCs that are the primary drivers in calculations in the BHHRA, as discussed in Section 4.3, are TCE and vinyl chloride

In 2006, TCE was detected at 7 of 12 groundwater monitoring wells in what is now OU02 (wells located within the dashed line boundary – in **Figure 3-2**), with an average detected concentration of 124 µg/L and a maximum observed concentration of 713 µg/L (J13-UC02); whereas, in May 2018, TCE was detected at 6 of 12 groundwater monitoring wells in OU02, with an average detected concentration of 47 µg/L and a maximum observed concentration of 170 µg/L at J13-UC02, a substantial reduction. In 2006 and 2018, vinyl chloride was not detected in any of the 12 groundwater monitoring wells in what is now OU02 (only wells located within the dashed line boundary – see **Figure 3-2**).

Figure 4-19 shows arithmetic and semi-logarithmic plots of concentrations of COCs versus time at monitoring well J13-UC02, which is located approximately 300 feet from OU01 and is the closest OU02 monitoring well to OU01 for which regulatory standards are exceeded in groundwater. The OU01 RA has already resulted in accelerated attenuation of concentrations of COCs at that location, particularly for TCA and its reductive dechlorination daughter product, 1,1-DCE. The observed reduction in concentrations at location J13-UC02 is early relative to expected average groundwater flow velocity in shallow unconsolidated deposits of 65 to 130 feet per year, even not considering retardation from sorption and degradation; nevertheless, it is occurring, and accelerated attenuation of the Facility Plume is expected downgradient as additional time passes post-OU01 RA. Per the NYSDEC-approved 2017 OU01 RAR, "*given the OU01 RA is performing as designed, any on-going contribution of OU01 constituents to groundwater in OU02 will continue to decline, and relative contributions to OU02 by South Plume #1 and South Plume #2, as defined in the NYSDEC-approved AAR/RAWP, will continue to increase*."

4.2.3 Bedrock Groundwater

Only one bedrock monitoring well within OU02 has contained detectable COCs since the PDI: J13-BR01, an artesian well located along the axis of OU02, approximately 300 feet from OU01. As shown in **Figure 4-20**, concentrations of COC in J13-BR01 were relatively stable prior to implementation of the OU01 RA; since then, concentrations of TCA have been declining, which is attributed to capture of shallow bedrock groundwater from beneath the containment cell footprint during operation of the OU01 RA. In May 2018, no COCs in J13-BR01 were in exceedance of NYSDEC regulatory standards – see **Table 4-3**.

4.2.4 Sediment Porewater

Seven (7) streambed sediment porewater sampling locations were established at locations of probable upwelling of groundwater for the PDI and subsequent semi-annual monitoring, five (5) of which are located within the OU02 boundary – see **Figure 3-6**. At those locations, passive diffusion bag samplers are installed for each event and retrieved for water sample collection and subsequent laboratory analysis. Laboratory results for the May 2018 monitoring event are provided in **Appendix G**. **Table 4-4** provides a summary of the data. Regulatory standards for groundwater were exceeded for COCs at two of the five locations in OU02 in May 2018: DIFF-02, and DIFF-05, both of which are located along the main trunk of the tributary to the first of the LFP, and along the main axis of the Facility plume, ranging in distance from approximately 300 to 600 feet from OU01 – see **Figure 3-6. Figure 4-21** shows concentration of COCs as a function of time at those locations in arithmetic and semi-logarithmic format, as well as at location DIFF-01, located closer to OU01. As a result of the reducing conditions in the streambed sediment, reductive dechlorination of TCE and TCA has resulted in biodegradation of the parent COCs and formation of daughter products of TCA (1,1-DCA) and TCE (cis-1,2-DCE and vinyl chloride) (JCO, 2008). Concentrations of COCs in streambed groundwater in OU02 have been generally stable or declining from peak levels since the May 2008 PDI Report.

Two COCs that are the primary drivers in calculations in the BHHRA, as discussed in Section 4.3, are TCE and vinyl chloride. In 2006, TCE was detected at 5 of 5 sediment porewater monitoring locations in what is now OU02, with an average detected concentration of 73 µg/L and a maximum observed concentration of 358 µg/L at DIFF-01; whereas, in May 2018, TCE was detected at 3 of 5 sediment porewater monitoring locations in OU02, with an average detected concentration of 2.9 µg/L and a maximum observed concentration of 5 µg/L at DIFF-05, a substantial reduction. In 2006, Vinyl chloride was detected at 3 of 5 sediment porewater monitoring locations in what is now OU02, with an average detected concentration of 18 μg/L and a maximum observed concentration of 39 μg/L at DIFF-01; whereas, in 2018, vinyl chloride was detected at 2 of 5 sediment porewater monitoring locations in what is now OU02, with an average detected concentration of 7.8 μg/L and a maximum observed concentration of 15 μg/L at DIFF-05, also a substantial reduction.

4.2.5 Surface Water

Table 4-5 provides a summary of laboratory analytical data for the May 2018 monitoring event. Laboratory analytical reports and the DUSR are provided in **Appendix G**. Section 703 Class C Fresh Water Standards (Class C Standards) were not exceeded at any location and have not been exceeded for COCs at any location in OU02 surface water since 2010.[1]

Figure 4-22 shows semi-logarithmic plots of concentrations of COCs in surface water collected in OU01 and OU02 between 2006 and spring 2018; concentrations of COCs have significantly attenuated at all surface water sampling locations since 2006.

Two COCs that are the primary drivers in calculations in the BHHRA, as discussed in Section 4.3, are TCE and vinyl chloride. In 2006, TCE was detected at 14 of 16 surface water monitoring locations, with a maximum observed concentration of 61 ug/L (RS-05); whereas, in May 2018, TCE was detected at 12 of 16 surface water monitoring locations, with a maximum observed concentration of 15 ug/L (RS-05). In 2006 vinyl chloride was detected at 5 of 16 surface water monitoring locations, with a maximum observed concentration of 4.4 ug/L (RS-07); whereas, in May 2018, vinyl chloride was not detected at *any* of the 16 surface water monitoring locations, despite a detection limit of just 0.5 ug/L.

4.2.6 Soil Vapor

An investigation of soil vapor quality was conducted on December 20, 2006 around the perimeter of the satellite building located on the northern portion of the property now owned by Amoia Realty, LLC; this is the only occupied structure within 100 feet of the OU02 boundary – see **Figure 1-3**. The investigation was conducted to confirm VOCs in shallow groundwater of the Facility Plume and South Plume #1 in OU02 are not adversely impacting indoor air quality in the satellite building. A total of six soil vapor investigation points were installed around the perimeter of the building – see **Figure 3-2**; as presented in the NYSDEC-approved PDI report, COCs were not detected in any of the soil vapor samples (JCO, 2008; see **Appendix B**).

There are no other residences or other occupied buildings within 100 feet of the OU02 boundary, and most are located at least 200 feet from the boundary – see **Figure 1-3**. USEPA's June 2015 "Technical Guide for Assessing and Mitigating the Vapor Intrusion Pathway from Subsurface Vapor Sources to Indoor Air", in which USEPA observes "*vapor intrusion impacts generally have not been observed at distances greater than one or two houses beyond the estimated extent of the groundwater plume where contaminated groundwater is the subsurface vapor source*" (USEPA, 2015). Therefore, no complete vapor intrusion pathways associated with OU02 should exist. This notwithstanding, an investigation of soil vapor quality was conducted east of OU02 in May 2009 per a NYSDEC-approved Work Plan. Six (6) soil vapor monitoring points were installed proximate to, and along the southern boundary of what is now OU02 on the LFP property – see **Figure 3-**

[1] The only constituent for which concentrations have exceeded Class C Standards since 2010 is PCE, which is not a COC, but is a primary constituent of South Plume #1. In May 2018, the Class C Standard for PCE of 1 ug/L was exceeded at two locations, RS-05 and RS-08 (see **Figure 3-2**), and only marginally at 2 ug/L – see **Table 4-5**.

2, and **Appendix H**. One monitoring point could not be sampled for soil vapor due to the clayey nature of soils present, which were not sufficiently conductive to vapor transport, and one could not be sampled due to the close proximity of groundwater to the ground surface. Soil vapor samples were collected from the other four locations and sent to a laboratory for analysis of 11 VOCs previously detected in groundwater samples collected from the LFP property, including the OU02 COCs. Results were provided to NYSDEC in the July 28, 2009 Soil Vapor Quality Assessment (SVQA) Report – Little Falls Ponds Property (JCO, 2009a; see **Appendix H**). TCE was detected at the two southernmost soil vapor sampling locations (SV-LFP-1 and SV-LFP-2) at concentrations of 5.8 μg/m^3 and 1.4 μg/m^3, respectively, but those detections were accompanied by detectable PCE, the primary constituent of South Plume #1. The SVQA evaluation concluded South Plume #1 is the source of the detected TCE and PCE at those locations. TCA was detected in one sample (SV-LFP-3) at a concentration of 1.5 μg/L, and its presence is attributed to South Plume #2, not the Facility Plume.

4.3 Risk Assessments

The BHHRA included in the NYSDEC-approved PDI Report (JCO, 2008; see **Appendix B**) included evaluations of potential exposures to: construction and/or utility workers making shallow excavations in the LFP (i.e., OU02) area; adult and child visitors in the LFP area; and adult and child residents living east of the LFP areas.[1] As noted in the BHHRA, *"Standard risk assessment practices and procedures require that conservative, health protective, estimates of these factors be used to avoid underestimating the true risks. As a result, the quantitative risk estimates are much more likely to overestimate, rather than underestimate, the true risks."* The BHHRA concluded that estimated excess human cancer risks from the Site are below, or within, but near the low-end of, the range of risks considered acceptable by government agencies (1E-04 to 1E-06). The factors driving the potential risks in OU02, which were within and at the low-end of the range that is generally acceptable to regulatory agencies, included the presence of TCE and vinyl chloride in surface water, sediment and shallow groundwater. As described in Section 4.2, significant attenuation of COCs, including TCE and vinyl chloride, has occurred in surface water and groundwater since the BHHRA was performed in 2008. The BHRRA determined estimated non-cancer hazard indices were all well below the level of concern (hazard index=1).

The SLERA included in the NYSDEC-approved PDI Report (JCO, 2008; see **Appendix B**) included evaluation of potential impacts of Site-related COCs to ecological resources in the Little Falls Ponds area, including plants, soil invertebrates, fish, benthic life, amphibians, birds and mammals. No ecological risks were identified for plants, soil invertebrates, fish, amphibians, and wildlife (JCO, 2008). Potential risks to benthic life from COCs were found to be limited to a single sample location near the upstream end of the main tributary leading to the First Little Falls Pond, indicating associated risks to benthos were restricted to a small area (JCO, 2008). That single sample location is SED-03, which is co-located with streambed sediment porewater sampling location DIFF-01, where concentrations of COCs have declined since 2008 - see Section 4.2.4**.** The SLERA concluded COC concentrations in sediment should rapidly dissipate in response to source

[1] Ingestion of groundwater was not evaluated as an exposure pathway. The area is served by Publicly Owned Treatment Works, and the EPA Safe Drinking Water Information System (SDWIS), National Water Information System (NWIS), NYSDEC Water Well Program, and the Federal Reporting Data System (FRDS) Public Water Supply Information (PWSI) databases do not indicate presence of water supply wells within one mile of the Site. Moreover, the former municipal water supply wells adjacent to OU02 have been out-of-service for 30 or more years and are abandoned, in a state of disrepair, and are not permitted for operation; and, when the Town of New Windsor adopted an updated and revised zoning code in 2012, the LFP property and the surrounding area was *not* designated as a "Watershed Overlay District".

removal [or isolation]; the observed attenuation of COCs in underlying groundwater and sediment porewater since 2008 are consistent with that conclusion.

Table 4-1: Summary of Potentiometric Measurements
2015-2018
Former Dennison Monarch Systems Site
New Windsor, New York

Structure Name	Ground Surface Elevation (ft AMSL)	Measuring Point Elevation (ft AMSL)	11/14/2015		6/16/2016		11/14/2016		5/1/2017		11/14/2017		5/15/2018	
			Depth Below Measuring Point (ft)	Potentiometric Elevation (ft. AMSL)	Depth Below Measuring Point (ft)	Potentiometric Elevation (ft. AMSL)	Depth Below Measuring Point (ft)	Potentiometric Elevation (ft. AMSL)	Depth Below Measuring Point (ft)	Potentiometric Elevation (ft. AMSL)	Depth Below Measuring Point (ft)	Potentiometric Elevation (ft. AMSL)	Depth Below Measuring Point (ft)	Potentiometric Elevation (ft. AMSL)
OU01 Monitoring Locations														
J01-BR01[5]	147.66	147.26	5.67	141.80	4.80	142.67	6.39	141.08	2.06	145.41	5.41	142.06	2.34	144.92
J01-BR02	147.43	147.22	2.62	144.60	1.54	145.68	3.16	144.06	-1.46	148.68	2.55	144.67	-1.01	148.23
J01-UC01	146.99	146.63	4.67	141.96	3.83	142.80	5.33	141.30	1.18	145.45	4.66	141.97	1.44	145.19
J01-UC02	147.27	147.09	5.04	142.05	4.19	142.90	5.83	141.26	1.57	145.52	5.16	141.93	1.81	145.28
J02-BR01 [4]	157.51	157.23	12.80	144.47	11.60	145.67	13.90	143.33	8.08	149.15	13.00	144.23	7.98	149.25
J02-BR02 [4]	157.45	156.92	12.18	144.80	10.91	146.07	13.44	143.48	7.47	149.45	12.49	144.43	7.31	149.61
J02-UC01 [4]	157.38	157.11	12.53	144.61	11.16	145.98	13.67	143.44	7.66	149.45	12.70	144.41	7.54	149.57
J04-BR01	143.57	143.36	1.84	141.52	1.86	141.50	3.32	140.04	-0.66	144.02	2.23	141.13	-0.06	143.42
J04-BR02[5]	143.69	143.19	2.08	141.32	1.66	141.74	3.26	140.14	-0.21	143.61	2.79	140.61	-0.57	143.76
J05-BR01	142.30	150.13 [3]	1.82	140.30	1.58	140.54	11.34	138.79	7.75	142.38	11.20	138.93	7.95	142.18
J05-BR02	142.51	150.46 [3]	1.68	140.49	1.20	140.97	11.48	138.98	7.24	143.22	11.23	139.23	7.42	143.04
J06-UC01	158.02	160.73 [2]	12.82	144.98	-	146.32*	17.00	143.73	10.64	150.09	15.90	144.83	10.40	150.33
J06-UC02	158.02	157.69	13.82	143.87	12.53	145.16	15.01	142.68	8.79	148.90	14.11	143.58	8.72	148.97
J07-UC02	158.06	157.80	14.21	143.59	12.75	145.05	15.46	142.34	8.64	149.16	14.62	143.18	8.59	149.21
J08-UC01	158.10	160.77 [2]	14.99	142.87	-	144.54*	19.07	141.70	11.87	148.90	18.32	142.45	11.92	148.85
J08-UC02	158.10	157.84	14.94	142.90	13.25	144.59	16.14	141.70	8.91	148.93	15.36	142.48	9.00	148.84
J23-UC01	142.84	142.73	-	-	3.79	138.94	4.22	138.51	2.61	140.11	3.92	138.81	2.52	140.21
J23-UC02	142.97	142.55	-	-	3.20	139.35	4.50	138.05	1.53	141.01	3.52	139.03	2.14	140.41
MW-1D	142.94	144.69 [3]	2.00	140.34	2.56	139.78	6.40	138.29	3.30	141.39	5.81	138.88	3.49	141.20
MW-1S[5]	142.93	145.25	3.02	139.40	3.46	138.96	7.52	138.00	5.19	140.33	6.91	138.61	5.06	140.19
MW-2[5]	142.87	142.59	3.05	139.38	3.44	138.99	3.95	138.48	2.25	140.18	3.72	138.71	2.67	139.92
MW-2I[5]	142.76	142.49	2.55	140.01	3.01	139.55	4.02	138.54	1.20	141.36	3.48	139.08	1.55	140.94
RIZ-7	146.78	146.24	4.33	141.91	3.66	142.58	5.20	141.04	1.58	144.66	4.53	141.71	1.65	144.59
RIZ-19	158.00	157.57	13.94	143.63	12.34	145.23	14.87	142.70	8.11	149.46	14.31	143.26	8.07	149.50
RS-08	145.00	146.20	3.98	142.22	3.86	142.34	3.89	142.31	3.88	142.32	--	--	3.27	142.93
J04-PZ-IN	-	150.84 [3]	-	-	-	138.66*	13.73	137.11	11.80	139.04	14.75	136.09	12.50	138.34
J04-PZ-OUT	-	146.69	-	-	6.86	139.83	7.75	138.94	5.41	141.28	7.29	139.40	5.55	141.14
J05-PZ-IN	-	150.58	-	-	-	138.93*	13.72	136.86	11.51	139.07	15.65	134.93	12.32	138.26
J05-PZ-OUT	-	145.18	-	-	-	138.79*	7.27	137.91	4.62	140.56	6.80	138.38	4.70	140.48
J06-PZ-IN	-	160.92	-	-	-	141.78*	20.91	140.01	17.57	143.35	21.26	139.66	17.77	143.15
J07-PZ-IN	-	161.02	-	-	19.38	141.64	21.23	139.79	17.82	143.20	21.64	139.38	18.08	142.94
J07-PZ-OUT	-	160.97	-	-	-	145.23*	18.48	142.49	11.62	149.35	17.67	143.30	11.51	149.46
J08-PZ-IN	-	161.03	-	-	-	141.59*	21.33	139.70	17.98	143.05	21.75	139.28	18.24	142.79
J09-PZ-IN	-	160.79	-	-	-	140.36*	22.52	138.27	19.48	141.31	23.80	136.99	20.03	140.76
J09-PZ-OUT	-	160.87	-	-	-	142.72*	20.69	140.18	14.69	146.18	20.10	140.77	14.76	146.11
J10-PZ-IN	-	158.56 [3]	-	-	-	141.19*	19.03	139.53	16.01	142.55	19.32	139.24	16.18	142.38
J10-PZ-OUT	-	155.75	-	-	-	144.05*	13.74	142.01	8.69	147.06	13.02	142.73	8.66	147.09

Note:
1) Artesian conditions are indicated by negative depth relative to the measuring point, as determined by installation of temporary riser extensions.
2) Well casings in J06-UC01 & J08-UC01 were raised and resurveyed in December 2015.
3) Well casings in J04-PZ-IN, J05-BR01, J05-BR02, J10-PZ-IN, MW-1D, and MW-1S were raised and resurveyed in Fall 2016.
4) The J02 well cluster was resurveyed in December 2016.
5) Well casings were resurveyed in September 2017.
* = Water elevations are recorded from the groundwater treatment system PLC display and are calculated from pressure transducers located in each piezometer.

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2015-2018
Former Dennison Monarch Systems Site
New Windsor, New York

Structure Name	Ground Surface Elevation (ft AMSL)	Measuring Point Elevation (ft AMSL)	11/14/2015		6/16/2016		11/14/2016		5/1/2017		11/14/2017		5/15/2018	
			Depth Below Measuring Point (ft)	Potentiometric Elevation (ft. AMSL)	Depth Below Measuring Point (ft)	Potentiometric Elevation (ft. AMSL)	Depth Below Measuring Point (ft)	Potentiometric Elevation (ft. AMSL)	Depth Below Measuring Point (ft)	Potentiometric Elevation (ft. AMSL)	Depth Below Measuring Point (ft)	Potentiometric Elevation (ft. AMSL)	Depth Below Measuring Point (ft)	Potentiometric Elevation (ft. AMSL)
OU02 Monitoring Locations														
J12-BR01	136.70	140.02	3.54	136.48	3.39	136.63	4.09	135.93	1.90	138.12	3.70	136.32	2.12	137.90
J12-BR02	136.60	139.88	2.45	137.43	1.91	137.97	3.00	136.88	-0.18	140.06	2.60	137.28	0.15	139.73
J13-BR01	136.70	137.91	-0.02	137.93	-0.20	138.11	0.66	137.25	-1.78	139.69	0.32	137.59	-2.49	140.40
J13-BR02	136.40	137.93	0.15	137.78	-0.21	138.14	0.57	137.36	-2.06	139.99	0.44	137.49	-2.88	140.81
J13-UC02	136.50	138.38	1.79	136.59	1.73	136.65	2.28	136.10	0.25	138.13	1.99	136.39	0.77	137.61
J13-UC03	136.70	138.30	1.64	136.66	1.58	136.72	2.16	136.14	0.54	137.76	1.86	136.44	0.43	137.87
J16-UC01	133.90	135.09	2.07	133.02	2.42	132.67	2.46	132.63	1.11	133.98	1.94	133.15	1.14	133.95
J16-UC02	133.80	135.25	2.18	133.07	2.06	133.19	2.64	132.61	0.59	134.66	1.95	133.30	0.70	134.55
J18-UC02	136.61	136.36	4.91	131.45	4.83	131.53	5.14	131.22	3.32	133.04	4.57	131.79	3.32	133.04
J18-UC03	136.55	136.19	4.78	131.41	4.62	131.57	4.85	131.34	3.11	133.08	4.05	132.14	3.02	133.17
J19-UC01	138.10	140.57	8.86	131.71	8.62	131.95	9.09	131.48	6.91	133.66	8.50	132.07	6.99	133.58
J19-UC02	138.10	140.36	8.78	131.58	8.57	131.79	9.04	131.32	6.84	133.52	8.42	131.94	6.91	133.45
RS-02	134.00	133.36	3.26	130.10	3.32	130.04	3.31	130.05	-	-	--	--		
RS-04	134.00	137.68	4.67	133.01	4.68	133.00	4.68	133.00	4.59	133.09	4.60	133.08	4.62	133.06
RS-05	134.00	136.49	3.84	132.65	4.19	132.30	4.22	132.27	4.25	132.24	3.86	132.63	4.52	131.97
RS-06	136.00	138.90	4.76	134.14	Dry	Dry	Dry	Dry	4.76	134.14	Dry	Dry	4.90	134.00
RS-07	136.00	139.61	4.42	135.19	4.39	135.22	4.26	135.35	4.12	135.49	4.32	135.29	4.46	135.15
RS-16	142.00	-	-	-	-	-	Dry	Dry	-	-	--	--		
Monitoring Locations Outside of OU01 and OU02														
J11-BR01[5]	143.79	143.17	4.50	138.86	4.04	139.32	5.50	137.86	1.97	141.39	5.16	138.20	3.09	140.08
J11-BR02[5]	144.05	143.18	4.96	138.78	4.41	139.33	5.89	137.85	2.80	140.94	4.02	139.72	3.49	139.69
J11-UC01[5]	143.56	142.86	4.58	138.60	5.72	137.46	6.41	136.77	3.42	139.76	5.40	137.78	2.31	140.55
J11-UC02[5]	143.70	143.06	5.58	137.78	5.36	138.00	6.40	136.96	3.40	139.96	5.85	137.51	2.07	140.99
J14-BR01[5]	142.01	141.48	4.68	137.02	4.32	137.38	5.18	136.52	2.91	138.79	4.34	137.36	2.79	138.69
J14-BR02[5]	141.97	141.53	4.57	137.16	4.32	137.41	4.95	136.78	2.85	138.88	4.37	137.36	2.72	138.81
J14-UC01[5]	141.81	141.21	4.52	137.01	4.30	137.23	5.04	136.49	2.75	138.78	4.13	137.40	2.57	138.64
J14-UC02[5]	141.63	141.06	4.32	136.99	4.15	137.16	4.81	136.50	2.54	138.77	4.00	137.31	2.42	138.64
J15-UC01	135.60	137.55	1.95	135.60	3.25	134.30	3.15	134.40	1.24	136.31	2.00	135.55	1.09	136.46
J15-UC02	135.50	136.33	3.11	133.22	2.98	133.35	3.52	132.81	1.32	135.01	2.85	133.48	1.44	134.89
J17-UC01	136.20	135.88	3.75	132.13	4.13	131.75	4.32	131.56	3.50	132.38	3.70	132.18	3.49	132.39
J17-UC02	135.92	135.54	3.55	131.99	3.55	131.99	3.90	131.64	2.17	133.37	3.20	132.34	2.18	133.36
J17-BR01	136.10	135.48	3.30	132.18	3.27	132.21	3.52	131.96	1.86	133.62	2.74	132.74	1.91	133.57
J17-BR02[5]	136.10	135.73	NM	-	3.65	132.00	3.48	132.17	1.75	133.90	2.95	132.70	1.80	133.93
J20-BR01	136.90	138.81	26.22	112.59	26.40	112.41	26.50	112.31	25.27	113.54	25.86	112.95	25.10	113.71
J20-BR02	136.90	138.88	18.80	120.08	18.44	120.44	19.05	119.83	17.43	121.45	18.57	120.31	17.53	121.35
J20-UC01	136.50	138.83	13.94	124.89	13.88	124.95	13.99	124.84	12.85	125.98	13.63	125.20	12.67	126.16
J20-UC02	136.30	138.66	13.80	124.86	13.72	124.94	13.84	124.82	12.69	125.97	13.48	125.18	12.51	126.15
J21-UC01	141.90	145.09	16.76	128.33	16.73	128.36	16.91	128.18	15.49	129.60	16.45	128.64	15.50	129.59
J21-UC02	141.20	144.80	16.42	128.38	16.34	128.46	16.51	128.29	15.22	129.58	16.07	128.73	15.12	129.68
J22-BR01	139.40	142.04	9.48	132.56	9.15	132.89	9.77	132.27	7.32	134.72	9.18	132.86	7.44	134.60
J22-BR02	139.50	142.02	8.96	133.06	8.53	133.49	9.26	132.76	6.55	135.47	8.67	133.35	6.70	135.32
RS-01	120.00	122.74	5.03	117.71	5.25	117.49	5.33	117.41	5.22	117.52	5.35	117.39	5.29	117.45
RS-03	132.00	136.00	3.28	132.72	NM	-	3.69	132.31	-	-	--	--		
RS-12A	115.30	118.78			3.70		3.59	115.19	-	-	3.69	115.09	3.85	114.93

Note:
1) Artesian conditions are indicated by negative depth relative to the measuring point, as determined by installation of temporary riser extensions.
2) Well casings in J06-UC01 & J08-UC01 were raised and resurveyed in December 2015.
3) Well casings in J04-PZ-IN, J05-BR01, J05-BR02, J10-PZ-IN, MW-1D, and MW-1S were raised and resurveyed in Fall 2016.
4) The J02 well cluster was resurveyed in December 2016.
5) Well casings were resurveyed in September 2017.
* = Water elevations are recorded from the groundwater treatment system PLC display and are calculated from pressure transducers located in each piezometer.

Table 4-2: Estimated Groundwater Velocities and Travel Times

Former Dennison/Monarch Systems Site

Operable Unit 02

New Windsor, New York

Shallow Unconsolidated Deposits					
Horizontal Hydraulic Gradient[1] (ft/ft)	Hydraulic Conductivity[2] (cm/sec)	Approximate Horizontal Velocity[3] (ft/year)	Estimated Groundwater Travel Time from OU01 to J13[4] (years)	Estimated Groundwater Travel Time from OU01 to J16[4] (years)	Estimated Groundwater Travel Time from OU01 to J18[4] (years)
0.01	3.7E-03	130	3	7	10
0.0075	3.7E-03	95	4	9	14
0.005	3.7E-03	65	6	13	20
Deep Unconsolidated Deposits					
Horizontal Hydraulic Gradient[1] (ft/ft)	Hydraulic Conductivity[2] (cm/sec)	Approximate Horizontal Velocity[3] (ft/year)	Estimated Groundwater Travel Time from OU01 to J13[4] (years)	Estimated Groundwater Travel Time from OU01 to J16[4] (years)	Estimated Groundwater Travel Time from OU01 to J18[4] (years)
0.01	6.9E-04	24	15	35	55
0.0075	6.9E-04	18	20	45	75
0.005	6.9E-04	12	30	70	110

Notes

[1]Horizontal hydrualic gradients were selected based on 2017 and 2018 water level data.

[2]Hydraulic conductivity values were reported in the PDI (JCO, 2008).

[3]Groundwater velocities are calculated using the method described in the PDI (JCO, 2008) using a porosity of 0.30.

[4]Groundwater travel times from OU01 to J13, J16, and J18 monitoring locations are determined by dividing the distance from OU01 to each monitoring location by the apporximate horizontal groundwater velocity.

Table 4-3: Spring 2018 Groundwater Analytical Results

Former Dennison/Monarch Systems Site

Operable Unit 2

New Windsor, New York

		Sample Location ID:	J01-UC01	J01-UC02	J02-UC01	J06-UC01	J06-UC02	J07-UC02	J08-UC01	J08-UC02	J23-UC01	J23-UC02	MW-1D	MW-1S	MW-1S(DUP)
		Date:	5/16/2018	5/16/2018	5/18/2018	5/16/2018	5/18/2018	5/16/2018	5/15/2018	5/15/2018	5/21/2018	5/21/2018	5/20/2018	5/20/2018	5/20/2018
		Operable Unit:	OU01	OU01	OU01	OU01	OU01	OU01	OU01	OU01	OU01	OU01	OU01	OU01	OU01
Compound	**NYSDEC Standard**	**Source of Standard**	UC	UC	UC	UC	UC	UC	UC	UC	UC	UC	UC	UC	UC
OU02 Constituents of Concern															
1,1,1-Trichloroethane	5	POC	3	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	280	250	ND < 0.5	ND < 0.5	ND < 0.5
1,1-Dichloroethane	5	POC	0.5 J	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	2	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5
1,2-Dichloroethane	0.6	GA Standard	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5
1,1-Dichloroethene	5	POC	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	25	14	ND < 0.5	ND < 0.5	ND < 0.5
Tetrachloroethene	5	POC	13	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	4	5	ND < 0.5	ND < 0.5	ND < 0.5
Trichloroethene	5	POC	5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	0.8 J	0.9 J	2	420	520	ND < 0.5	ND < 0.5	ND < 0.5
cis-1,2-Dichloroethene	5	POC	1	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	2	1 J	ND < 0.5	ND < 0.5	ND < 0.5
Vinyl chloride	2	GA Standard	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5
Other Target Analyte List Compounds															
Acetone	50	GA Guidance	ND < 6	ND < 6	ND < 6	ND < 6	ND < 6	ND < 6	ND < 6	ND < 6	ND < 6	ND < 6	ND < 6	ND < 6	ND < 6
Benzene	1	GA Standard	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5
Carbon disulfide	120	GA Standard	ND < 1	ND < 1	ND < 1	ND < 1	ND < 1	ND < 1	ND < 1	ND < 1	ND < 1	ND < 1	ND < 1	ND < 1	ND < 1
Chloroform	7	GA Standard	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5
1,2-Dichlorobenzene	3	GA Standard	ND < 1	ND < 1	ND < 1	ND < 1	ND < 1	ND < 1	ND < 1	ND < 1	ND < 1	ND < 1	ND < 1	ND < 1	ND < 1
Dichloromethane	5	GA Standard	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5
Ethyl benzene	5	POC	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5
Freon-113	5	POC	ND < 2	ND < 2	ND < 2	ND < 2	ND < 2	ND < 2	ND < 2	ND < 2	ND < 2	ND < 2	ND < 2	ND < 2	ND < 2
2-Butanone (MEK)	50	GA Guidance	ND < 3	ND < 3	ND < 3	ND < 3	ND < 3	ND < 3	ND < 3	ND < 3	ND < 3	ND < 3	ND < 3	ND < 3	ND < 3
Naphthalene	10	GA Guidance	ND < 1	ND < 1	ND < 1	ND < 1	ND < 1	ND < 1	ND < 1	ND < 1	ND < 1	ND < 1	ND < 1	ND < 1	ND < 1
Toluene	5	POC	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5
m&p-Xylene	5*	POC	--	--	--	--	--	--	--	--	--	--	--	--	--
o-Xylene	5	POC	--	--	--	--	--	--	--	--	--	--	--	--	--
Total Xylenes	5	POC	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5
1,4-Dioxane	NS	NS	ND < 0.2	0.2 J	ND < 0.2	ND < 0.2	ND < 0.2	ND < 0.2	ND < 0.2	ND < 0.2	0.6 J	ND < 0.4	ND < 0.2	ND < 0.2	ND < 0.2

Notes:

1. ND < ## = Compound not detected above laboratory Method Detection Limit (MDL), limit provided.
2. J = Value is estimated by the laboratory.
3. POC = NYSDEC Classification "Principal Organic Contaminant" for groundwater.
4. GA Standard = NYSDEC GA Standard.
5. GA Guidance = NYSDEC GA Guidance Value.
6. "--" = Compound not analyzed.
7. UC = Unconsolidated Deposits.
8. All values in ug/L.
9. NS indicates No Standard

* Standard applies separately to each isomer (i.e., m-Xylene and p-Xylene).

Table 4-3: Spring 2018 Groundwater Analytical Results
Former Dennison/Monarch Systems Site
Operable Unit 2
New Windsor, New York

		Sample Location ID:	MW-2	MW-2-DUP	MW-2I	RIZ-7	RIZ-19	J01-BR01	J01-BR02	J02-BR01	J02-BR02	J04-BR01	J04-BR02	J05-BR01	J05-BR02	J05-BR02(DUP)
		Date:	5/22/2018	5/22/2018	5/22/2018	5/20/2018	5/21/2018	5/16/2018	5/16/2018	5/18/2018	5/18/2018	5/16/2018	5/16/2018	5/18/2018	5/18/2018	5/18/2018
		Operable Unit:	OU01	OU01	OU01	OU01	OU01	OU01	OU01	OU01	OU01	OU01	OU01	OU01	OU01	OU01
Compound	NYSDEC Standard	Source of Standard	UC	UC	UC	UC	UC	Bedrock	Bedrock	Bedrock	Bedrock	Bedrock	Bedrock	Bedrock	Bedrock	Bedrock
OU02 Constituents of Concern																
1,1,1-Trichloroethane	5	POC	95	96	4	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	2	2
1,1-Dichloroethane	5	POC	3	3	0.9 J	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	2	3	3
1,2-Dichloroethane	0.6	GA Standard	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5
1,1-Dichloroethene	5	POC	9	10	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	0.6 J	0.6 J
Tetrachloroethene	5	POC	3	3	ND < 0.5	0.8 J	0.8 J	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5
Trichloroethene	5	POC	310	310	8	1	6	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	14	14
cis-1,2-Dichloroethene	5	POC	22	22	1	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5
Vinyl chloride	2	GA Standard	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5
Other Target Analyte List Compounds																
Acetone	50	GA Guidance	ND < 6	ND < 6	ND < 6	ND < 6	ND < 6	ND < 6	ND < 6	ND < 6	ND < 6	ND < 6	ND < 6	ND < 6	ND < 6	ND < 6
Benzene	1	GA Standard	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5
Carbon disulfide	120	GA Standard	ND < 1	ND < 1	ND < 1	ND < 1	ND < 1	ND < 1	ND < 1	ND < 1	ND < 1	ND < 1	ND < 1	ND < 1	ND < 1	ND < 1
Chloroform	7	GA Standard	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5
1,2-Dichlorobenzene	3	GA Standard	ND < 1	ND < 1	ND < 1	ND < 1	ND < 1	ND < 1	ND < 1	ND < 1	ND < 1	ND < 1	ND < 1	ND < 1	ND < 1	ND < 1
Dichloromethane	5	GA Standard	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5
Ethyl benzene	5	POC	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5
Freon-113	5	POC	ND < 2	ND < 2	ND < 2	ND < 2	ND < 2	ND < 2	ND < 2	ND < 2	ND < 2	ND < 2	ND < 2	ND < 2	ND < 2	ND < 2
2-Butanone (MEK)	50	GA Guidance	ND < 3	ND < 3	ND < 3	ND < 3	ND < 3	ND < 3	ND < 3	ND < 3	ND < 3	ND < 3	ND < 3	ND < 3	ND < 3	ND < 3
Naphthalene	10	GA Guidance	ND < 1	ND < 1	ND < 1	ND < 1	ND < 1	ND < 1	ND < 1	ND < 1	ND < 1	ND < 1	ND < 1	ND < 1	ND < 1	ND < 1
Toluene	5	POC	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5
m&p-Xylene	5*	POC	--	--	--	--	--	--	--	--	--	--	--	--	--	--
o-Xylene	5	POC	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total Xylenes	5	POC	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5
1,4-Dioxane	NS	NS	0.2 J	0.2 J	ND < 0.2	ND < 0.2	ND < 0.2	ND < 0.2	ND < 0.2	ND < 0.2	ND < 0.2	ND < 0.2	ND < 0.2	ND < 0.2	ND < 0.2	ND < 0.2

Notes:
1. ND < ## = Compound not detected above laboratory Method Detection Limit (MDL), limit provided.
2. J = Value is estimated by the laboratory.
3. POC = NYSDEC Classification "Principal Organic Contaminant" for groundwater.
4. GA Standard = NYSDEC GA Standard.
5. GA Guidance = NYSDEC GA Guidance Value.
6. "--" = Compound not analyzed.
7. UC = Unconsolidated Deposits.
8. All values in ug/L.
9. NS indicates No Standard
* Standard applies separately to each isomer (i.e., m-Xylene and p-Xylene).

Table 4-3: Spring 2018 Groundwater Analytical Results
Former Dennison/Monarch Systems Site
Operable Unit 2
New Windsor, New York

		Sample Location ID:	J13-UC02	J13-UC03	J16-UC01	J16-UC02	J18-UC02	J18-UC03	J19-UC01	J19-UC02	J12-BR01	J12-BR02	J13-BR01	J13-BR02
		Date:	5/17/2018	5/17/2018	5/16/2018	5/16/2018	5/17/2018	5/18/2018	5/18/2018	5/19/2018	5/17/2018	5/17/2018	5/17/2018	5/17/2018
		Operable Unit:	OU02	OU02	OU02	OU02	OU02	OU02	OU02	OU02	OU02	OU02	OU02	OU02
Compound	**NYSDEC Standard**	**Source of Standard**	UC	UC	UC	UC	UC	UC	UC	UC	Bedrock	Bedrock	Bedrock	Bedrock
OU02 Constituents of Concern														
1,1,1-Trichloroethane	5	POC	19	4	17	19	25	4	ND < 0.5	1	ND < 0.5	ND < 0.5	2	ND < 0.5
1,1-Dichloroethane	5	POC	1	2	0.6 J	1	ND < 0.5	ND < 0.5	ND < 0.5	0.6 J	ND < 0.5	ND < 0.5	4	ND < 0.5
1,2-Dichloroethane	0.6	GA Standard	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5
1,1-Dichloroethene	5	POC	2 J	ND < 0.5	1	1	1	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	1 J	ND < 0.5
Tetrachloroethene	5	POC	2	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5
Trichloroethene	5	POC	170	0.9 J	32	36	36	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	5	ND < 0.5
cis-1,2-Dichloroethene	5	POC	0.8 J	ND < 0.5	0.6 J	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5
Vinyl chloride	2	GA Standard	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5
Other Target Analyte List Compounds														
Acetone	50	GA Guidance	ND < 6	ND < 6	ND < 6	ND < 6	ND < 6	ND < 6	ND < 6	ND < 6	ND < 6	ND < 6	ND < 6	ND < 6
Benzene	1	GA Standard	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5
Carbon disulfide	120	GA Standard	ND < 1	ND < 1	ND < 1	ND < 1	ND < 1	ND < 1	ND < 1	ND < 1	ND < 1	ND < 1	ND < 1	ND < 1
Chloroform	7	GA Standard	ND < 0.5	ND < 0.5	0.7 J	ND < 0.5	0.6 J	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5
1,2-Dichlorobenzene	3	GA Standard	ND < 1	ND < 1	ND < 1	ND < 1	ND < 1	ND < 1	ND < 1	ND < 1	ND < 1	ND < 1	ND < 1	ND < 1
Dichloromethane	5	GA Standard	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5
Ethyl benzene	5	POC	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5
Freon-113	5	POC	ND < 2	ND < 2	ND < 2	ND < 2	ND < 2	ND < 2	ND < 2	ND < 2	ND < 2	ND < 2	ND < 2	ND < 2
2-Butanone (MEK)	50	GA Guidance	ND < 3	ND < 3	ND < 3	ND < 3	ND < 3	ND < 3	ND < 3	ND < 3	ND < 3	ND < 3	ND < 3	ND < 3
Naphthalene	10	GA Guidance	ND < 1	ND < 1	ND < 1	ND < 1	ND < 1	ND < 1	ND < 1	ND < 1	ND < 1	ND < 1	ND < 1	ND < 1
Toluene	5	POC	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5
m&p-Xylene	5*	POC	--	--	--	--	--	--	--	--	--	--	--	--
o-Xylene	5	POC	--	--	--	--	--	--	--	--	--	--	--	--
Total Xylenes	5	POC	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5
1,4-Dioxane	NS	NS	1.1	4.9	ND < 0.2	0.3 J	0.3 J	0.4	ND < 0.2	ND < 0.2	ND < 0.2	ND < 0.2	2.8	ND < 0.2

Notes:
1. ND < ## = Compound not detected above laboratory Method Detection Limit (MDL), limit provided.
2. J = Value is estimated by the laboratory.
3. POC = NYSDEC Classification "Principal Organic Contaminant" for groundwater.
4. GA Standard = NYSDEC GA Standard.
5. GA Guidance = NYSDEC GA Guidance Value.
6. "--" = Compound not analyzed.
7. UC = Unconsolidated Deposits.
8. All values in ug/L.
9. NS indicates No Standard
* Standard applies separately to each isomer (i.e., m-Xylene and p-Xylene).

Table 4-3: Spring 2018 Groundwater Analytical Results

Former Dennison/Monarch Systems Site

Operable Unit 2

New Windsor, New York

		Sample Location ID:	J11-UC01	J11-UC02	J14-UC01	J14-UC02	J15-UC01	J15-UC02	J17-UC01	J17-UC02	J20-UC01	J20-UC02	J21-UC01	J21-UC02
		Date:	5/21/2018	5/21/2018	5/20/2018	5/20/2018	5/17/2018	5/17/2018	5/19/2018	5/19/2018	5/17/2018	5/19/2018	5/18/2018	5/18/2018
		Operable Unit:	Outside OU02	Outside OU02	Outside OU02	Outside OU02	Outside OU02	Outside OU02	Outside OU02	Outside OU02	Outside OU02	Outside OU02	Outside OU02	Outside OU02
Compound	**NYSDEC Standard**	**Source of Standard**	UC	UC	UC	UC	UC	UC	UC	UC	UC	UC	UC	UC
OU02 Constituents of Concern														
1,1,1-Trichloroethane	5	POC	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5
1,1-Dichloroethane	5	POC	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	1	ND < 0.5	ND < 0.5
1,2-Dichloroethane	0.6	GA Standard	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5
1,1-Dichloroethene	5	POC	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5
Tetrachloroethene	5	POC	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5
Trichloroethene	5	POC	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	0.8 J	ND < 0.5	0.7 J	ND < 0.5
cis-1,2-Dichloroethene	5	POC	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	0.7 J	ND < 0.5	ND < 0.5
Vinyl chloride	2	GA Standard	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5
Other Target Analyte List Compounds														
Acetone	50	GA Guidance	ND < 6	ND < 6	ND < 6	ND < 6	ND < 6	ND < 6	ND < 6	ND < 6	ND < 6	ND < 6	ND < 6	ND < 6
Benzene	1	GA Standard	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5
Carbon disulfide	120	GA Standard	ND < 1	ND < 1	ND < 1	ND < 1	ND < 1	ND < 1	ND < 1	ND < 1	ND < 1	ND < 1	ND < 1	ND < 1
Chloroform	7	GA Standard	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	1	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5
1,2-Dichlorobenzene	3	GA Standard	ND < 1	ND < 1	ND < 1	ND < 1	ND < 1	ND < 1	ND < 1	ND < 1	ND < 1	ND < 1	ND < 1	ND < 1
Dichloromethane	5	GA Standard	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5
Ethyl benzene	5	POC	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5
Freon-113	5	POC	ND < 2	ND < 2	ND < 2	ND < 2	ND < 2	ND < 2	ND < 2	ND < 2	ND < 2	ND < 2	ND < 2	ND < 2
2-Butanone (MEK)	50	GA Guidance	ND < 3	ND < 3	ND < 3	ND < 3	ND < 3	ND < 3	ND < 3	ND < 3	ND < 3	ND < 3	ND < 3	ND < 3
Naphthalene	10	GA Guidance	ND < 1	ND < 1	ND < 1	ND < 1	ND < 1	ND < 1	ND < 1	ND < 1	ND < 1	ND < 1	ND < 1	ND < 1
Toluene	5	POC	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5
m&p-Xylene	5*	POC	--	--	--	--	--	--	--	--	--	--	--	--
o-Xylene	5	POC	--	--	--	--	--	--	--	--	--	--	--	--
Total Xylenes	5	POC	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5
1,4-Dioxane	NS	NS	ND < 0.2	ND < 0.2	ND < 0.2	ND < 0.2	ND < 0.2	ND < 0.2	0.3 J	ND < 0.2	ND < 0.2	ND < 0.2	ND < 0.2	ND < 0.2

Notes:

1. ND < ## = Compound not detected above laboratory Method Detection Limit (MDL), limit provided.
2. J = Value is estimated by the laboratory.
3. POC = NYSDEC Classification "Principal Organic Contaminant" for groundwater.
4. GA Standard = NYSDEC GA Standard.
5. GA Guidance = NYSDEC GA Guidance Value.
6. "--" = Compound not analyzed.
7. UC = Unconsolidated Deposits.
8. All values in ug/L.
9. NS indicates No Standard

* Standard applies separately to each isomer (i.e., m-Xylene and p-Xylene).

Table 4-3: Spring 2018 Groundwater Analytical Results
Former Dennison/Monarch Systems Site
Operable Unit 2
New Windsor, New York

		Sample Location ID:	J11-BR01	J11-BR02	J14-BR01	J14-BR02	J17-BR01	J20-BR01	J20-BR02	J22-BR01	J22-BR02
		Date:	5/21/2018	5/21/2018	5/20/2018	5/20/2018	5/19/2018	5/19/2018	5/17/2018	5/16/2018	5/16/2018
		Operable Unit:	Outside OU02	Outside OU02	Outside OU02	Outside OU02	Outside OU02	Outside OU02	Outside OU02	Outside OU02	Outside OU02
Compound	**NYSDEC Standard**	**Source of Standard**	Bedrock	Bedrock	Bedrock	Bedrock	Bedrock	Bedrock	Bedrock	Bedrock	Bedrock
OU02 Constituents of Concern											
1,1,1-Trichloroethane	5	POC	ND < 0.5	ND < 0.5	5	ND < 0.5	ND < 0.5	ND < 0.5	1	ND < 0.5	ND < 0.5
1,1-Dichloroethane	5	POC	ND < 0.5	ND < 0.5	0.9 J	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5
1,2-Dichloroethane	0.6	GA Standard	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5
1,1-Dichloroethene	5	POC	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5
Tetrachloroethene	5	POC	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5
Trichloroethene	5	POC	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5
cis-1,2-Dichloroethene	5	POC	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5
Vinyl chloride	2	GA Standard	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5
Other Target Analyte List Compounds											
Acetone	50	GA Guidance	ND < 6	ND < 6	ND < 6	ND < 6	ND < 6	ND < 6	ND < 6	ND < 6	ND < 6
Benzene	1	GA Standard	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5
Carbon disulfide	120	GA Standard	ND < 1	ND < 1	ND < 1	ND < 1	ND < 1	ND < 1	ND < 1	ND < 1	ND < 1
Chloroform	7	GA Standard	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5
1,2-Dichlorobenzene	3	GA Standard	ND < 1	ND < 1	ND < 1	ND < 1	ND < 1	ND < 1	ND < 1	ND < 1	ND < 1
Dichloromethane	5	GA Standard	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5
Ethyl benzene	5	POC	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5
Freon-113	5	POC	ND < 2	ND < 2	ND < 2	ND < 2	ND < 2	ND < 2	ND < 2	ND < 2	ND < 2
2-Butanone (MEK)	50	GA Guidance	ND < 3	ND < 3	ND < 3	ND < 3	ND < 3	ND < 3	ND < 3	ND < 3	ND < 3
Naphthalene	10	GA Guidance	ND < 1	ND < 1	ND < 1	ND < 1	ND < 1	ND < 1	ND < 1	ND < 1	ND < 1
Toluene	5	POC	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5
m&p-Xylene	5*	POC	--	--	--	--	--	--	--	--	--
o-Xylene	5	POC	--	--	--	--	--	--	--	--	--
Total Xylenes	5	POC	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5
1,4-Dioxane	NS	NS	ND < 0.2	ND < 0.2	0.2 J	ND < 0.2	ND < 0.2	ND < 0.2	ND < 0.2	ND < 0.2	ND < 0.2

Notes:
1. ND < ## = Compound not detected above laboratory Method Detection Limit (MDL), limit provided.
2. J = Value is estimated by the laboratory.
3. POC = NYSDEC Classification "Principal Organic Contaminant" for groundwater.
4. GA Standard = NYSDEC GA Standard.
5. GA Guidance = NYSDEC GA Guidance Value.
6. "--" = Compound not analyzed.
7. UC = Unconsolidated Deposits.
8. All values in ug/L.
9. NS indicates No Standard
* Standard applies separately to each isomer (i.e., m-Xylene and p-Xylene).

Table 4-4: Spring 2018 Sediment Porewater Analytical Results
Former Dennison/Monarch Systems Site
New Windsor, New York

		Sample Location ID:	DIFF-01	DIFF-01	DIFF-02	DIFF-03	DIFF-04	DIFF-05	DIFF-06	DIFF-07
		Date:	5/30/2018	5/30/2018	5/30/2018	5/30/2018	5/30/2018	5/29/2018	5/29/2018	5/29/2018
		Operable Unit:	OU02	OU02	OU02	OU02	OU02	OU02	Outside of OU02	Outside of OU02
Compound	**NYSDEC Groundwater Standard**	**Source of Standard**		Duplicate						
OU02 Contaminants of Concern										
1,1,1-Trichloroethane	5	POC	0.6 J	2	0.8 J	ND < 0.5	ND < 0.5	5	0.7 J	ND < 0.5
1,1-Dichloroethane	5	POC	2	2	7	0.6 J	3	1	ND < 0.5	1
trans-1,2-Dichloroethene	5	POC	ND < 0.5	ND < 0.5	0.8 J	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5
1,1-Dichloroethene	5	POC	ND < 0.5	ND < 0.5	0.6 J	ND < 0.5	ND < 0.5	0.6 J	ND < 0.5	ND < 0.5
Tetrachloroethene	5	POC	0.6 J	0.7 J	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5
Trichloroethene	5	POC	0.6 J	0.7 J	3	ND < 0.5	ND < 0.5	5	ND < 0.5	ND < 0.5
cis-1,2-Dichloroethene	5	POC	1 J	2	23	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5
Vinyl chloride	2	GA Standard	ND < 0.5	0.6 J	15	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5
Other Target Analyte List Compounds										
Acetone	50	GA Guidance	ND < 6	ND < 6	ND < 6	ND < 6	ND < 6	ND < 6	ND < 6	ND < 6
Carbon disulfide	120	GA Standard	ND < 1	ND < 1	ND < 1	ND < 1	ND < 1	ND < 1	ND < 1	ND < 1
Freon-113	5	POC	ND < 2	ND < 2	ND < 2	ND < 2	ND < 2	ND < 2	ND < 2	ND < 2
2-Butanone (MEK)	50	GA Guidance	ND < 3	ND < 3	ND < 3	ND < 3	ND < 3	ND < 3	ND < 3	ND < 3
Toluene	5	POC	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5
Total Xylenes	5	POC	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5

Notes:
1. ND < ## = Compound not detected above Laboratory Method Detection Limit (MDL), limit provided.
2. J = Indicates value is estimated by the laboratory.
3. All values shown in ug/L.
4. "--" Compound not
5. POC = NYSDEC Classification "Principal Organic Contaminant" for groundwater.
6. GA Standard = NYSDEC GA Standard.
7. GA Guidance = NYSDEC GA Guidance Value.

Table 4-5: Spring 2018 Surface Water Analytical Results
Former Dennison/Monarch Systems Facility
New Windsor, New York

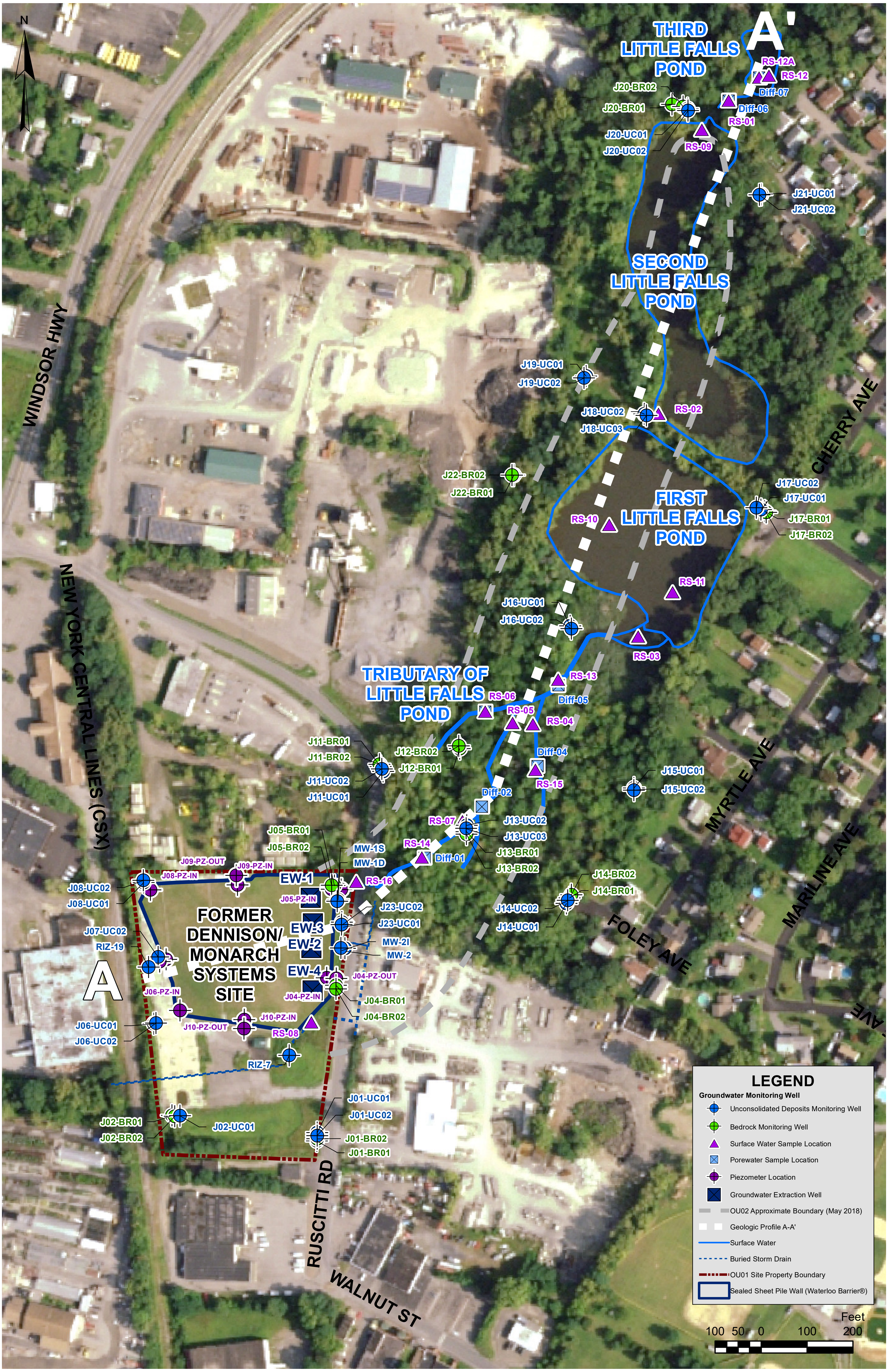
	Sample Location ID:	RS-08	RS-16	RS-02	RS-04	RS-05	RS-06	RS-07	RS-10	RS-13
	Date:	5/15/2018	5/15/2018	5/15/2018	5/15/2018	5/15/2018	5/15/2018	5/15/2018	5/15/2018	5/15/2018
	Operable Unit:	OU01	OU01	OU02	OU02	OU02	OU02	OU02	OU02	OU02
Compound	**NYSDEC Class C Standard or Guidance Value**									
OU02 Contaminants of Concern										
1,1,1-Trichloroethane	-	ND < 0.5	ND < 0.5	0.5 J	4	4	ND < 0.5	0.6 J	ND < 0.5	3
1,1-Dichloroethane	-	ND < 0.5	ND < 0.5	ND < 0.5	0.7 J	0.8 J	ND < 0.5	0.5 J	ND < 0.5	0.8 J
trans-1,2-Dichloroethene	-	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5
1,1-Dichloroethene	-	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5
Tetrachloroethene	1*	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	2	ND < 0.5	1	ND < 0.5	1
Trichloroethene	40	ND < 0.5	ND < 0.5	2	6	14	ND < 0.5	1	0.7 J	12
cis-1,2-Dichloroethene	-	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	1	ND < 0.5	1	ND < 0.5	1
Vinyl Chloride	-	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5
Other Target Analyte List Compounds										
Acetone	-	ND < 6	ND < 6	ND < 6	ND < 6	ND < 6	ND < 6	ND < 6	ND < 6	ND < 6
Methylene Chloride	200	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5
2-Butanone	-	ND < 3	ND < 3	ND < 3	ND < 3	ND < 3	ND < 3	ND < 3	3 J	ND < 3
Toluene	6000	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	96	ND < 0.5
1,4-Dioxane	-	ND < 70	ND < 70	ND < 70	ND < 70	ND < 70	ND < 70	ND < 70	ND < 70	ND < 70

Notes:
1. "-" = No Class C NYSDEC Standard or Guidance Value.
2. ND < ## = Compound not detected above laboratory Detection Limit (MDL).
3. J = indicates value is estimated by the laboratory.
4. All values in ug/L.

Table 4-5: Spring 2018 Surface Water Analytical Results
Former Dennison/Monarch Systems Facility
New Windsor, New York

	Sample Location ID:	RS-14	RS-15	RS-01	RS-03	RS-03(DUP)	RS-09	RS-11	RS-12A
	Date:	5/15/2018	5/15/2018	5/15/2018	5/15/2018	5/15/2018	5/15/2018	5/15/2018	5/15/2018
	Operable Unit:	OU02	OU02	Outside of OU02	Outside of OU02	Outside of OU02	Outside of OU02	Outside of OU02	Outside of OU02
Compound	**NYSDEC Class C Standard or Guidance Value**								
OU02 Contaminants of Concern									
1,1,1-Trichloroethane	-	ND < 0.5	2	ND < 0.5	3	3	ND < 0.5	ND < 0.5	ND < 0.5
1,1-Dichloroethane	-	ND < 0.5	0.5 J	ND < 0.5	0.7 J	0.7 J	ND < 0.5	ND < 0.5	ND < 0.5
trans-1,2-Dichloroethene	-	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5
1,1-Dichloroethene	-	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5
Tetrachloroethene	1*	2	ND < 0.5	ND < 0.5	1	1	ND < 0.5	ND < 0.5	ND < 0.5
Trichloroethene	40	1	ND < 0.5	0.8 J	12	11	1	ND < 0.5	ND < 0.5
cis-1,2-Dichloroethene	-	ND < 0.5	ND < 0.5	ND < 0.5	1	1 J	ND < 0.5	ND < 0.5	ND < 0.5
Vinyl Chloride	-	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5
Other Target Analyte List Compounds									
Acetone	-	ND < 6	ND < 6	ND < 6	ND < 6	ND < 6	ND < 6	7 J	ND < 6
Methylene Chloride	200	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5
2-Butanone	-	ND < 3	ND < 3	ND < 3	ND < 3	ND < 3	ND < 3	ND < 3	ND < 3
Toluene	6000	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	ND < 0.5	0.9 J	ND < 0.5
1,4-Dioxane	-	ND < 70	ND < 70	ND < 70	ND < 70	ND < 70	ND < 70	ND < 70	ND < 70

Notes:
1. "-" = No Class C NYSDEC Standard or Guidance Value.
2. ND < ## = Compound not detected above laboratory Detection Limit (MDL).
3. J = indicates value is estimated by the laboratory.
4. All values in ug/L.



Sources:
Aerial photo taken in August 2017 (USDA Farm Service Agency - NAIP).

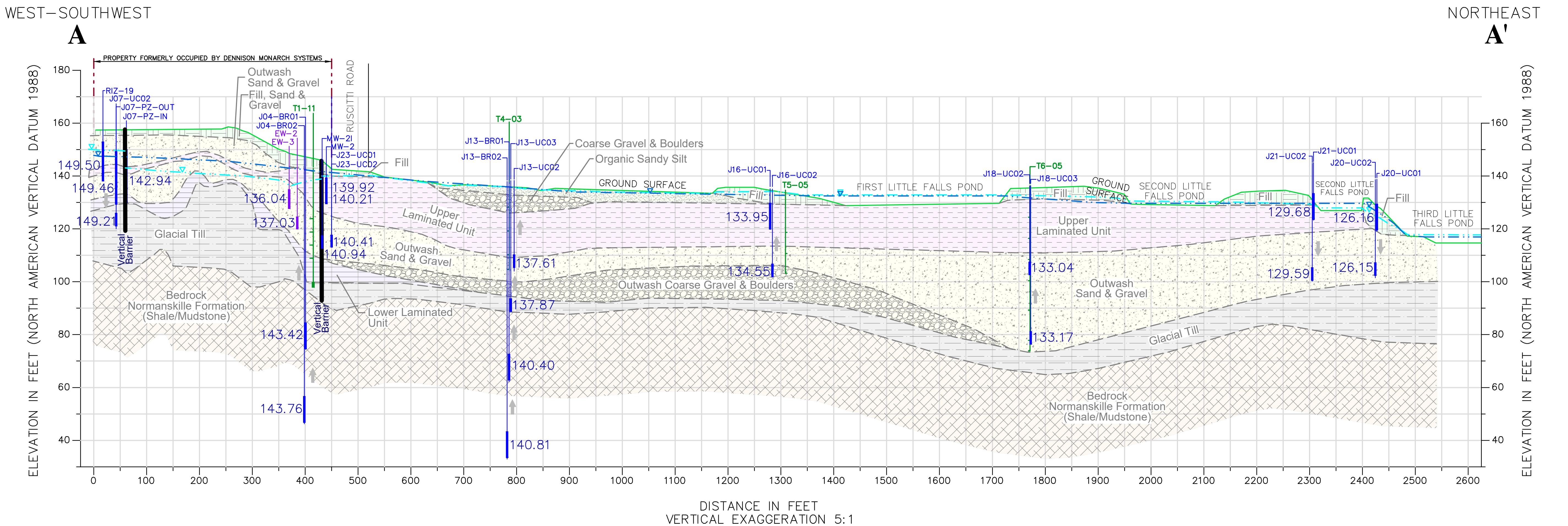
FIGURE 4-1: GEOLOGIC CROSS SECTION A-A' LOCATION
FORMER DENNISON/MONARCH SYSTEMS SITE
NEW WINDSOR, NEW YORK

vhb

VHB Engineering, Surveying, Landscape and Geology, P.C.
100 Great Oaks Boulevard, Suite 118, Albany, NY 12203

Drawn by: TEH Date: 12/08/18
Reviewed by: GWL Date: 06/26/19
Scale: As Shown Project: 58300.00

GEOLOGIC CROSS SECTION A-A'



KEY

- FILL, SAND, AND GRAVEL
- ORGANIC SILTY SAND
- UPPER LAMINATED UNIT
- OUTWASH SAND AND GRAVEL
- OUTWASH GRAVEL AND BOULDERS
- LOWER LAMINATED UNIT
- GLACIAL TILL
- BEDROCK

KEY TO RECONAISSANCE SAMPLING LOCATIONS

SAMPLE ID T1-11

GEOPROBE SAMPLE

PROFILER SAMPLE

KEY TO MONITORING WELL LOCATIONS

WELL ID J13-UC02

DIRECTION OF VERTICAL HYDRAULIC GRADIENT

WELL SCREEN 145.03 HYDRAULIC HEAD (FT. AMSL) MAY 15, 2018

KEY TO EXTRACTION WELL LOCATIONS

WELL ID J13-UC02

WELL SCREEN 145.03 HYDRAULIC HEAD (FT. AMSL) MAY 15, 2018

ESTIMATED LOCATION OF GEOLOGIC INTERFACE

ESTIMATED WATER TABLE (12/21/2006)

ESTIMATED WATER TABLE (05/15/2018)

\\vhb\gbl\proj\Montpelier\58300.00 ADC New Windsor NY\JCOdata\CAD\AAR 2018\Cross section A-A' 20181204.dwg

VHB Engineering, Surveying Landscape and Geology, P.C.
100 Great Oaks Blvd. Ste 118, Albany, NY

Drawn by: TEH Date: 12/12/18
Chk'd by: GAK Date: 12/12/18
Scale: As Shown Project: 58300.00

FIGURE 4-2: GEOLOGIC CROSS SECTION A-A' THROUGH OU02 FORMER DENNISON/MONARCH SYSTEMS SITE NEW WINDSOR, NEW YORK

\\vhb\gbl\proj\Montpelier\58300.00 ADC New Windsor NY\JCOdata\CAD\Potentiometric Contour Maps\Potentiometric_2016_v2.dwg

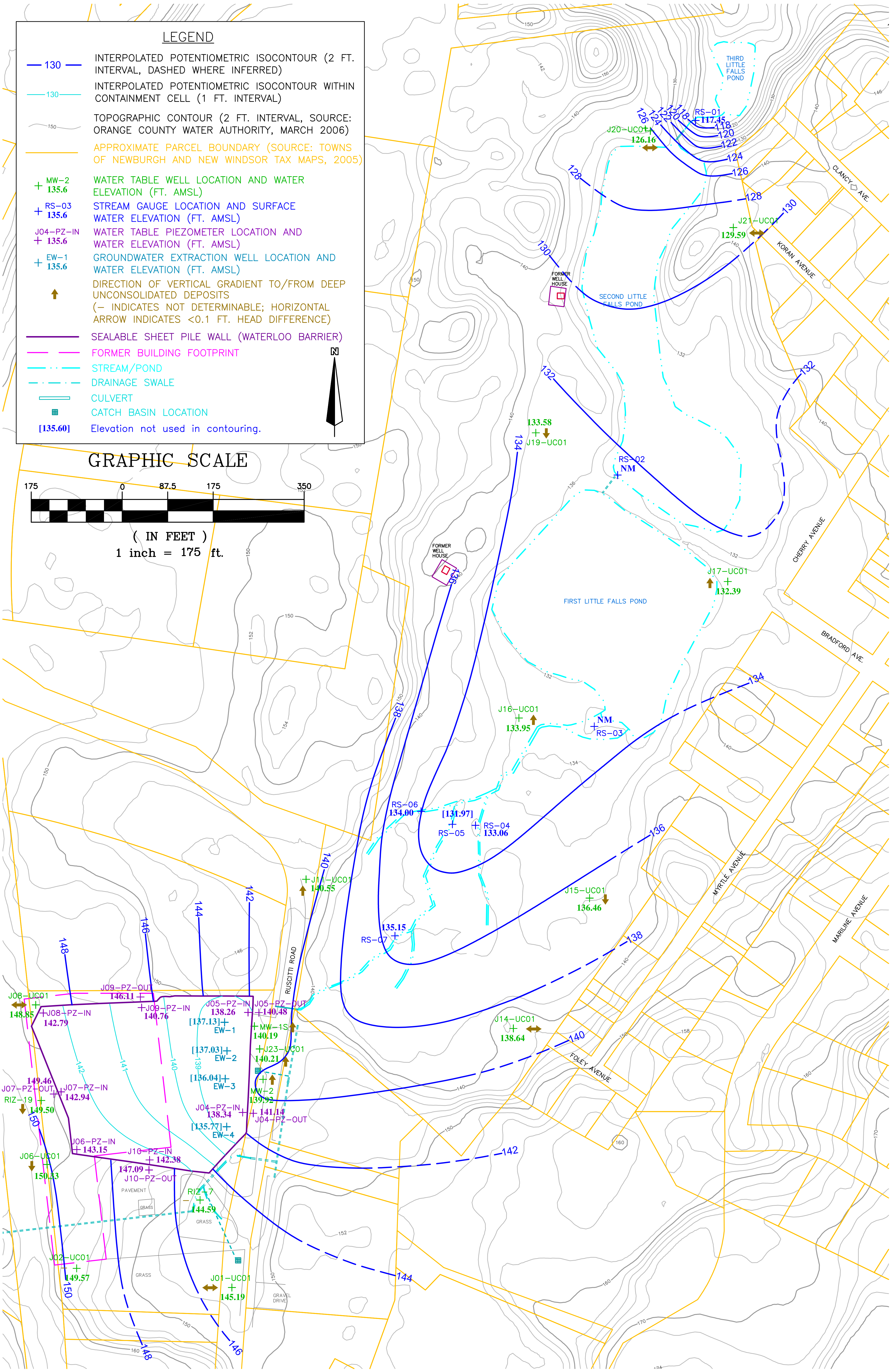


FIGURE 4-3: POTENTIOMETRIC MAP
WATER TABLE - MAY 15, 2018
FORMER DENNISON/MONARCH SYSTEMS SITE
NEW WINDSOR, NEW YORK

VHB Engineering, Surveying Landscape and Geology, P.C.
100 Great Oaks Blvd, Ste 118, Albany, NY

Drawn by: TEH	Date: 01/08/19
Chk'd by: GWL	Date: 06/26/19
Scale: Shown	Project: 58300.00

\\vhb\gbl\proj\Montpelier\58300.00 ADC New Windsor NY\JCOdata\CAD\Potentiometric Contour Maps\Potentiometric_2016_v2.dwg

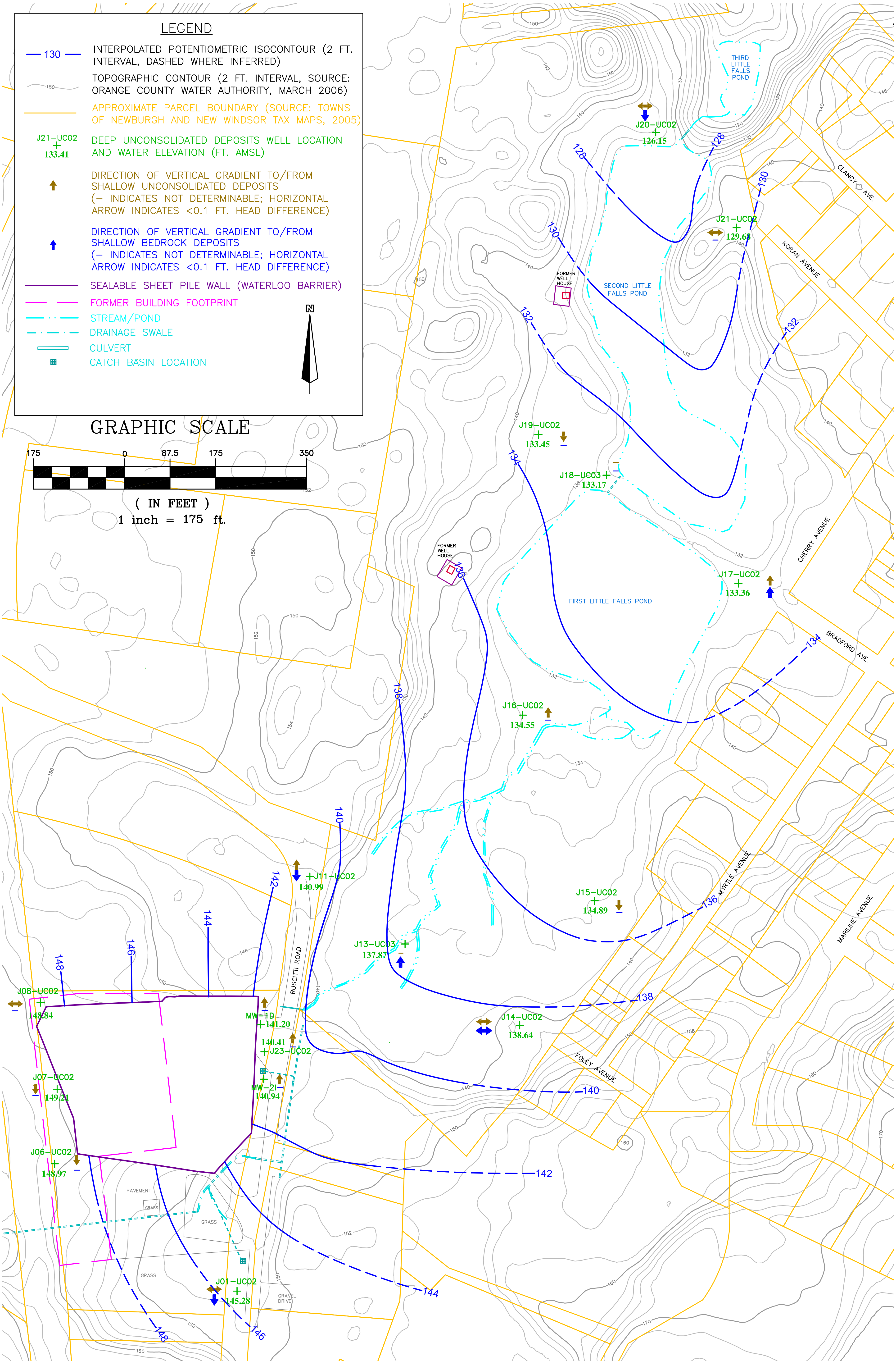


FIGURE 4-4: POTENTIOMETRIC MAP
DEEP UNCONSOLIDATED DEPOSITS - MAY 15, 2018
FORMER DENNISON/MONARCH SYSTEMS SITE
NEW WINDSOR, NEW YORK

VHB Engineering, Surveying Landscape and Geology, P.C.
100 Great Oaks Blvd, Ste 118, Albany, NY

Drawn by: TEH	Date: 01/08/19
Chk'd by: GWL	Date: 07/03/19
Scale: Shown	Project: 58300.00

\\vhb\gbl\proj\Montpelier\58300.00 ADC New Windsor NY\JCOdata\CAD\Potentiometric Contour Maps\Potentiometric_2016_v2.dwg

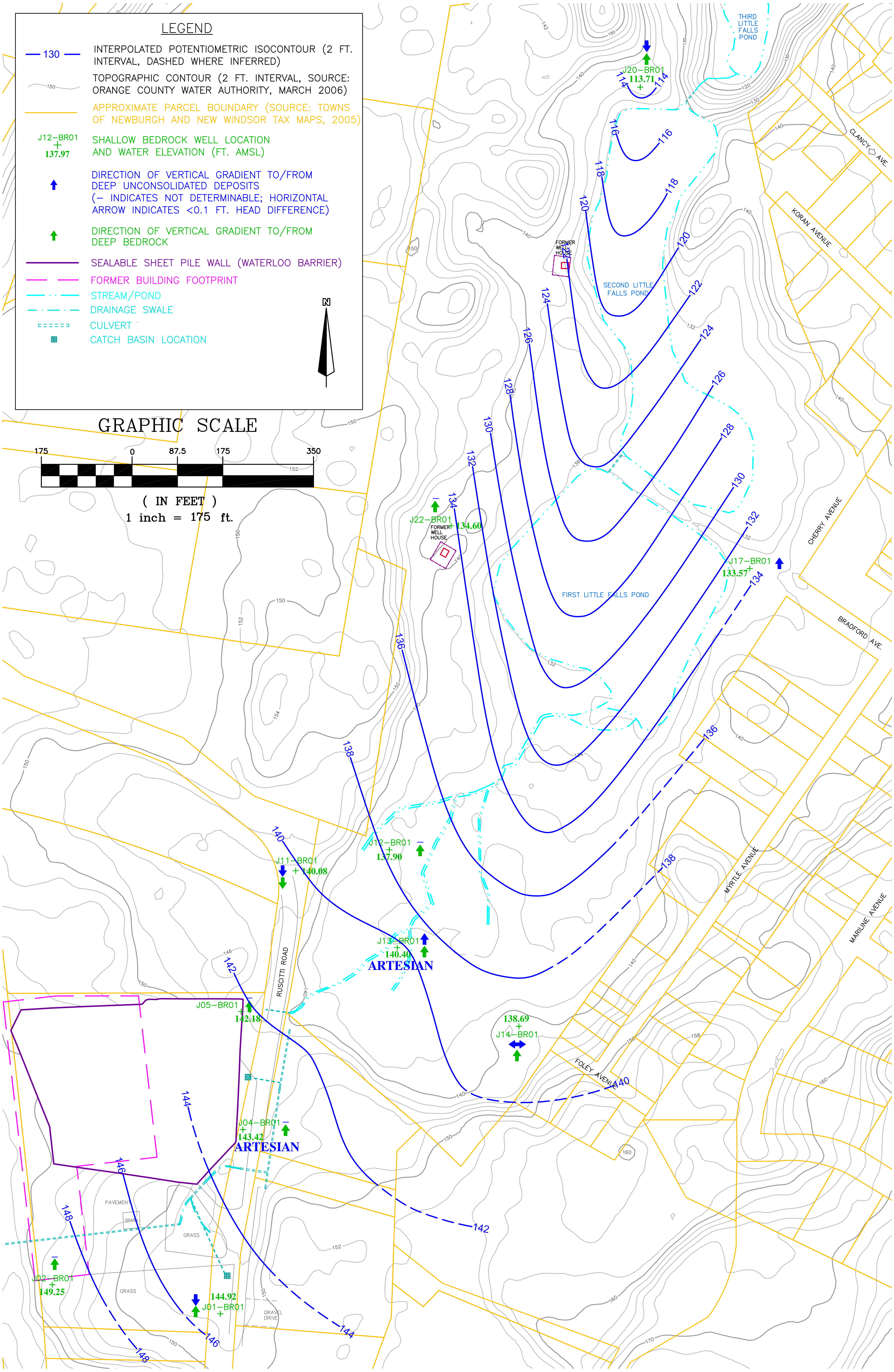


FIGURE 4-5: POTENTIOMETRIC MAP
SHALLOW BEDROCK - MAY 15, 2018
FORMER DENNISON/MONARCH SYSTEMS SITE
NEW WINDSOR, NEW YORK

VHB Engineering, Surveying Landscape and Geology, P.C.
100 Great Oaks Blvd, Ste 118, Albany, NY

Drawn by: TEH	Date: 01/08/19
Chk'd by: GAK	Date: 06/12/19
Scale: Shown	Project: 58300.00

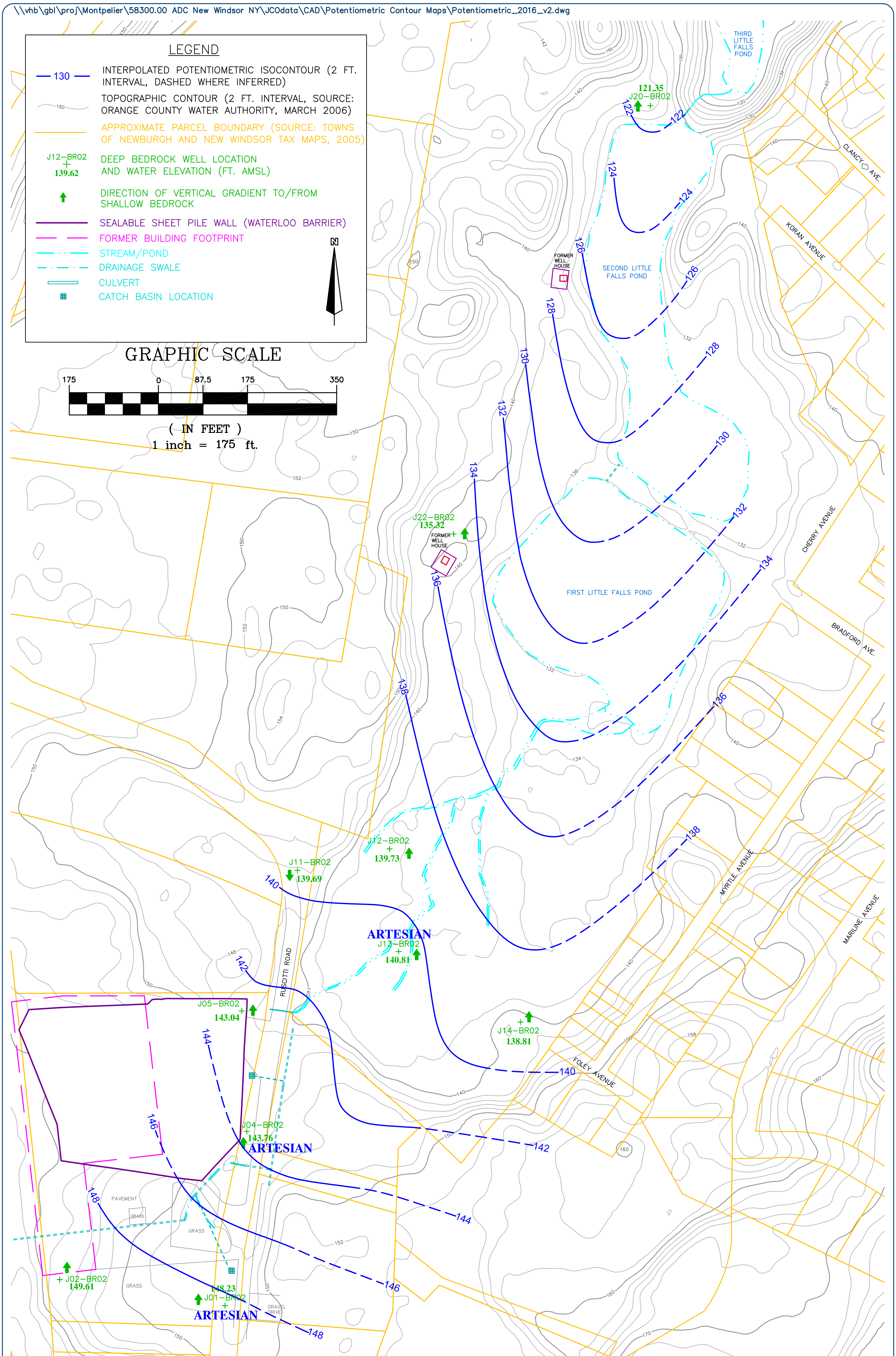


FIGURE 4-6: POTENTIOMETRIC MAP
DEEP BEDROCK - MAY 15, 2018
FORMER DENNISON/MONARCH SYSTEMS SITE
NEW WINDSOR, NEW YORK

VHB Engineering, Surveying Landscape and Geology, P.C.
100 Great Oaks Blvd, Ste 118, Albany, NY

Drawn by: TEH Date: 01/08/19
Chk'd by: GWL Date: 06/26/19
Scale: Shown Project: 58300.00

LEGEND

- Pre-Design Investigation Monitoring Well Location
- Abandoned Well Location
- Drivepoint Groundwater Profiling Location (2006)
- Drivepoint Groundwater Profiling Location (2012)
- 130 Water Table Interpolated Potentiometric Isocontour (2 ft. interval, dashed where inferred) - Dec. 2006 & Nov. 2011
- Approximate Parcel Boundary from Town of New Windsor, New York Tax Maps

- 1 µg/L < [TCE] < 10 µg/L
- 10 µg/L < [TCE] < 50 µg/L
- 50 µg/L < [TCE] < 500 µg/L
- 500 µg/L < [TCE] < 1000 µg/L
- 1000 µg/L < [TCE]

N

0 80 160 320

SCALE IN FEET

Notes:

(1) TCE concentrations in groundwater for 2012 drivepoint groundwater profiling locations are derived from Spring 2012 data. TCE concentrations for monitoring well locations are sourced from either Fall 2006 or Fall 2011 data. Drivepoint groundwater profiling data for 2006 were considered for the estimated contours where other data is unavailable.

(2) The data shown represent the maximum concentration at any depth in the vertical profile.

(3) TCE = Trichloroethene

Base Map: USDA Farm Service Agency - NAIP (August 2017)

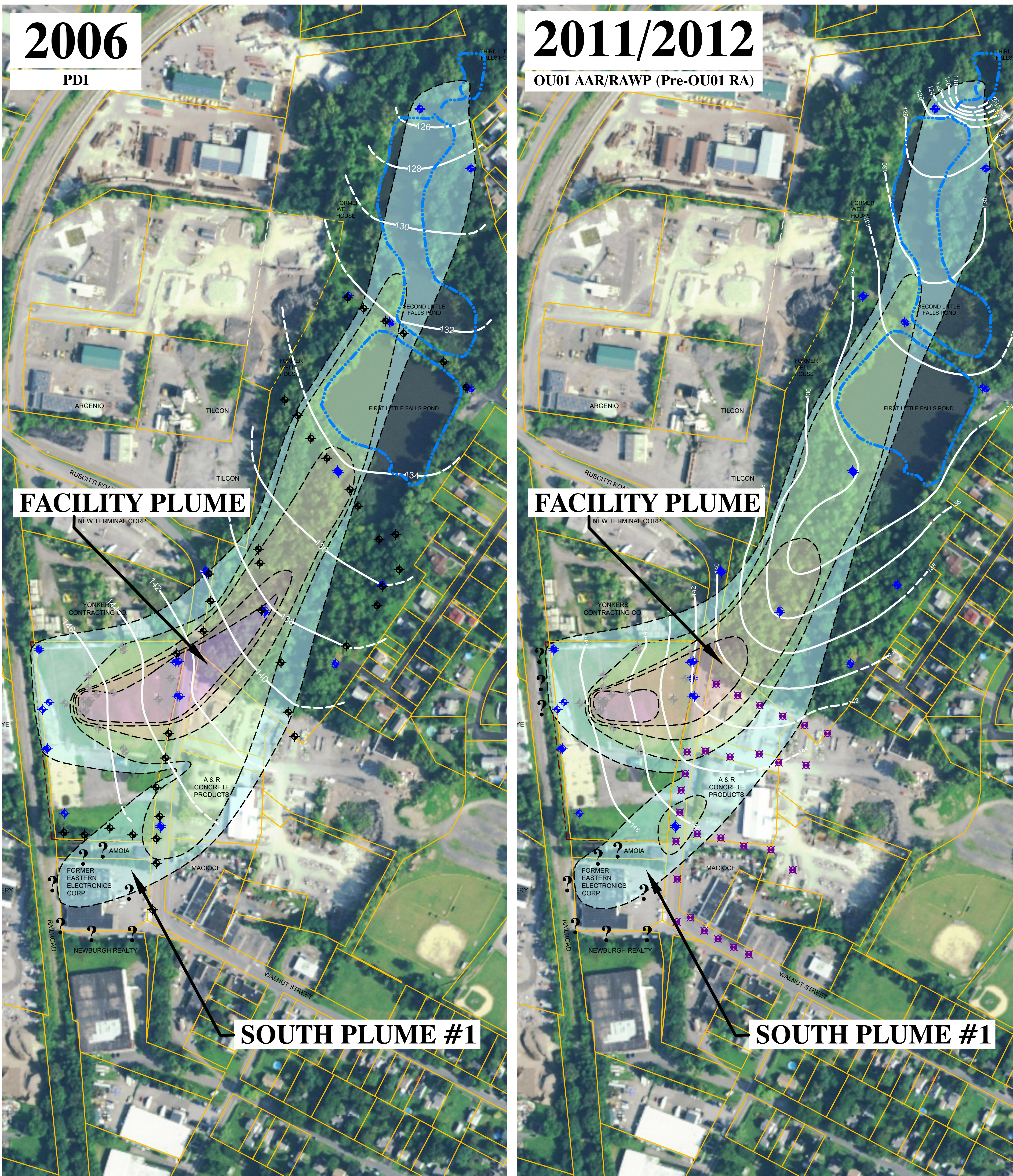


FIGURE 4-7: TCE GROUNDWATER CONCENTRATIONS IN UNCONSOLIDATED DEPOSITS: 2006 & 2011/2012
FORMER DENNISON/MONARCH SYSTEMS SITE
NEW WINDSOR, NEW YORK

VHB Engineering, Surveying Landscape and Geology, P.C.
100 Great Oaks Blvd, Ste 118, Albany, NY

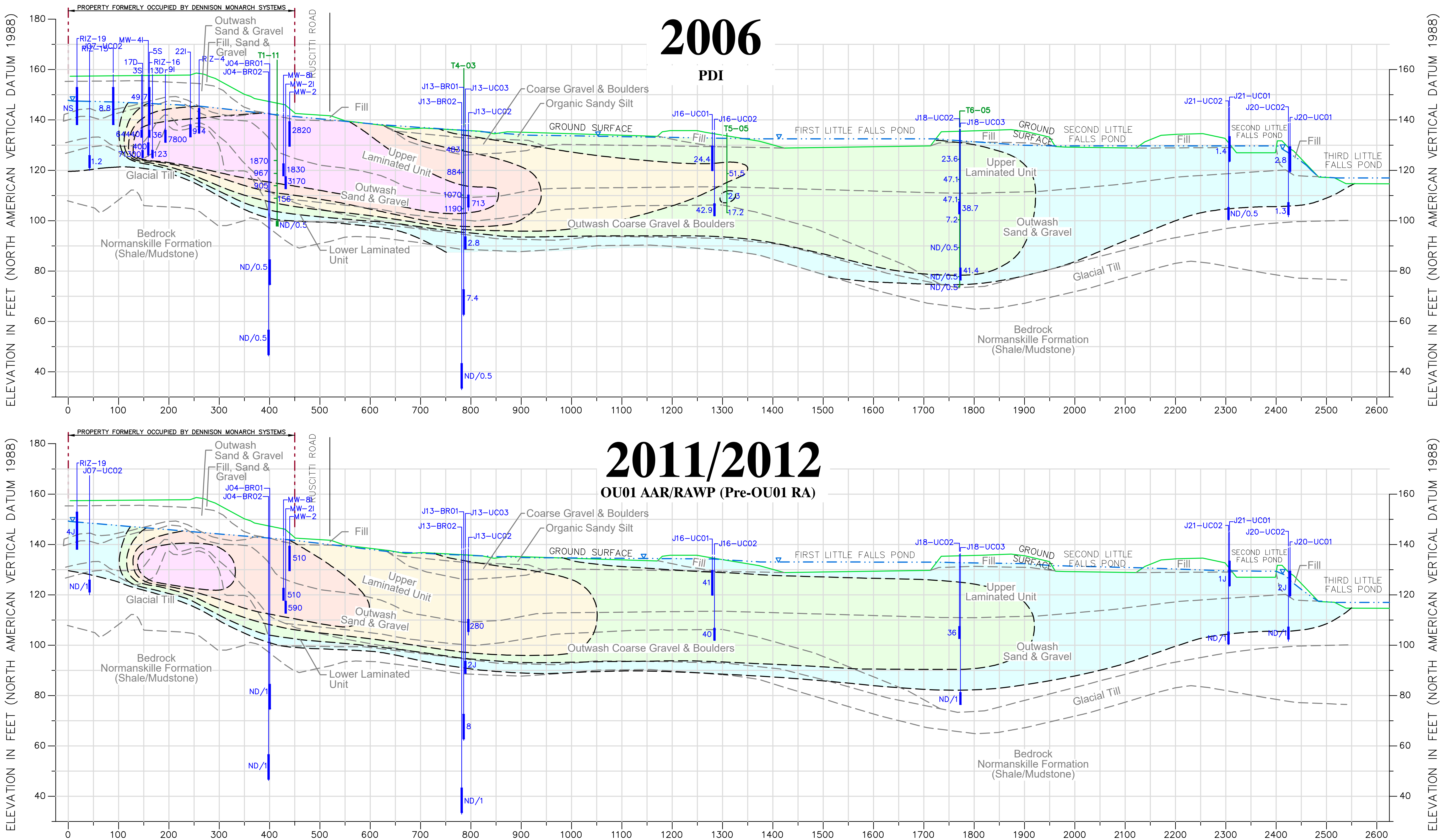
Drawn by: TEH Date: 01/02/19
Chk'd by: GAK Date: 01/02/19
Scale: As Shown Project: 58300.00

\\vhb\gbl\proj\Montpelier\58300.00 ADC New Windsor NY\JCOdata\CAD\AAR 2018\VOC 2018 122018.dwg

WEST–SOUTHWEST **A**

CROSS SECTION A-A': TRICHLOROETHENE (TCE) CONCENTRATIONS IN GROUNDWATER (μg/L)

NORTHEAST **A'**



KEY

- 1 μg/L < [TCE] < 10 μg/L
- 10 μg/L < [TCE] < 50 μg/L
- 50 μg/L < [TCE] < 500 μg/L
- 500 μg/L < [TCE] < 1000 μg/L
- 1000 μg/L < [TCE]

ND/0.5 = Non Detect/Detection Limit; NS = Not Sampled

\\vhb\gbl\proj\Montpelier\58300.00 ADC New Windsor NY\JCOdata\CAD\AAR 2018\Cross section A–A' 20181204.dwg

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100 Great Oaks Blvd. Ste 118, Albany, NY

Drawn by: TEH	Date: 01/07/19
Chk'd by: GAK	Date: 01/07/19
Scale: As Shown	Project: 58300.00

FIGURE 4-8: TCE GROUNDWATER CONCENTRATIONS ALONG CROSS-SECTION A-A': 2006 & 2011/2012 FORMER DENNISON/MONARCH SYSTEMS SITE NEW WINDSOR, NEW YORK

LEGEND

- Pre-Design Investigation Monitoring Well Location
- Abandoned Well Location
- Drivepoint Groundwater Profiling Location (2006)
- Drivepoint Groundwater Profiling Location (2012)
- 130 — Water Table Interpolated Potentiometric Isocontour (2 ft. interval, dashed where inferred) - Dec. 2006 & Nov. 2011
- Approximate Parcel Boundary from Town of New Windsor, New York Tax Maps

- 1 μg/L < [TCA] < 10 μg/L
- 10 μg/L < [TCA] < 50 μg/L
- 50 μg/L < [TCA] < 500 μg/L
- 500 μg/L < [TCA] < 1000 μg/L
- 1000 μg/L < [TCA]

N

0 80 160 320

SCALE IN FEET

Notes:

(1) TCA concentrations in groundwater for 2012 drivepoint groundwater profiling locations are derived from Spring 2012 data. TCA concentrations for monitoring well locations are sourced from either Fall 2006 or Fall 2011 data. Drivepoint groundwater profiling data for 2006 were considered for the estimated contours where other data is unavailable.

(2) The data shown represent the maximum concentration at any depth in the vertical profile.

(3) TCA = 1,1,1-Trichloroethane

Base Map: USDA Farm Service Agency - NAIP (August 2017)

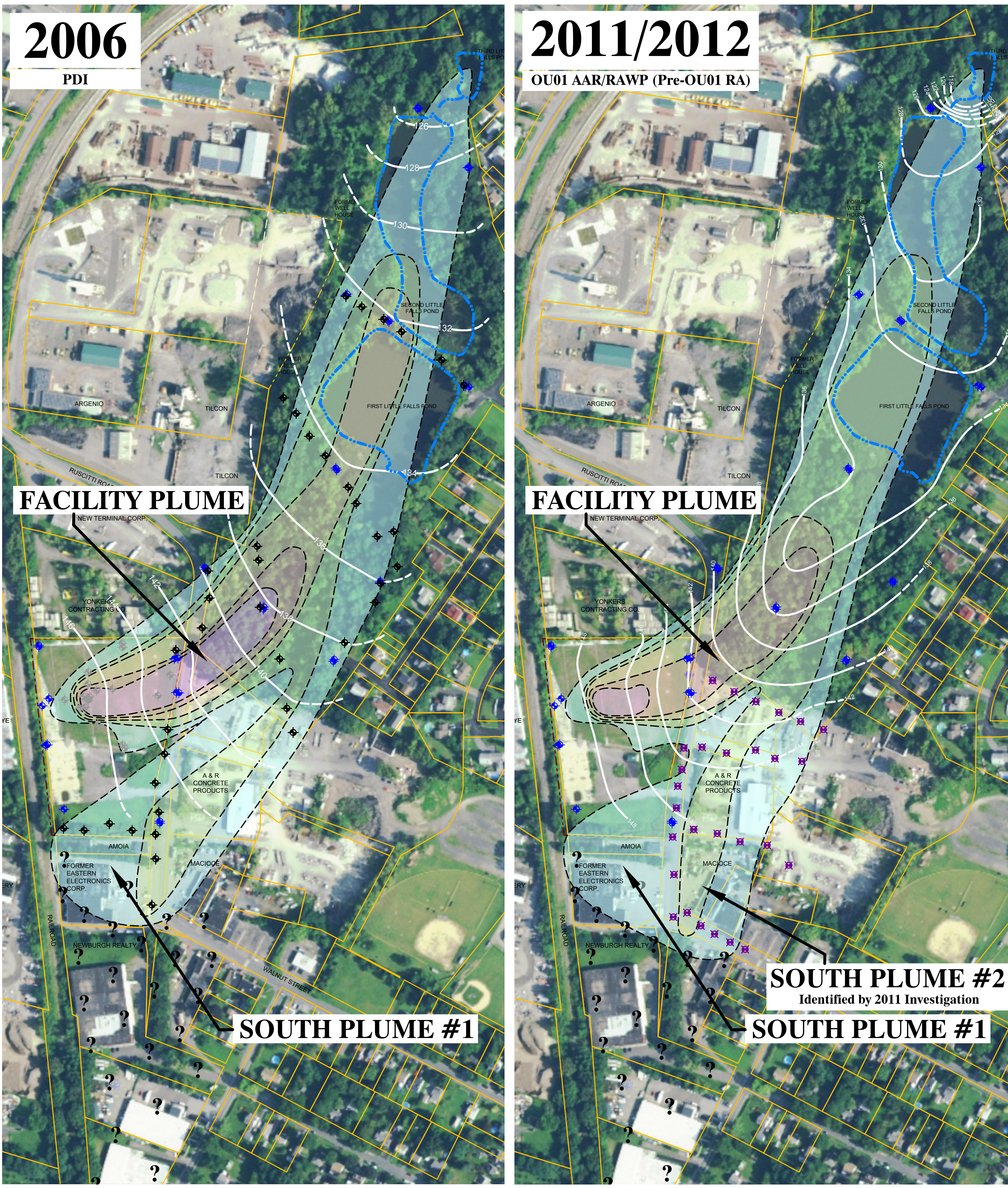

FIGURE 4-9: TCA GROUNDWATER CONCENTRATIONS IN UNCONSOLIDATED DEPOSITS: 2006 & 2011/2012
FORMER DENNISON/MONARCH SYSTEMS SITE
NEW WINDSOR, NEW YORK

VHB Engineering, Surveying Landscape and Geology, P.C.
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Drawn by: TEH	Date: 01/02/19
Chk'd by: GAK	Date: 01/02/19
Scale: As Shown	Project: 58300.00

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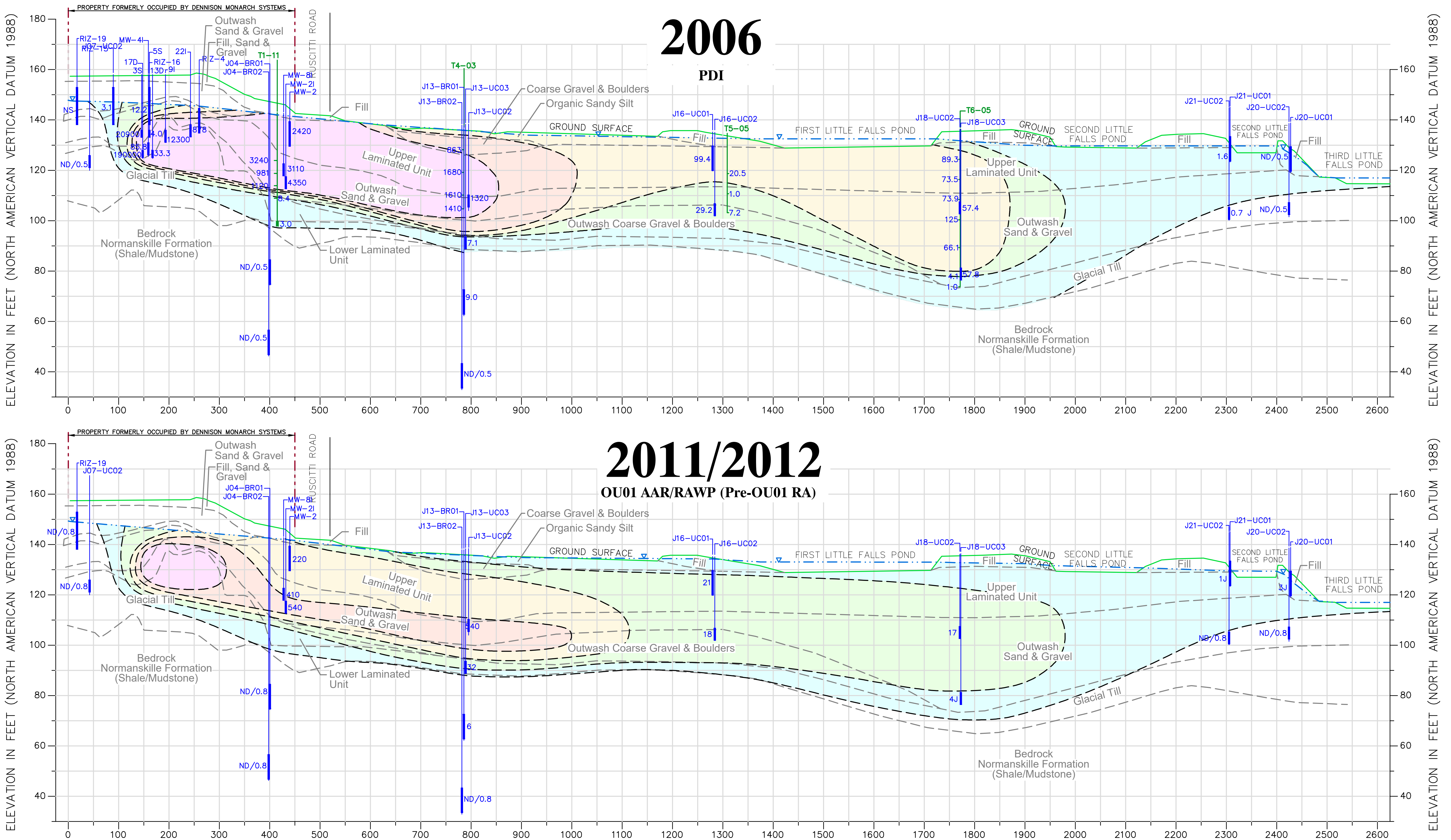
WEST–SOUTHWEST **A**

CROSS SECTION A-A': 1,1,1-TRICHLOROETHANE (TCA) CONCENTRATIONS IN GROUNDWATER (μg/L)

NORTHEAST **A'**



DISTANCE IN FEET
VERTICAL EXAGGERATION 5:1

KEY

- 1 μg/L < [TCA] < 10 μg/L
- 10 μg/L < [TCA] < 50 μg/L
- 50 μg/L < [TCA] < 500 μg/L
- 500 μg/L < [TCA] < 1000 μg/L
- 1000 μg/L < [TCA]

ND/0.5 = Non Detect/Detection Limit; NS = Not Sampled

\\vhb\gbl\proj\Montpelier\58300.00 ADC New Windsor NY\JCOdata\CAD\AAR 2018\Cross section A-A' 20181204.dwg

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Drawn by: TEH	Date: 01/07/19
Chk'd by: GAK	Date: 01/07/19
Scale: As Shown	Project: 58300.00

FIGURE 4-10: TCA GROUNDWATER CONCENTRATIONS ALONG CROSS-SECTION A-A': 2006 & 2011/2012
FORMER DENNISON/MONARCH SYSTEMS SITE
NEW WINDSOR, NEW YORK

LEGEND

- Pre-Design Investigation Monitoring Well Location
- Abandoned Well Location
- Drivepoint Groundwater Profiling Location (2006)
- Drivepoint Groundwater Profiling Location (2012)
- 130 — Water Table Interpolated Potentiometric Isocontour (2 ft. interval, dashed where inferred) - Nov. 2011 & May 2018
- Approximate Parcel Boundary from Town of New Windsor, New York Tax Maps
- Sealed Sheet Pile Wall (Waterloo Barrier)

- 1 μg/L < [TCE] < 10 μg/L
- 10 μg/L < [TCE] < 50 μg/L
- 50 μg/L < [TCE] < 500 μg/L
- 500 μg/L < [TCE] < 1000 μg/L
- 1000 μg/L < [TCE]

N

0 80 160 320
SCALE IN FEET

Notes:

(1) TCE concentrations in groundwater for 2012 drivepoint groundwater profiling locations are derived from Spring 2012 data. TCE concentrations for monitoring well locations are sourced from either Fall 2011 or Spring 2018 data. Drivepoint groundwater profiling data for 2006 were considered for the estimated contours where other data is unavailable.

(2) The data shown represent the maximum concentration at any depth in the vertical profile.

(3) TCE = Trichloroethene

Base Map: USDA Farm Service Agency - NAIP (August 2017)

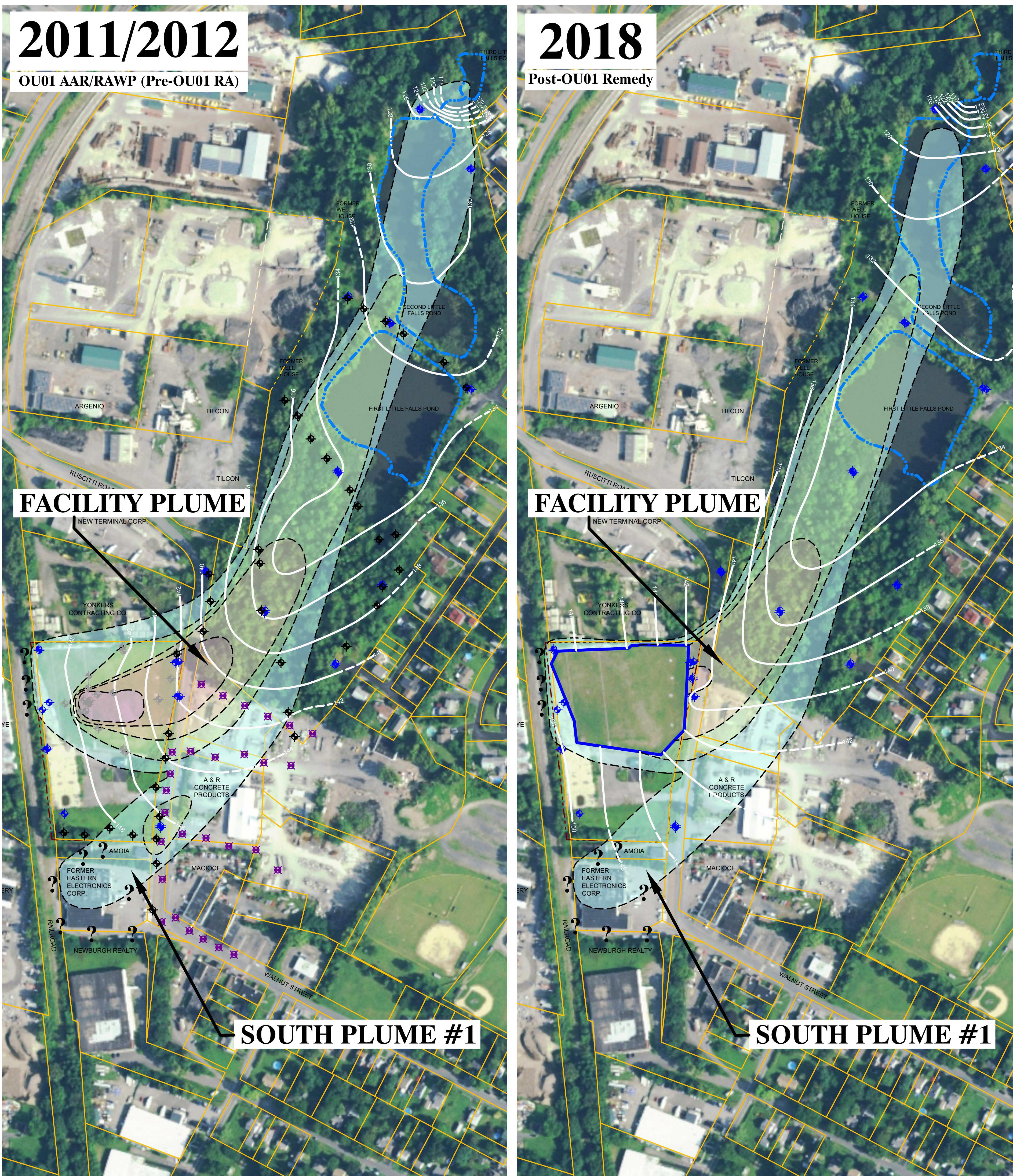

FIGURE 4-11: TCE GROUNDWATER CONCENTRATIONS IN UNCONSOLIDATED DEPOSITS: 2011/2012 & 2018
FORMER DENNISON/MONARCH SYSTEMS SITE
NEW WINDSOR, NEW YORK

vhb

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Drawn by: TEH Date: 01/02/19
Chk'd by: GWL Date: 06/26/19
Scale: As Shown Project: 58300.00

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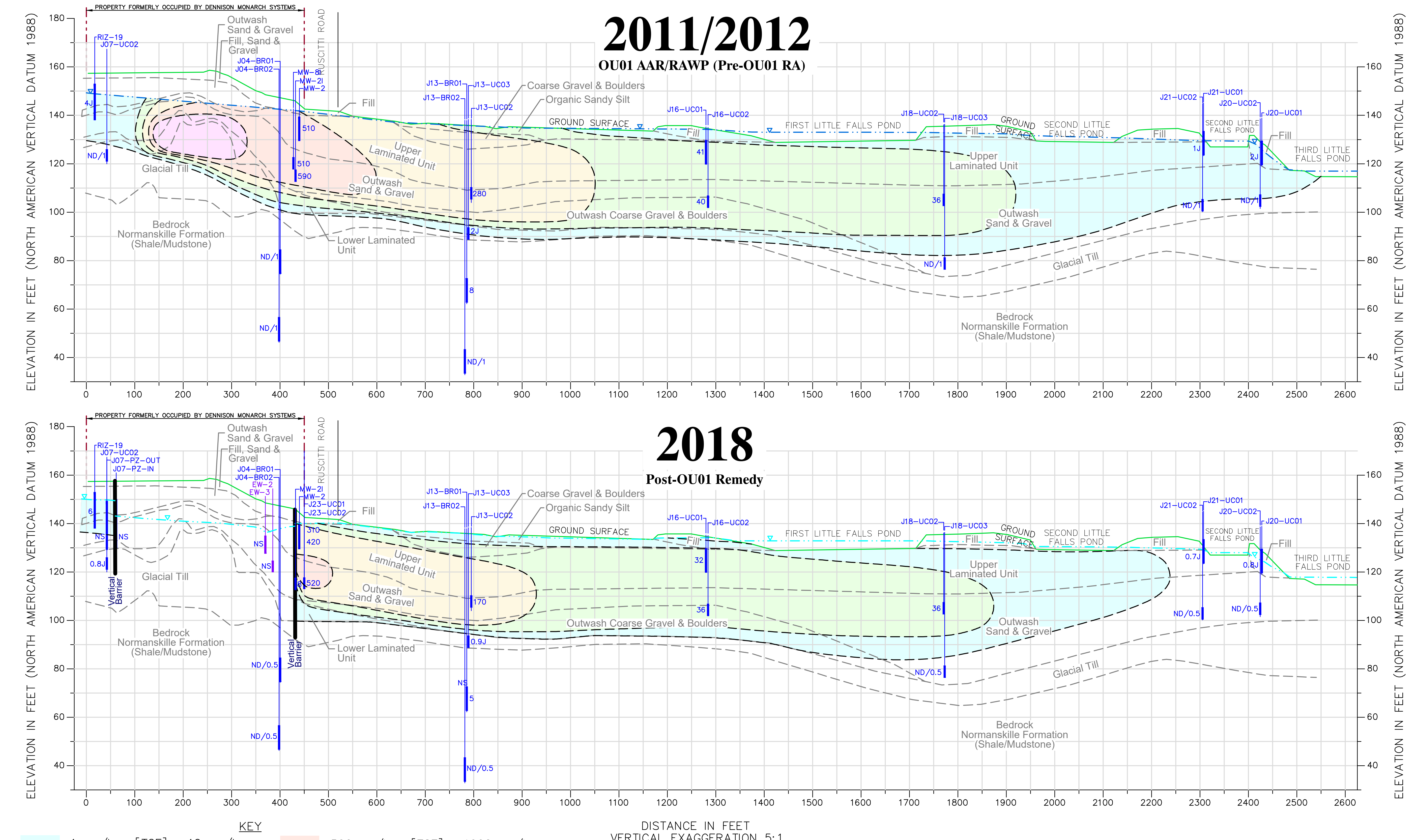
CROSS SECTION A-A': TRICHLOROETHENE (TCE) CONCENTRATIONS IN GROUNDWATER (μg/L)



KEY

- 1 μg/L < [TCE] < 10 μg/L
- 10 μg/L < [TCE] < 50 μg/L
- 50 μg/L < [TCE] < 500 μg/L
- 500 μg/L < [TCE] < 1000 μg/L
- 1000 μg/L < [TCE]

ND/0.5 = Non Detect/Detection Limit; NS = Not Sampled

\\vhb\gbl\proj\Montpelier\58300.00 ADC New Windsor NY\JCOdata\CAD\AAR 2018\Cross section A-A' 20181204.dwg

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Chk'd by: GAK	Date: 01/07/19
Scale: As Shown	Project: 58300.00

FIGURE 4-12: TCE GROUNDWATER CONCENTRATIONS ALONG CROSS-SECTION A-A': 2012 & 2018
FORMER DENNISON/MONARCH SYSTEMS SITE
NEW WINDSOR, NEW YORK

LEGEND

- Pre-Design Investigation Monitoring Well Location
- Abandoned Well Location
- Drivepoint Groundwater Profiling Location (2006)
- Drivepoint Groundwater Profiling Location (2012)
- 130 — Water Table Interpolated Potentiometric Isocontour (2 ft. interval, dashed where inferred) - Nov. 2011 & May 2018
- Approximate Parcel Boundary from Town of New Windsor, New York Tax Maps
- Sealed Sheet Pile Wall (Waterloo Barrier)

- 1 µg/L < [TCA] < 10 µg/L
- 10 µg/L < [TCA] < 50 µg/L
- 50 µg/L < [TCA] < 500 µg/L
- 500 µg/L < [TCA] < 1000 µg/L
- 1000 µg/L < [TCA]

N

0 80 160 320

SCALE IN FEET

Notes:

(1) TCA concentrations in groundwater for 2012 drivepoint groundwater profiling locations are derived from Spring 2012 data. TCA concentrations for monitoring well locations are sourced from either Fall 2011 or Spring 2018 data. Drivepoint groundwater profiling data for 2006 were considered for the estimated contours where other data is unavailable.

(2) The data shown represent the maximum concentration at any depth in the vertical profile.

(3) TCA = 1,1,1-Trichloroethane

Base Map: USDA Farm Service Agency - NAIP (August 2017)

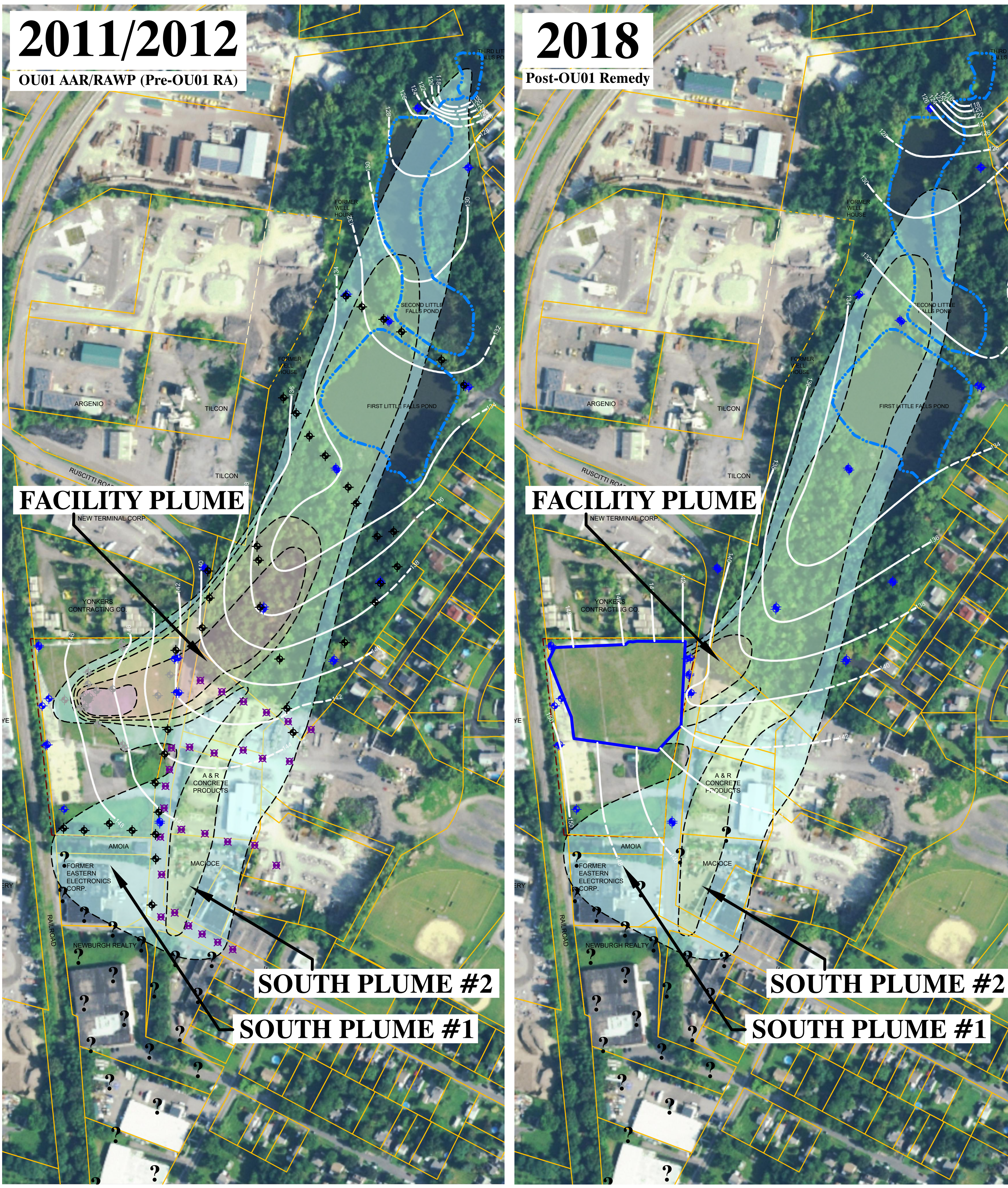

FIGURE 4-13: TCA GROUNDWATER CONCENTRATIONS IN UNCONSOLIDATED DEPOSITS: 2011/2012 & 2018
FORMER DENNISON/MONARCH SYSTEMS SITE
NEW WINDSOR, NEW YORK

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Chk'd by: GWL Date: 06/26/19
Scale: As Shown Project: 58300.00

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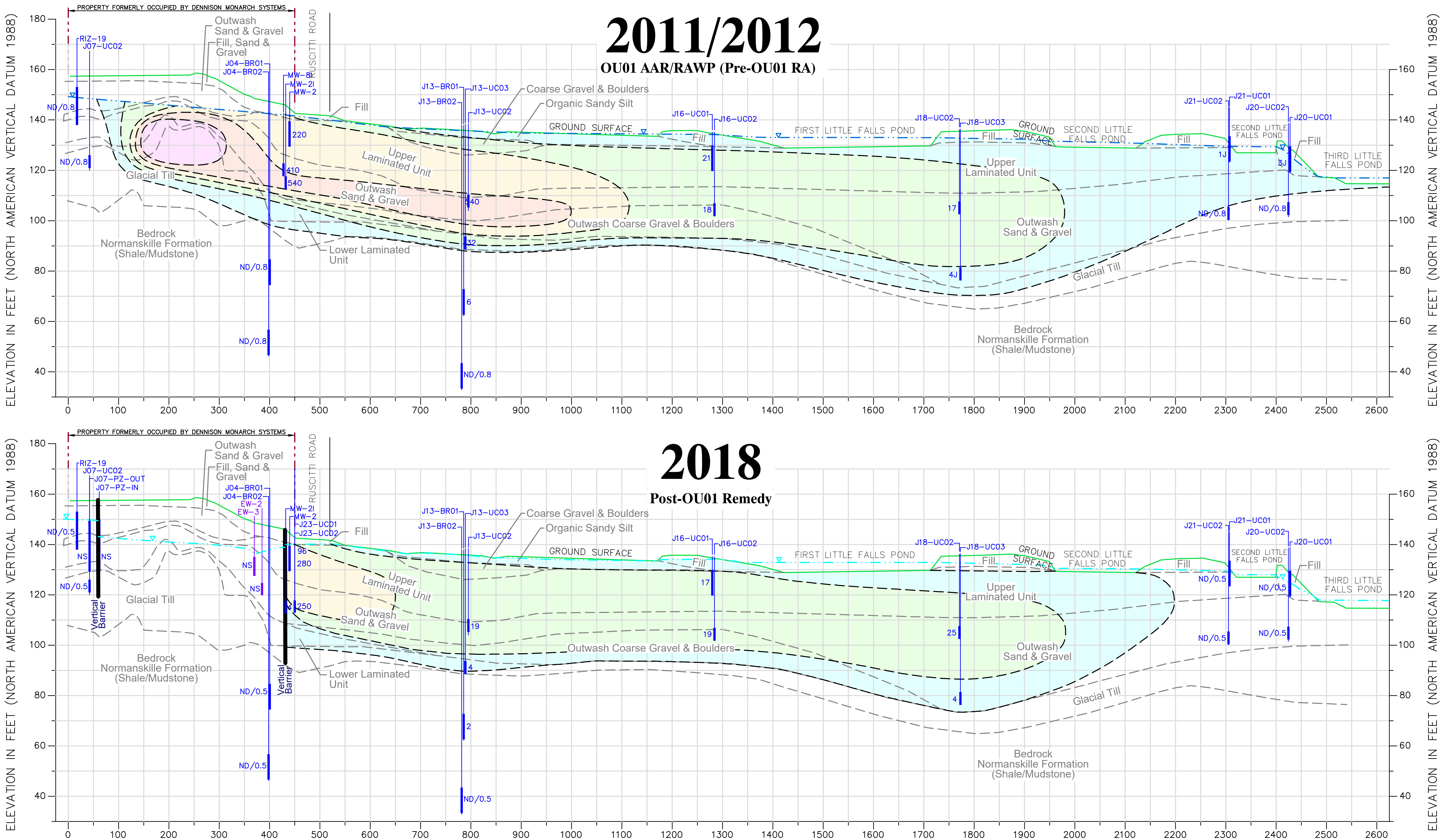
WEST–SOUTHWEST
A

CROSS SECTION A-A': 1,1,1-TRICHLOROETHANE (TCA) CONCENTRATIONS IN GROUNDWATER (μg/L)

NORTHEAST
A'



KEY

- 1 μg/L < [TCA] < 10 μg/L
- 10 μg/L < [TCA] < 50 μg/L
- 50 μg/L < [TCA] < 500 μg/L
- 500 μg/L < [TCA] < 1000 μg/L
- 1000 μg/L < [TCA]

ND/0.5 = Non Detect/Detection Limit; NS = Not Sampled

\\vhb\gbl\proj\Montpelier\58300.00 ADC New Windsor NY\JCOdata\CAD\AAR 2018\Cross section A-A' 20181204.dwg

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Drawn by: TEH Date: 01/07/19
Chk'd by: GAK Date: 01/07/19
Scale: As Shown Project: 58300.00

FIGURE 4-14: TCA GROUNDWATER CONCENTRATIONS ALONG CROSS-SECTION A-A': 2012 & 2018
FORMER DENNISON/MONARCH SYSTEMS SITE
NEW WINDSOR, NEW YORK

LEGEND

- Pre-Design Investigation Monitoring Well Location
- Abandoned Well Location
- Drivepoint Groundwater Profiling Location (2006)
- 130 — Water Table Interpolated Potentiometric Isocontour (2 ft. interval, dashed where inferred) - Dec. 2006 & May 2018
- Approximate Parcel Boundary from Town of New Windsor, New York Tax Maps
- Sealed Sheet Pile Wall (Waterloo Barrier)

- 1 µg/L < [TCE] < 10 µg/L
- 10 µg/L < [TCE] < 50 µg/L
- 50 µg/L < [TCE] < 500 µg/L
- 500 µg/L < [TCE] < 1000 µg/L
- 1000 µg/L < [TCE]

N

0 80 160 320

SCALE IN FEET

Notes:

(1) TCE concentrations for monitoring well locations are sourced from either Fall 2006 or Spring 2018 data. Drivepoint groundwater profiling data from 2006 and 2012 were considered for the estimated contours where other data is unavailable.

(2) The data shown represent the maximum concentration at any depth in the vertical profile.

(3) TCE = Trichloroethene

Base Map: USDA Farm Service Agency - NAIP (August 2017)

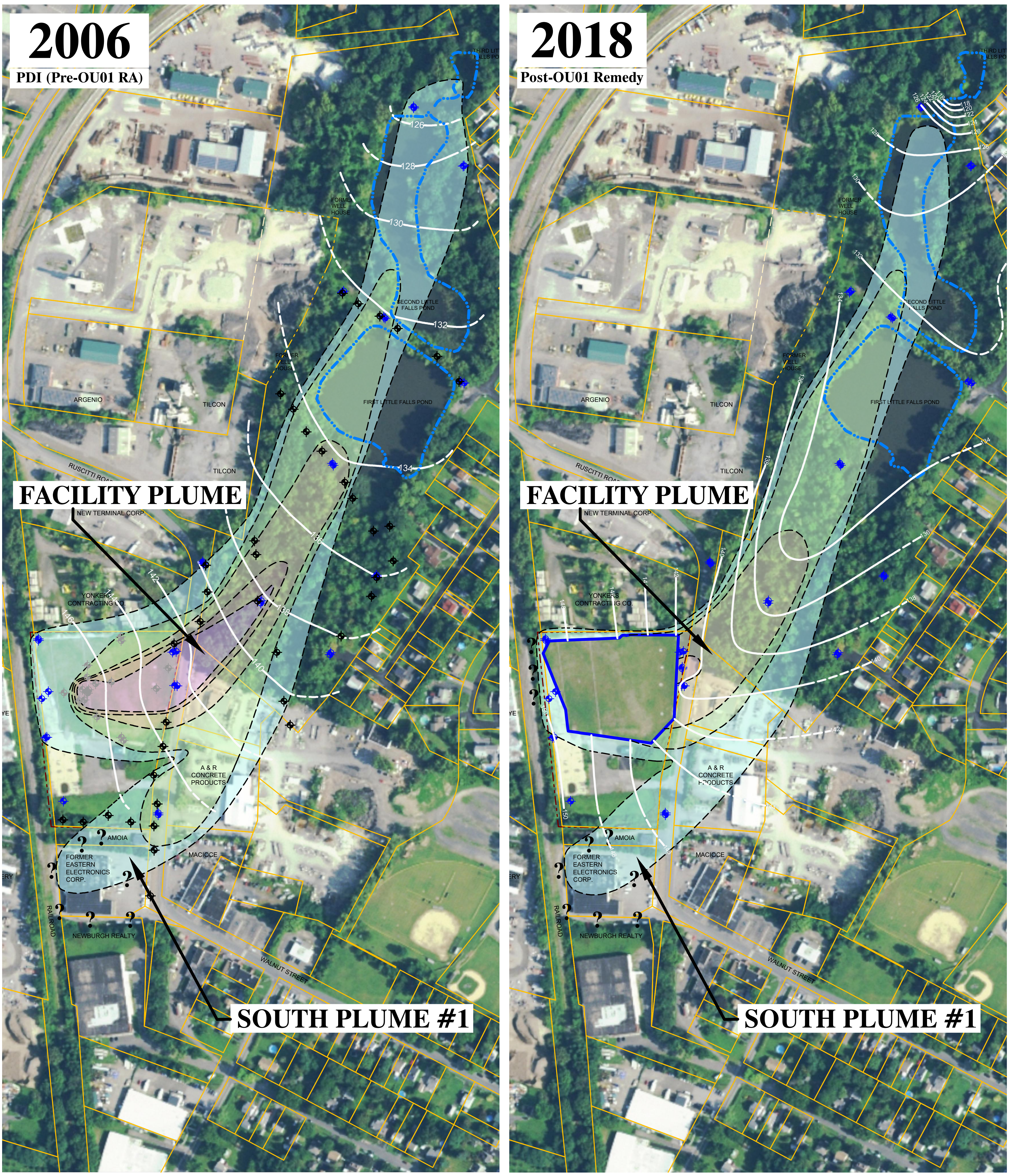

FIGURE 4-15: TCE GROUNDWATER CONCENTRATIONS IN UNCONSOLIDATED DEPOSITS: 2006 & 2018
FORMER DENNISON/MONARCH SYSTEMS SITE
NEW WINDSOR, NEW YORK

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Drawn by: TEH Date: 01/02/19
Chk'd by: GWL Date: 06/26/19
Scale: As Shown Project: 58300.00

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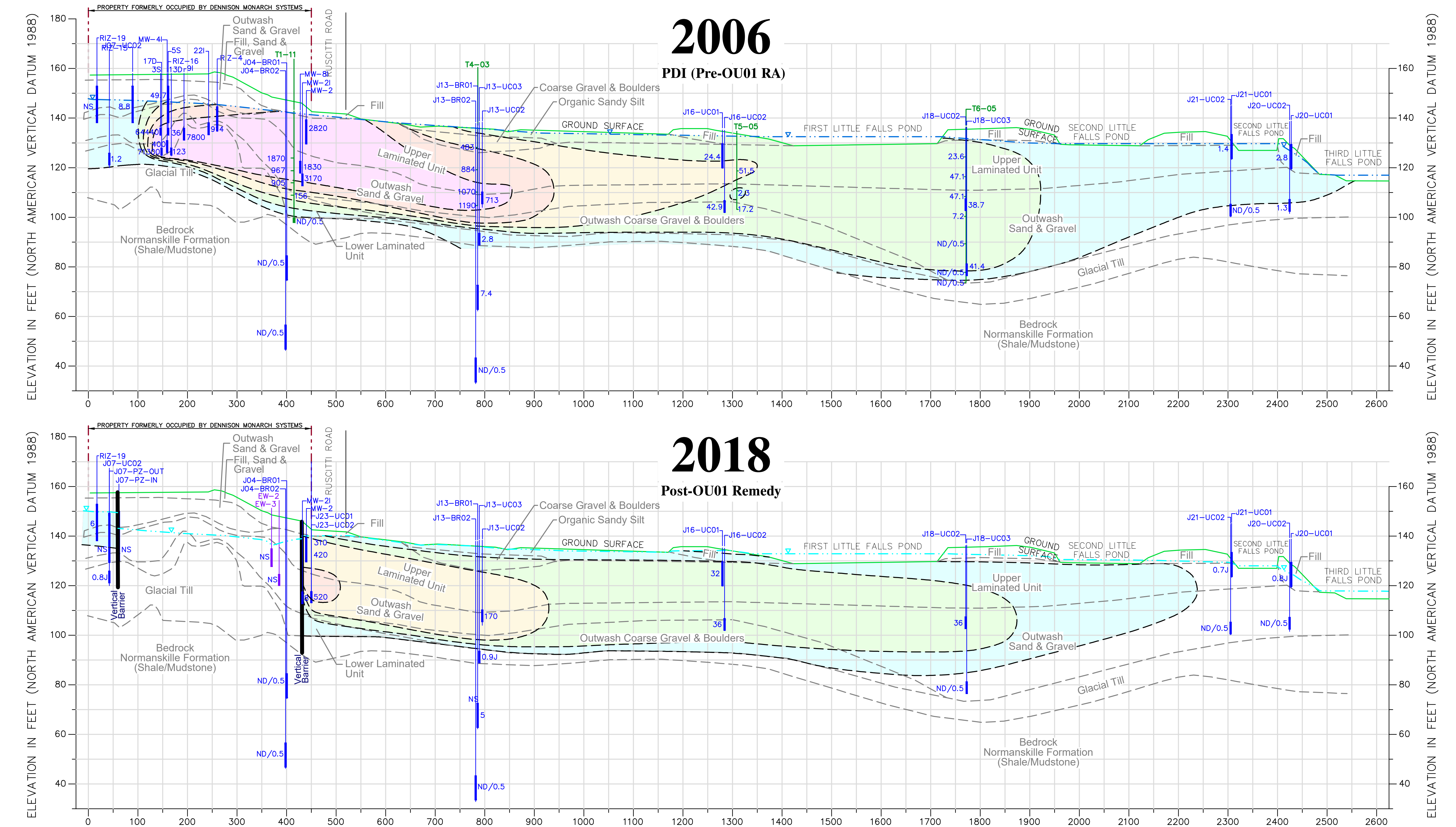
CROSS SECTION A-A': TRICHLOROETHENE (TCE) CONCENTRATIONS IN GROUNDWATER (μg/L)

WEST-SOUTHWEST
A

NORTHEAST
A'



KEY

1 μg/L < [TCE] < 10 μg/L	500 μg/L < [TCE] < 1000 μg/L
10 μg/L < [TCE] < 50 μg/L	1000 μg/L < [TCE]
50 μg/L < [TCE] < 500 μg/L	ND/0.5 = Non Detect/Detection Limit; NS = Not Sampled

\\vhb\gbl\proj\Montpelier\58300.00 ADC New Windsor NY\JCOdata\CAD\AAR 2018\Cross section A-A' 20181204.dwg

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Chk'd by: GAK Date: 01/07/19
Scale: As Shown Project: 58300.00

FIGURE 4-16: TCE GROUNDWATER CONCENTRATIONS ALONG CROSS-SECTION A-A': 2006 & 2018
FORMER DENNISON/MONARCH SYSTEMS SITE
NEW WINDSOR, NEW YORK

LEGEND

- Pre-Design Investigation Monitoring Well Location
- Abandoned Well Location
- Drivepoint Groundwater Profiling Location (2006)
- 130 — Water Table Interpolated Potentiometric Isocontour (2 ft. interval, dashed where inferred) - Dec. 2006 & May 2018
- Approximate Parcel Boundary from Town of New Windsor, New York Tax Maps
- Sealed Sheet Pile Wall (Waterloo Barrier)

- 1 µg/L < [TCA] < 10 µg/L
- 10 µg/L < [TCA] < 50 µg/L
- 50 µg/L < [TCA] < 500 µg/L
- 500 µg/L < [TCA] < 1000 µg/L
- 1000 µg/L < [TCA]

N

0 80 160 320

SCALE IN FEET

Notes:

(1) TCA concentrations for monitoring well locations are sourced from either Fall 2006 or Spring 2018 data. Drivepoint groundwater profiling data from 2006 and 2012 were considered for the estimated contours where other data is unavailable.

(2) The data shown represent the maximum concentration at any depth in the vertical profile.

(3) TCA = 1,1,1-Trichloroethane

Base Map: USDA Farm Service Agency - NAIP (August 2017)

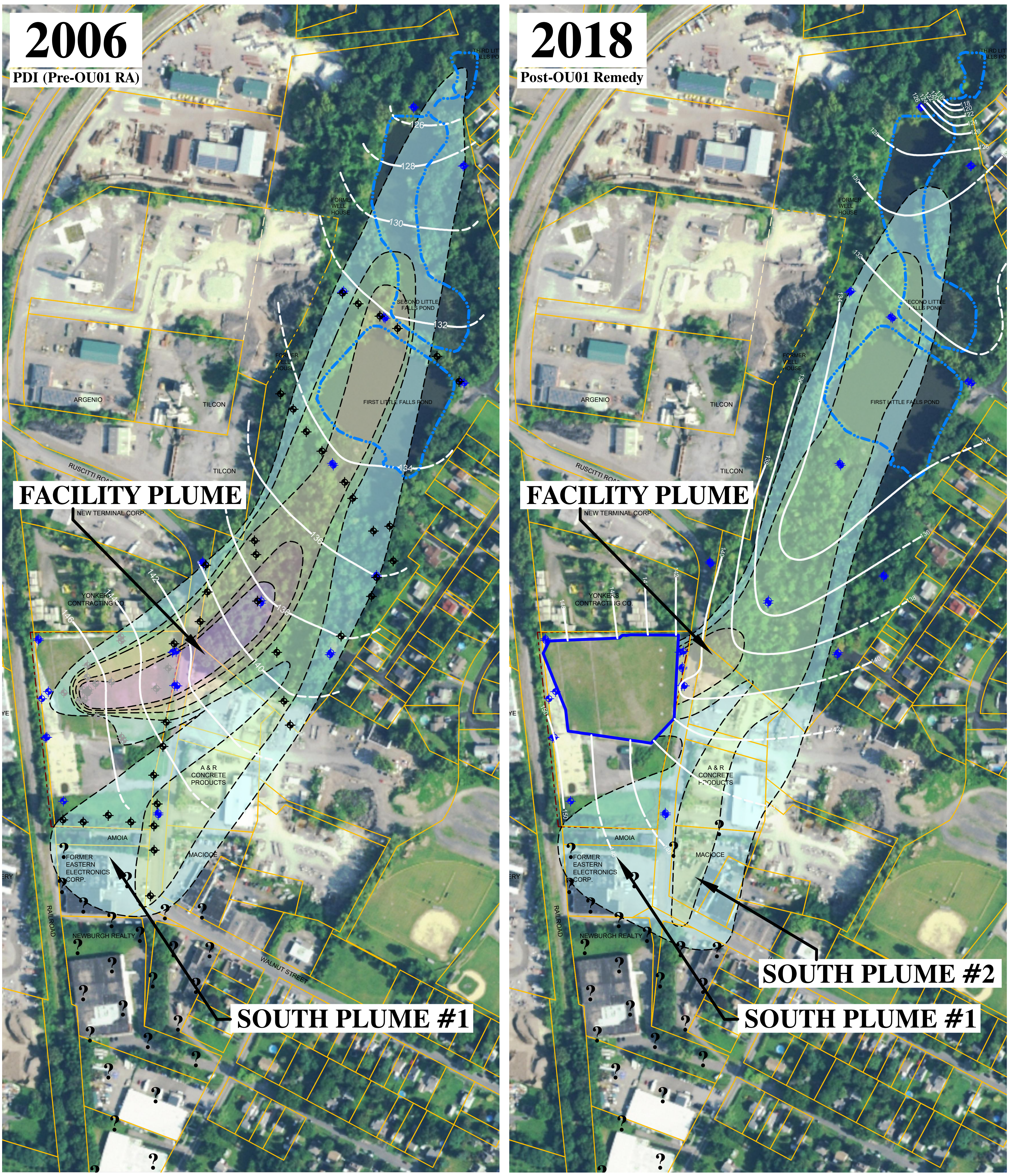

FIGURE 4-17: TCA GROUNDWATER CONCENTRATIONS IN UNCONSOLIDATED DEPOSITS: 2006 & 2018
FORMER DENNISON/MONARCH SYSTEMS SITE
NEW WINDSOR, NEW YORK

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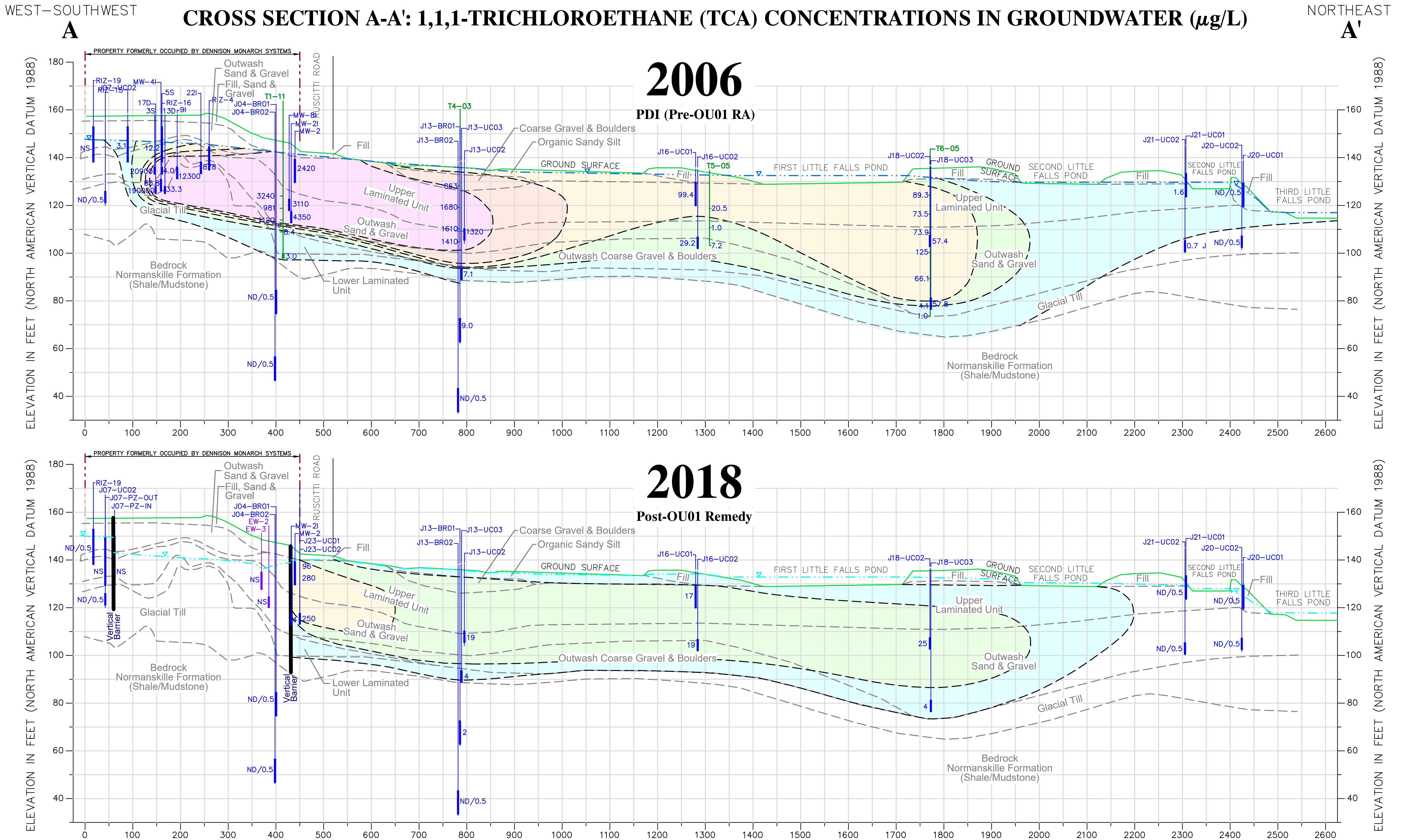
Drawn by: TEH Date: 01/02/19
Chk'd by: GWL Date: 06/26/19
Scale: As Shown Project: 58300.00

\\vhb\gbl\proj\Montpelier\58300.00 ADC New Windsor NY\JCOdata\CAD\AAR 2018\VOC 2018 122018.dwg

CROSS SECTION A-A': 1,1,1-TRICHLOROETHANE (TCA) CONCENTRATIONS IN GROUNDWATER (µg/L)



KEY

- 1 µg/L < [TCA] < 10 µg/L
- 10 µg/L < [TCA] < 50 µg/L
- 50 µg/L < [TCA] < 500 µg/L
- 500 µg/L < [TCA] < 1000 µg/L
- 1000 µg/L < [TCA]

ND/0.5 = Non Detect/Detection Limit; NS = Not Sampled

\\vhb\gbl\proj\Montpelier\58300.00 ADC New Windsor NY\JCOdata\CAD\AAR 2018\Cross section A-A' 20181204.dwg

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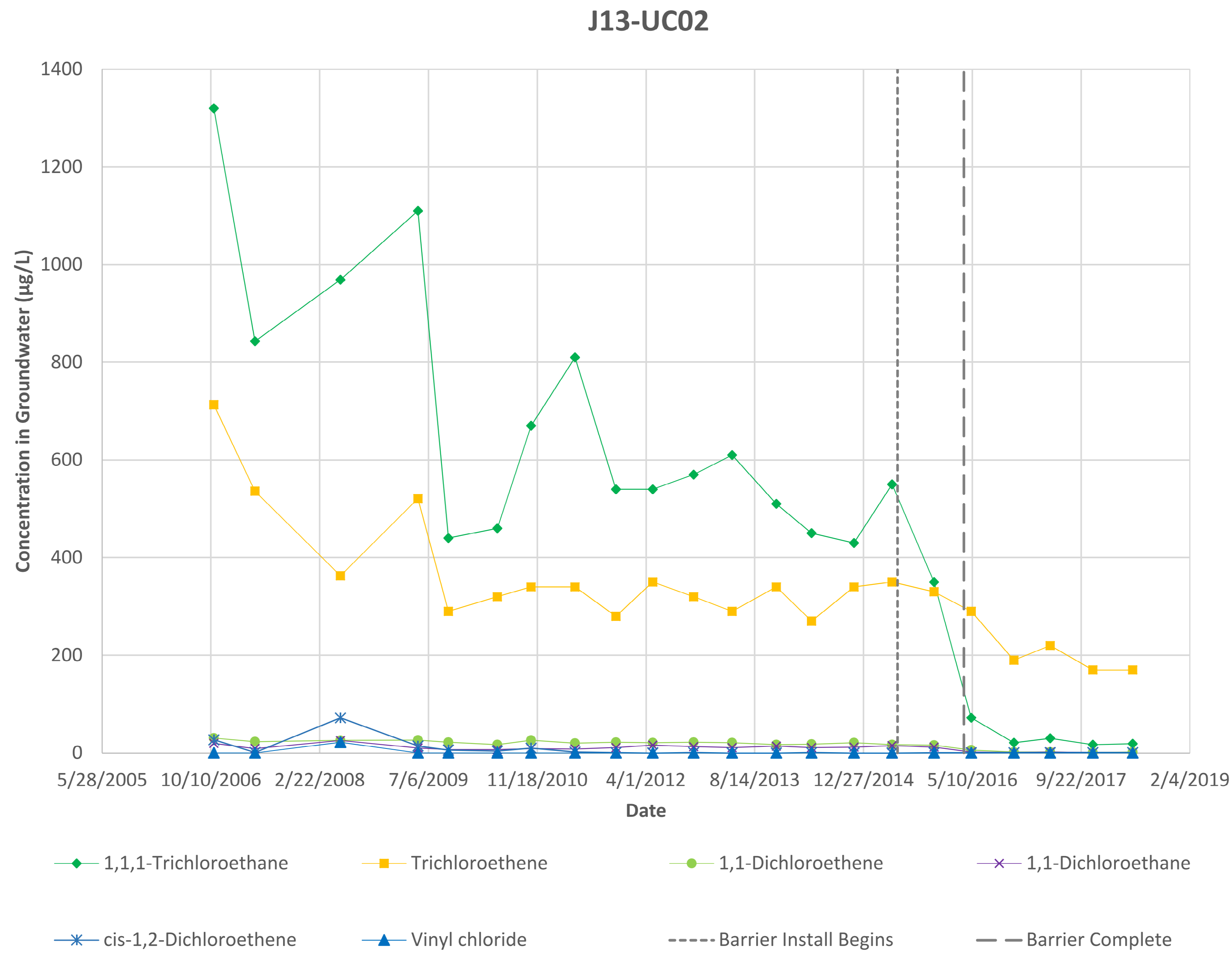
Drawn by: TEH Date: 01/07/19
Chk'd by: GAK Date: 01/07/19
Scale: As Shown Project: 58300.00

FIGURE 4-18: TCA GROUNDWATER CONCENTRATIONS ALONG CROSS-SECTION A-A': 2006 & 2018
FORMER DENNISON/MONARCH SYSTEMS SITE
NEW WINDSOR, NEW YORK

J13-UC02; ~300 FEET DOWNGRADIENT OF OU01



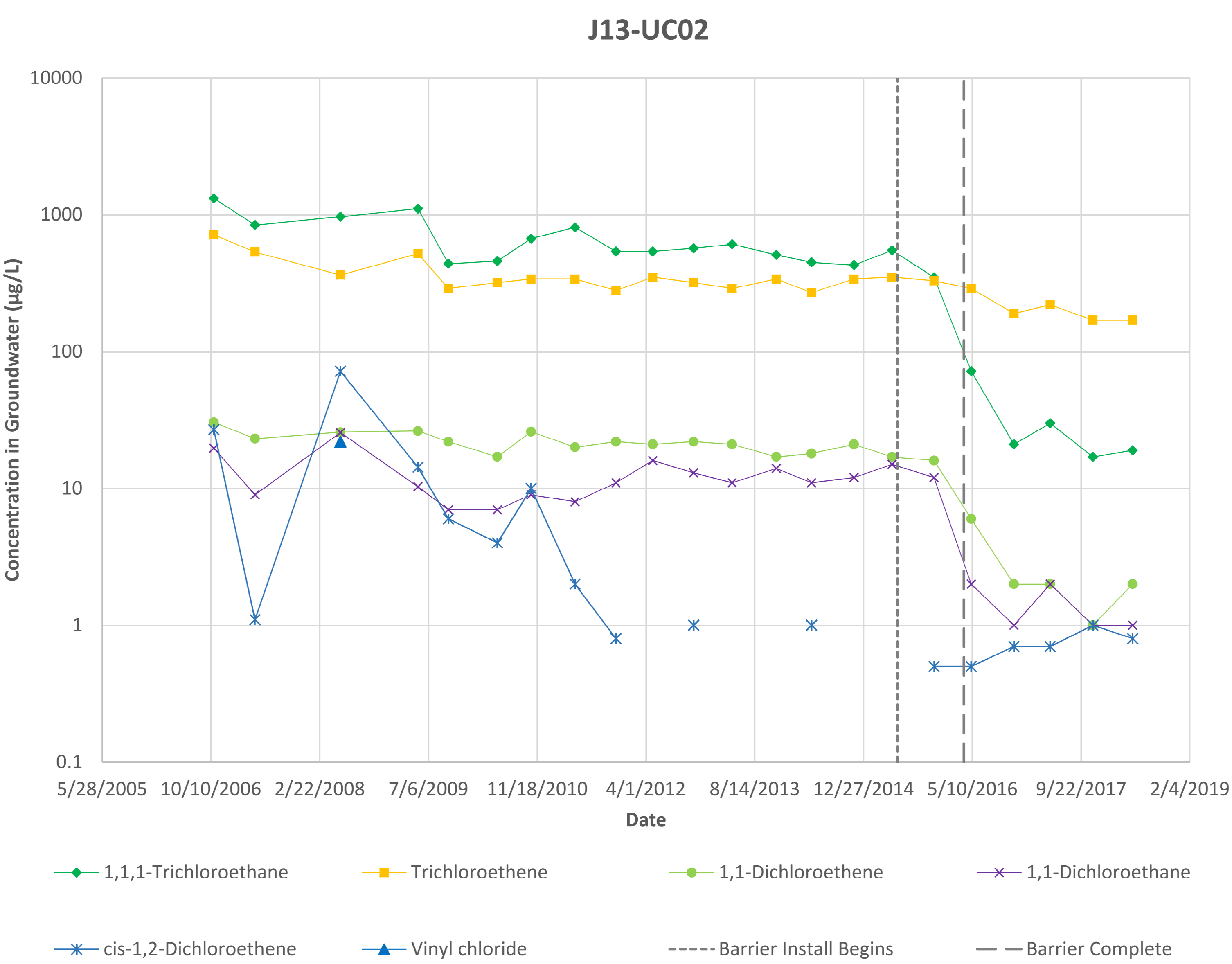
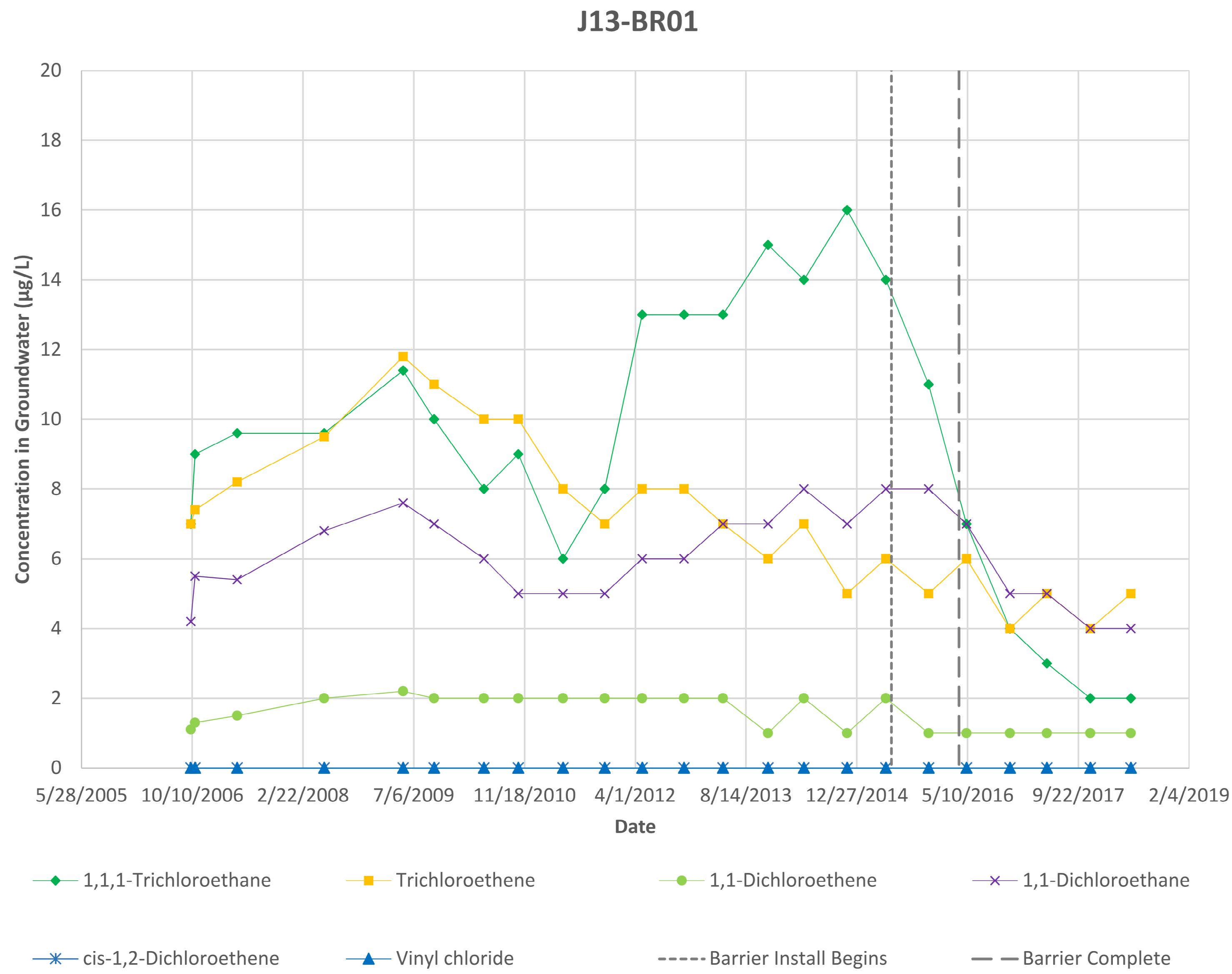


FIGURE 4-19: COC CONCENTRATION TRENDS
IN UNCONSOLIDATED DEPOSITS GROUNDWATER
FORMER DENNISON/MONARCH SYSTEMS SITE
NEW WINDSOR, NEW YORK

VHB Engineering, Surveying Landscape and Geology, P.C.
100 Great Oaks Blvd, Ste 118, Albany, NY

Drawn by: TEH	Date: 01/08/19
Chk'd by: GAK	Date: 01/10/19
Scale: None	Project: 58300.00

J13-BR01; ~300 FEET DOWNGRADIENT OF OU01



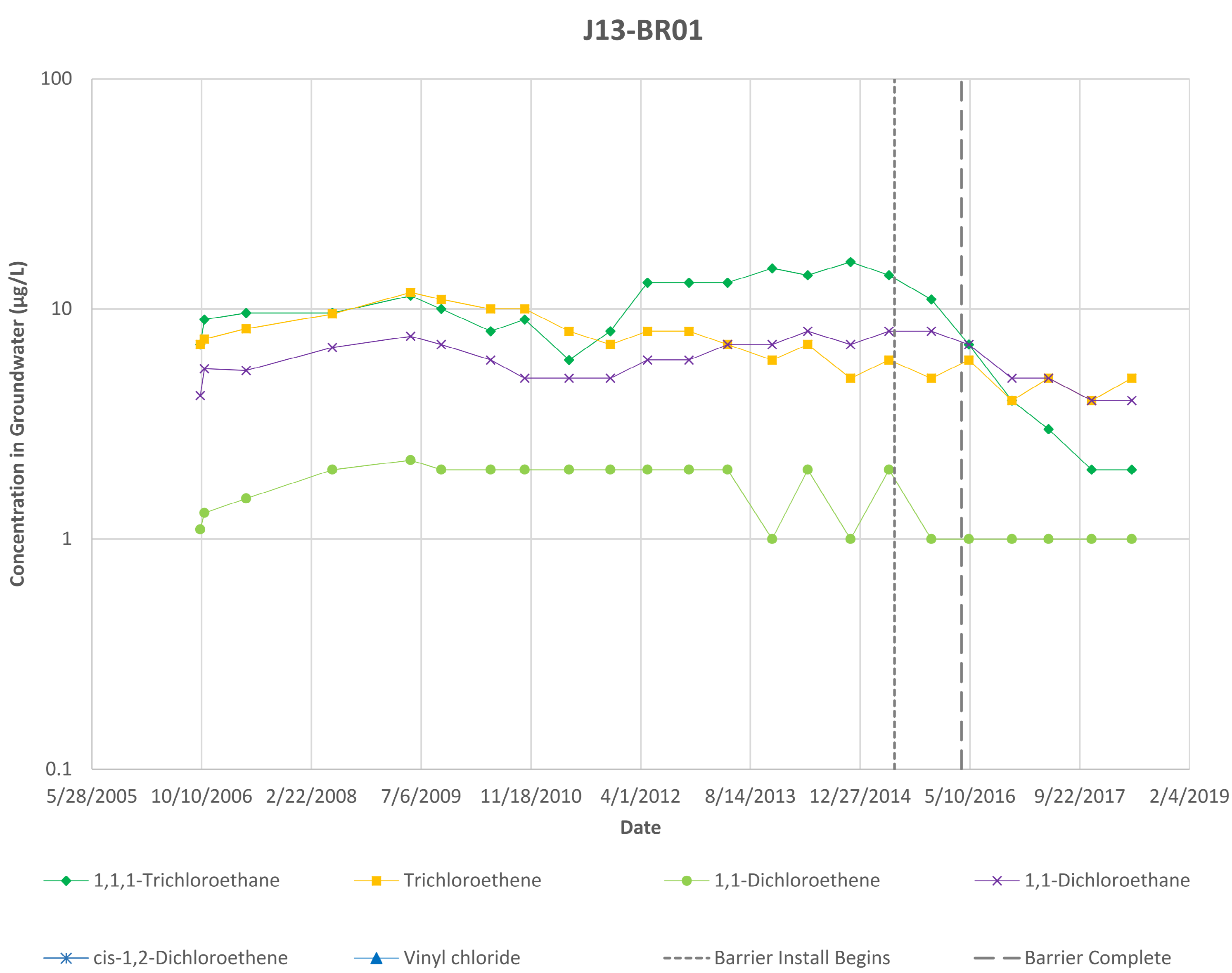
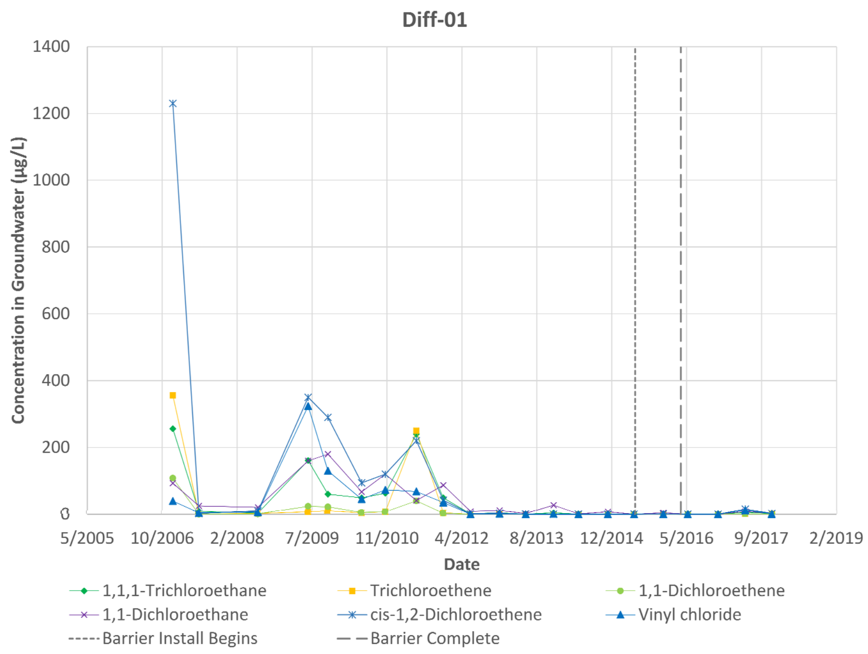


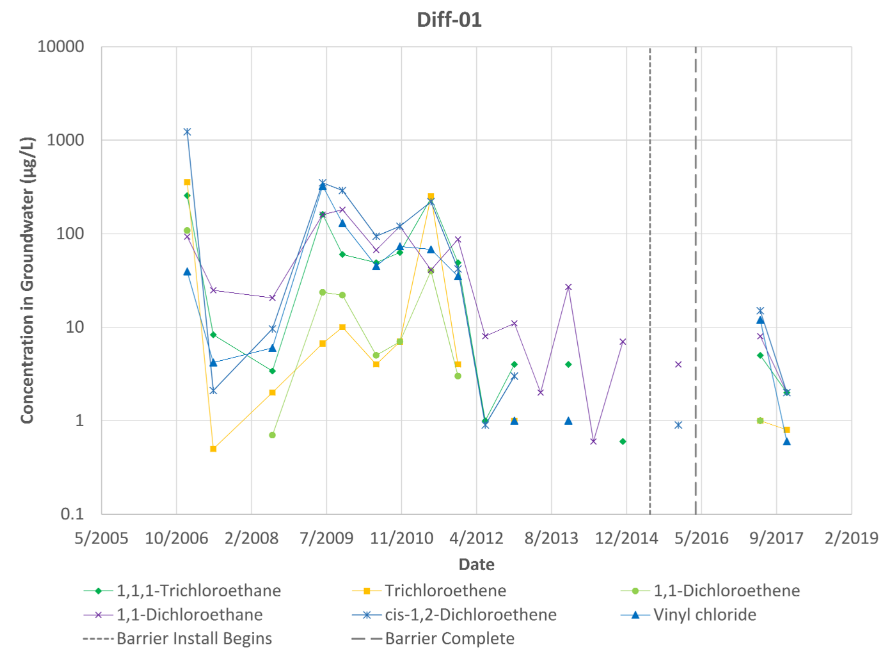
FIGURE 4-20: COC CONCENTRATION TRENDS IN BEDROCK GROUNDWATER
FORMER DENNISON/MONARCH SYSTEMS SITE
NEW WINDSOR, NEW YORK

VHB Engineering, Surveying Landscape and Geology, P.C.
100 Great Oaks Blvd, Ste 118, Albany, NY

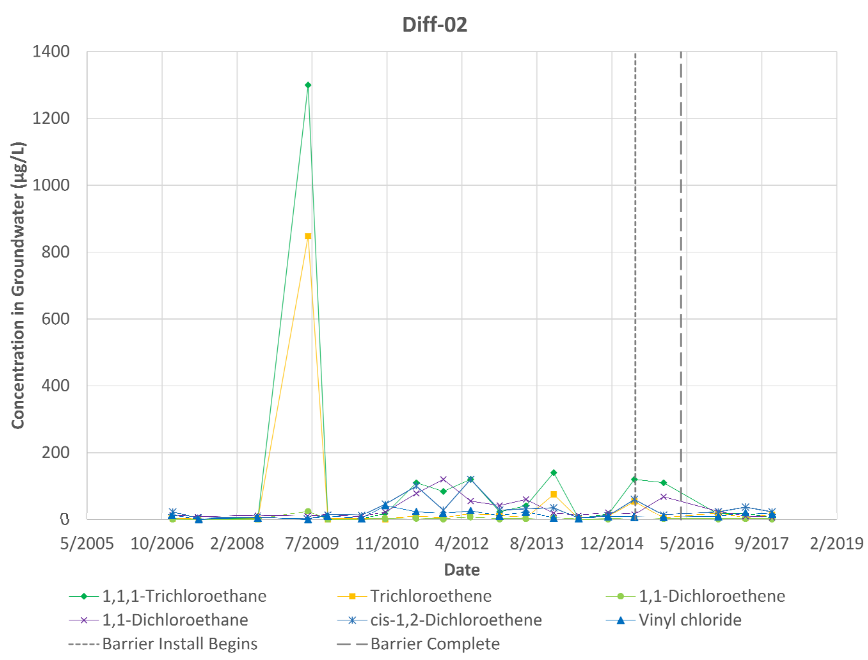
Drawn by: TEH Date: 01/08/19
Chk'd by: GAK Date: 01/10/19
Scale: None Project: 58300.00

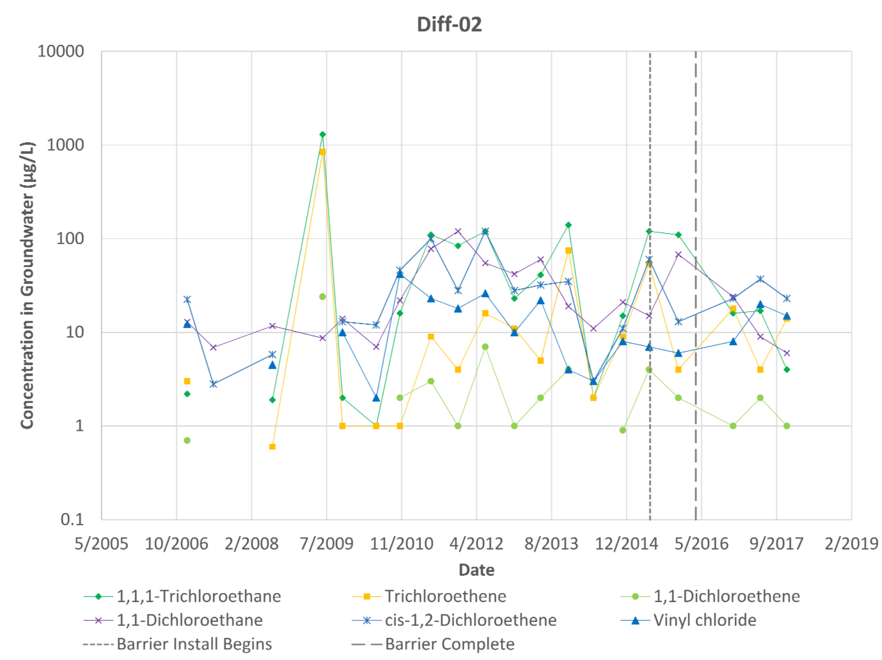
DIFF-01; ~150 FEET DOWNGRADIENT OF OU01



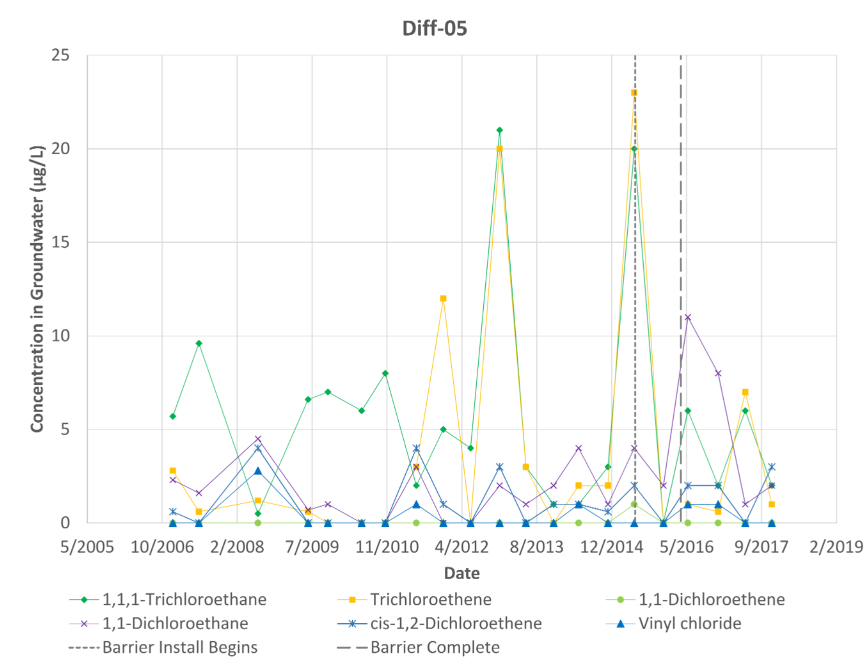


DIFF-02; ~300 FEET DOWNGRADIENT OF OU01





DIFF-05; ~600 FEET DOWNGRADIENT OF OU01



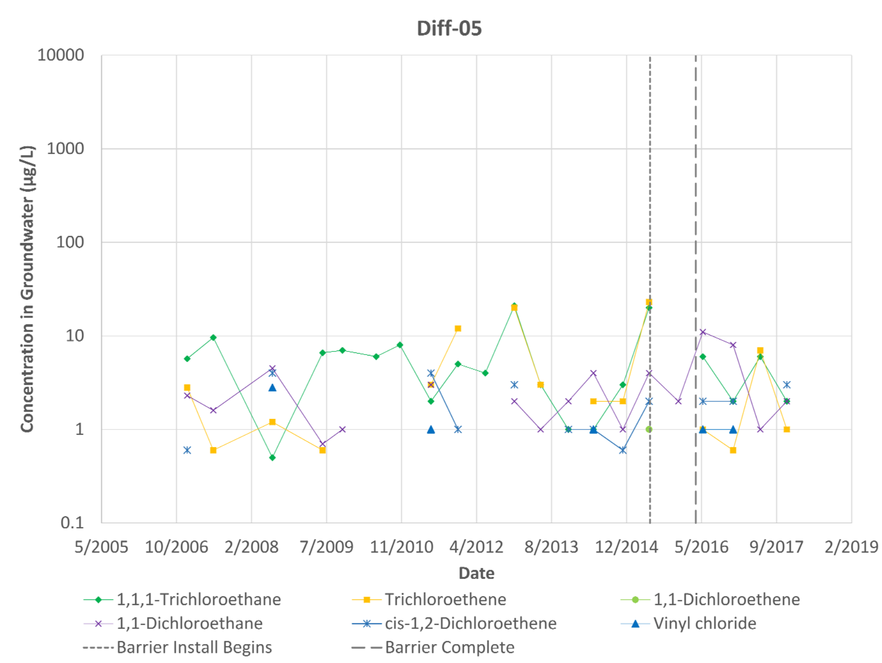


FIGURE 4-21: COC CONCENTRATION TRENDS IN SEDIMENT POREWATER
FORMER DENNISON/MONARCH SYSTEMS SITE
NEW WINDSOR, NEW YORK

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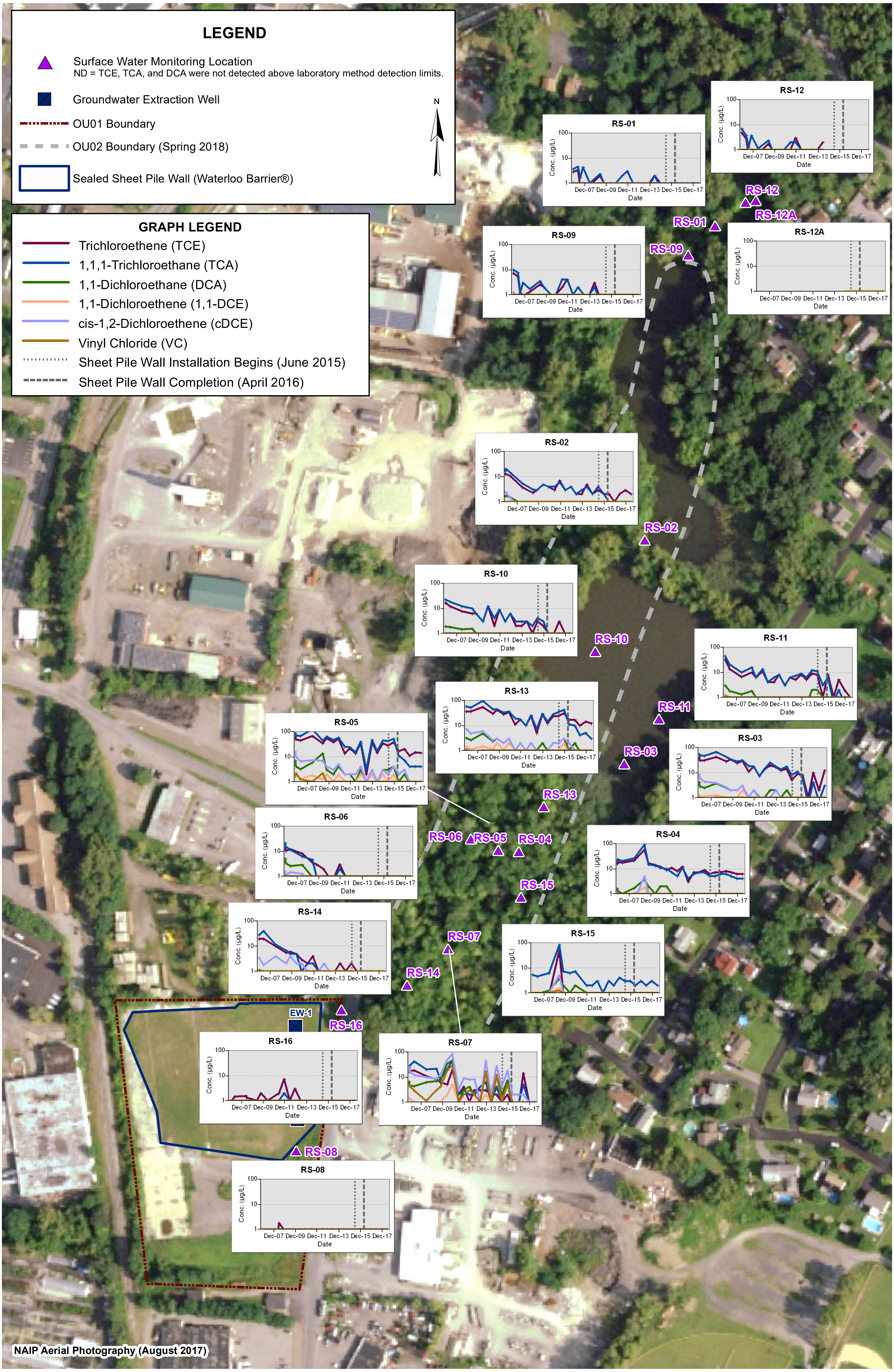
Drawn by: TEH	Date: 01/08/19
Chk'd by: GAK	Date: 01/10/19
Scale: None	Project: 58300.00



0 100 200 300 400

Scale in Feet

FIGURE 4-22: CONCENTRATIONS OF CONSTITUENTS OF CONCERN IN SURFACE WATER: OU01 & OU02 (2006-2018)
FORMER DENNISON/MONARCH SYSTEMS SITE
NEW WINDSOR, NEW YORK

VHB Engineering, Surveying, Landscape and Geology, P.C.
100 Great Oaks Boulevard, Suite 118, Albany, NY 12203

Drawn by: TEH Date: 06/28/18
Reviewed by: GAK Date: 06/28/18
Scale: As Shown Project: 58300.00

5.0 REMEDIAL ACTION OBJECTIVES

The Order defines OU02 as the downgradient and off-site portion of the groundwater contaminants migrating from OU01, i.e., the Facility Plume. The media for which RAOs are considered included:

- groundwater in OU02 that is migrating from OU01;
- soil vapor arising from groundwater in OU02;
- indoor air, if there is a complete vapor intrusion pathway from soil vapor associated with groundwater in OU02;
- sediment at locations in OU02 where groundwater discharges to surface water; and
- surface water.

As described in Section 4.2.6, there are no complete vapor intrusion pathways arising from soil vapor associated with OU02; therefore, soil vapor and indoor air were eliminated from media for which RAOs are considered for this AAR.

As described in Section 4.3, there are no complete exposure pathways for sediments within OU02 (JCO, 2008 – see **Appendix B**). The BHHRA concluded that estimated excess human cancer risks from the Site were below, or within, but near the low-end of, the range of risks considered acceptable by government agencies (1E-04 to 1E-06) and estimated non-cancer hazard indices were all well below the level of concern (hazard index=1). Since the time of the BHHRA, considerable attenuation of COCs has occurred in groundwater, sediment porewater, and surface water. The SLERA concluded no ecological risks were identified for plants, soil invertebrates, fish, amphibians, and wildlife (JCO, 2008), and potential risks to benthic life from COCs were found to be limited to a single sample location near the upstream end of the main tributary leading to the First LFP where concentrations of COCs in sediment porewater have declined since the SLERA was performed. Therefore, sediments are eliminated from media for which RAOs are considered in this AAR.

As described in Section 4.2.5, Section 703 Class C Fresh Water Standards (Class C Standards) were not exceeded at any surface water monitoring location in OU02 in May 2018 and have not been exceeded at any location in OU02 surface water since 2010. Therefore, surface water is eliminated from media for which RAOs are considered in this AAR.

The sole remaining media for which RAOs are to be considered is, groundwater in OU02 that is migrating from OU01, i.e., the Facility Plume – see **Figures 4-15 through 4-18;** therefore**,** the generic NYSDEC RAOs that remain for application to OU02 in this AAR are:

- prevent ingestion of groundwater with contaminant levels exceeding drinking water standards; and
- restore the groundwater aquifer to pre-disposal/pre-release conditions, to the extent practicable.

With regard to the former, the area is served by Publicly Owned Treatment Works, and the EPA Safe Drinking Water Information System (SDWIS), National Water Information System (NWIS), NYSDEC Water Well Program, and the Federal Reporting Data System (FRDS) Public Water Supply Information (PWSI) databases do not indicate presence of water supply wells within one mile of the Site. Moreover, as described in Section 3.0, the former municipal water supply wells adjacent to OU02 have been out-of-service for 30 or more years and are abandoned, in a state of disrepair, and are not permitted for operation; and, when the Town of New Windsor adopted an updated and revised zoning code in 2012, the LFP property and the surrounding area was *not* designated as a "Watershed Overlay District". Therefore, ingestion of groundwater with COCs exceeding drinking water standards is not a current exposure pathway. And, per Section 6.2.1., an environmental easement to prevent future use of OU02 groundwater as a drinking water source is a component of the planned remedy; therefore, since there is no current or future exposure pathway from ingestion of groundwater, it is eliminated as an RAO for this AAR.

There is, therefore, one remaining RAO for OU02: restore the groundwater aquifer to pre-disposal/pre-release conditions, to the extent practicable.

6.0 IDENTIFICATION, DEVELOPMENT, AND SCREENING OF REMEDIAL ALTERNATIVES

6.1 General Response Action

With the source area of the Facility Plume now effectively isolated by the in-place and effective OU01 RA, the General Response Action for the OU02 RA is to select a remedial alternative suitable for mitigating the low-level COCs of the remnant Facility Plume in OU02 that is already naturally attenuating.

As is required to define by Section 4.3(a)3 of DER-10, the estimated area and volume of the remnant Facility Plume in OU02 is, as of May 2018, currently approximately 12 acres and contains an estimated 60 million gallons of groundwater. As the Facility Plume continues to naturally attenuate, its area and volume will decrease.

6.2 Identification and Screening of Remedial Technologies

With regard to the application of remedial technologies, the NYSDEC-approved PDI Report (JCO, 2008) evaluated the comprehensive PDI dataset to identify and screen remedial technologies for implementability and effectiveness of mitigating the Facility Plume should the source area be remediated or isolated. Since the COC source area of the Facility Plume has now been effectively isolated by the OU01 RA (JCO, 2018), that screening of remedial technologies – see Section 6 of **Appendix B** – is applicable to this AAR. Per the screening evaluation, enhanced in-situ bioremediation by biostimulation (EISB) is retained for evaluation as a remedial alternative, as is monitored natural attenuation (MNA), which has already demonstrated effectiveness at reducing concentrations of COCs in OU02 groundwater, both before and after implementation of the OU01 RA. A no action alternative is also presented and evaluated herein, as is an excavation and disposal (E&D) alternative, which was requested by NYSDEC for comparative purposes.

6.2.1 Institutional Controls

Institutional controls (ICs) in the form of an environmental easement will be included as a component of an MNA or EISB remedy. Notwithstanding the current absence of use of OU02 groundwater as a source of potable or process water, the ICs will protect human health by prohibiting the use of OU02 groundwater for such purposes without necessary water quality treatment as determined by the NYS Department of Health (DOH) or Orange County DOH. Also, prior to the construction of any future building within OU02 that is intended for human occupation, the ICs will require a vapor intrusion pathway evaluation be performed in accordance with the "Guidance for Evaluating Soil Vapor Intrusion in the State of New York" (NYSDOH, 2006) to maintain the protectiveness of human health.

6.2.2 No Action

The no action alternative assumes no remedial action is performed in OU02 and is a baseline alternative to which other remedial alternatives are compared. Under this alternative, the already demonstrated natural attenuation in OU02 would continue, but no monitoring would be performed. The no action alternative does not include ICs.

6.2.3 Monitored Natural Attenuation

An MNA remedy is a monitored evaluation of the attenuation that results from natural physical, chemical, or biological processes that act without human intervention to reduce the mass, toxicity, mobility, volume, mass flux, mass discharge or concentration of COCs in groundwater. Examples of such in-situ processes include: biodegradation, dispersion, dilution, sorption, volatilization, and chemical or biological transformation or destruction of COCs. At least several of these natural in-situ processes have been underway in OU02 and are expected to continue. Dispersion and dilution are natural mechanical processes that occur in all situations with flowing groundwater in the natural hydrologic cycle, and key organisms for biodegradation were confirmed at the Site with acceptable frequency and presence of necessary microbial genes, as described in Section 4.2.2. The data clearly indicate natural attenuation of COCs in OU02 groundwater, even prior to the OU01 RA – see **Figures 4-7** through **4-10**. The NYSDEC-approved AAR/RAWP (JCO, 2013) formally concluded natural attenuation of COCs was occurring in OU01 and OU02 prior to implementation of the OU01 RA showing that "*the extent of the groundwater plume of Site constituents has attained a steady-state condition and concentrations at its core are declining.*"

The source zone of the Facility Plume was effectively isolated by the installation of the OU01 RA, for which the OU01 groundwater extraction and treatment system began operation in December 2015 and the sealing of the Waterloo Barrier® was completed in April 2016. As described in Section 3.0, the NYSDEC-approved OU01 RARs for 2016 and 2017 (JCO, 2017c; JCO, 2018) provided certification of the effective performance of the OU01 RA which has already resulted in accelerated attenuation of concentrations of COCs in the core of the Facility Plume, particularly for TCA and its reductive dechlorination daughter product, 1,1-DCE – see **Figures 4-11 through 4-12, and Figure 4-20**. The observed accelerated reduction of COC concentrations is early relative to the expected average groundwater flow velocity in shallow unconsolidated deposits of 65 to 130 feet per year and is even earlier when retardation due to sorption/desorption processes are considered. The reduction of COC concentrations is occurring and accelerated attenuation is expected downgradient as additional time passes post-OU01 RA implementation. And, as discussed in Section 4.2.2 and concluded in the NYSDEC-approved 2017 OU01 RAR, "*given the OU01 RA is performing as designed, any on-going contribution of OU01 constituents to groundwater in OU02 will continue to decline, and relative contributions to OU02 by South Plume #1 and South Plume #2, as defined in the NYSDEC-approved AAR/RAWP, will continue to increase*." As provided by the Order, ADC is not responsible for South Plume #1 and South Plume #2.

The groundwater and surface water of OU02 is currently monitored as a component of the groundwater and surface water monitoring that is performed semi-annually per the NYSDEC-approved OU01 SMP. Per the OU01 SMP, that monitoring program is to continue until spring 2021, which is five years following completion of the OU01 RA construction; and, per the OU01 SMP, the period, frequency, and duration of monitoring will be evaluated after that.

Table 6-1 is a comparison of the current monitoring program specified in the OU01 SMP[1] and the monitoring scope for each OU02 remedial alternative. The primary difference between current monitoring per the OU01 SMP and the monitoring proposed for the OU02 MNA alternative is the cessation of surface water monitoring, which is supported by the lack of exceedances of the Class C Standards in OU02 surface water since 2010, and the observed natural attenuation described herein. Additionally, it is assumed that, beginning in 2021 when the program specified in the OU01 SMP is to be reviewed, long-term monitoring for the MNA alternative will also be reviewed. For purposes of this AAR, it is assumed the long-term monitoring for the MNA alternative will be reduced to include only groundwater and sediment pore water monitoring locations located within the boundary of the Facility Plume.

[1] The OU01 SMP includes monitoring locations within OU01, within OU02, and boundary locations in the Little Falls Ponds property outside of OU01/OU02. The monitoring locations discussed herein do not include those located in OU01.

6.2.4 Enhanced In-Situ Bioremediation (EISB) by Biostimulation

For OU02, the NYSDEC-approved PDI Report (JCO, 2008) concluded *"there is ample evidence that the necessary key organisms are present as of the time of this study; therefore, bioaugmentation is probably not necessary for current conditions [in OU02]. The key organisms express dechlorinating enzymes with acceptable frequency, and the key genes are present."* (JCO, 2008). The PDI Report further identifies biostimulation as *"a feasible approach to stimulate biodegradation, if necessary following [OU01] source area treatment"* (JCO, 2008). As stated above, and in the NYSDEC-approved 2017 OU1 RAR, the effective isolation of the source area of the Facility Plume by the OU01 RA means "*…any on-going contribution of OU01 constituents to groundwater in OU02 will continue to decline, and relative contributions to OU02 by South Plume #1 and South Plume #2, as defined in the NYSDEC-approved AAR/RAWP, will continue to increase*" (JCO, 2018). Therefore, as a remedial alternative for OU02, the purpose of EISB would be to attempt to accelerate the MNA that is already occurring in an area for which the BHHRA and SLERA showed the Facility Plume in OU02 groundwater does not result in an unacceptable risk, and in an area that is affected by other plumes migrating from sources not associated with the Site. As provided by the Order, ADC is not responsible for South Plume #1 and South Plume #2.

Stroo and Ward (2010) describe biostimulation as a process of stimulating anaerobic degradation of chlorinated solvents by delivering a fermentable organic substrate (to produce hydrogen) or a direct electron donor (such as hydrogen or acetate) into the subsurface for the purpose of stimulating microbial growth and development. The direct addition of electron donor creates an anaerobic treatment zone conducive to biodegradation of chlorinated solvents dissolved in groundwater, and the process may increase the rate of desorption or dissolution of COCs sorbed to the aquifer matrix.

Anaerobic bioremediation of chlorinated solvents is not an instantaneous process; the time required to develop the appropriate environmental conditions and to grow a microbial population capable of complete degradation may be on the order of several months to years at most sites (Stroo and Ward, 2010). Additionally, repeated applications of substrate will likely be required, at which point the existing MNA program would have already further attenuated the Facility Plume.

Several system configurations and delivery strategies can be used to distribute organic substrates in the subsurface. Direct injection of liquid substrates into the subsurface by direct-push or permanent injection wells, groundwater recirculation systems, infiltration galleries or trenches are all options to consider. The determination of the delivery strategy is made in the design phase, often as a result of pilot testing, and is dependent, at least in part, on the type of substrate to be applied. Available substrate types include soluble (e.g., lactate, molasses), slow-release (e.g., HRC®, emulsified vegetable oil), or solid substrates (e.g., mulch, chitin). Stroo and Ward (2010) note that solid substrates are not practical for large plumes of many acres (OU02 is 12 acres), leaving two options for consideration for OU02: soluble substrates, or slow-release substrates.

Advantages of soluble substrates include the ability to readily distribute the substrate in the subsurface and to modify the rate at which the substrate is applied over time to more accurately achieve the desired biogeochemical conditions (Stroo and Ward, 2010). The primary disadvantages are the requirement for multiple injections and the potential for biofouling, resulting in a greater timeline for injections and higher operation and maintenance cost. Adjusting substrate loading rates and mixing ratios during the initial phase of injection is also often necessary (Stroo and Ward, 2010).

Advantages of slow-release substrates include the need for less frequent injections; in fact, a single injection often may be sufficient if adequate contact and coverage with the Facility Plume can be achieved and could last on the order of 1 to 4 years (Stroo and Ward, 2010). The primary disadvantage is that it is difficult to modify the biogeochemical conditions of the reaction zone after the initial injection; therefore, there is less flexibility and room for optimization with design, increasing the likelihood for necessary additional injection(s). Also, the plumes of dissolved substrate created by the slow-release source generally do not extend more than a few tens of feet from the point of injection, thereby requiring a higher resolution of injection points.

Direct injection is the simplest approach for addition of substrate and is likely to be suitable for the upper unconsolidated deposits in OU02, but not the lower part of the unit, and is only practical for slow-release substrates such as HRC ® or vegetable oil emulsions (Stroo and Ward, 2010). Permanent injection wells are used with soluble substrates where continuous or multiple injections of substrate are required, or where recirculation will be used to improve distribution (Stroo and Ward, 2010). Recirculation wells, infiltration galleries and trenches require additional infrastructure and land disturbance to implement but can be more effective at overcoming site-specific limitations that may include low permeability or a high degree of heterogeneity that limits the ability to effectively distribute the substrate throughout the treatment zone.

Effective mixing of substrate within the plume is one of the most difficult challenges for biostimulation (Stroo and Ward, 2010). Well spacing perpendicular to groundwater flow may range from 1.5 m (5 ft) on center for passive systems in low permeability silts and clays, to perhaps 6 m (20 ft) or more in permeable formations (Stroo and Ward, 2010). When it is not practical to cover the plume in a grid configuration, as would be the case for the 12 acres of Facility Plume in OU02, several rows of injection wells would be necessary to truncate the plume into smaller segments. Suthersan et al. (2002) recommend a 100-day travel time distance as an optimal spacing of injection wells parallel to the direction of groundwater flow for plume-wide treatment, which would be approximately 20 to 40 feet for upper unconsolidated deposits based on estimated average groundwater velocities presented in Section 4.1.3.

These stated challenges notwithstanding, a conceptual EISB design and cost estimate has been completed for this AAR. Pilot testing, which is included in the cost estimate, is likely to substantially influence the scope and cost of the final design, and would provide important additional design data such as the presence and number of existing dechlorinating organisms, oil retained per unit mass of aquifer material (ORM), injection methods and rates, radii of influence, and type and volume of substrate, etc.

The conceptual design considered herein is based on existing OU02 data, peer-reviewed literature, and professional judgement. The conceptual design assumes injections of enriched emulsified vegetable oil (EEVO)[1], a slow release compound, are performed by direct injection using a direct push drill rig over discrete vertical intervals to a depth of approximately 40 feet with a five-foot radius of influence. At each injection location, a volume of potable water equal to 25% of the injected EEVO volume would be used as chase water for the EEVO injections. An engineering analysis based on pilot testing must be performed to determine the volume and injection rate of both the substrate and chase water to limit mobilization of the Facility Plume.

The heavily wooded and swampy nature of the southwestern portion of OU02 limits the locations that can be practicably accessed by a drill rig; therefore, three zones were selected to for EEVO injections, as shown on **Figure 6-1**. Each zone encompasses the width of the estimated 50 µg/L TCE isocontour of the Facility

[1] EEVO was selected for this analysis, pilot testing is required to confirm the effectiveness of EEVO.

plume in OU02.[1] Each injection point and the associated estimated radius of influence are shown on **Figure 6-1**. Using the conceptual layout and existing OU02 data, the EEVO substrate requirements were estimated using the online EOS® Design Tool.[2] Then, using an assumed injection rate of 10 gallons per minute, the time required for injection was calculated, which is approximately 26 weeks for all three zones. A zone-by-zone summary of the injection information is included on **Figure 6-1**.

Additional considerations used in the development of the implementation cost estimate include traffic control on Ruscitti Road for the duration of the Road Zone injections and resurfacing of Ruscitti Road following the injections. Underground utility locations are not considered for conceptual design purposes but must be confirmed and considered in the final design. The installation of the injection wells and the supporting infrastructure will result in increased truck and equipment traffic in the LFP Property and surrounding area and result in loss of some vegetated area and associated habitat for access roads and equipment pads and paths, creating the need to obtain wetland construction permits. The process of obtaining wetland construction permits and the compensatory measures that may be required are not incorporated into the conceptual design considered herein, but may result in considerable additional cost and duration for implementation.

The cost estimate includes pilot testing, design and permitting, installation, and five years of groundwater and surface water monitoring using the monitoring program for OU02 that is specified in the OU01 SMP,[3,4] but with the addition of sampling and analysis for total organic carbon, nitrate, sulfate, and dissolved gases, as shown on **Table 6-1**. The additional sampling and analysis will provide data that can be used to determine the ongoing effectiveness of the EISB remedy by ensuring that the in-situ conditions remain favorable for sustaining anaerobic degradation of chlorinated solvents and to verify that there are no negative impacts to groundwater or surface water in the LFP property outside of OU02.

6.2.5 Excavation and Disposal

NYSDEC requested excavation and disposal (E&D) of all soil in OU02 that is in contact with the Facility Plume be considered as a remedial alternative in this AAR for comparative purposes. ICs would not be required for OU02 in this alternative. It is important to note that for such an E&D remedy to be effective for prompt restoration to a pre-disposal condition, South Plume #1 and South Plume #2 must be addressed beforehand, as they would otherwise continue to contribute contamination to OU02 after the E&D remedy is implemented.

There are numerous design and implementability challenges for an E&D remedial action, particularly given the current large 12-acre footprint of the Facility Plume in OU02, and its volume – approximately 60 million gallons of groundwater. Moreover, OU02 is located within a stormwater retention control system[5] that receives a concentration of stormwater during storm events, and such stormwater would need to be managed during excavation activities. The excavation extents include two of the Little Fall Ponds; thus, the excavation, would trigger permitting under Section 404 of the Clean Water Act (CWA). The permitting

[1] The 50 µg/L TCE isocontour was selected as the extents of the injection zone because it is the widest 50 µg/L isocontour of any of the primary OU02 COCs.

[2] Found at: https://www.eosremediation.com/eos-design-tool/, accessed on June 3, 2019.

[3] The OU01 SMP includes monitoring locations within OU01, within OU02, and boundary locations in the Little Falls Ponds property outside of OU01/OU02. The monitoring locations discussed herein do not include those located in OU01.

[4] The monitoring program in OU1/OU2 required by the OU01 SMP will be reviewed with NYSDEC following the Spring 2021 monitoring event.

[5] The reservoir capacity of Little Falls Ponds provides for stormwater attenuation during precipitation events.

process would likely require extensive investigation and stipulations for significant compensatory measures due to the impacts to the natural habitat. The permitting process may delay the implementation of an E&D remedial by at least one year.

The depth of excavation would be approximately 40-50 feet in most locations. Groundwater in the excavation area is within a few feet of ground surface. This would preclude conventional dewatering and excavation and would require the installation of sheet piling with tiebacks or a similar method of excavation shoring. Upward hydraulic gradients from bedrock and the reported high yield of the overburden (as much as 200 gallons per minute in the former water supply wells of the LFP property) would require a specialized dewatering system design. The groundwater removed from the excavation areas would require sedimentation and treatment for low-level dissolved VOCs. Approximately 980,000 cubic yards of soils would be removed from OU02 and disposed of at an appropriate disposal facility. Engineered fill would be required for backfill within the excavation area to ensure there are not adverse effects to the groundwater and surface water hydrology in the area.

The conceptual approach for the excavation is to complete shored zones of 1-2 acres in a leap-frog fashion beginning at the eastern edge of OU01. The OU01 Waterloo Barrier® would need to be braced as it was not designed to resist lateral earth pressures at the depths required for excavation. The dewatering in the vicinity would impact the performance of the OU01 RA. The excavation would create a groundwater sink that would draw OU01 groundwater below the Waterloo Barrier® and through the glacial till that it is keyed-in to. The potentiometric depression created by the dewatering operations could result in the loss of inward hydraulic gradients across the Waterloo Barrier, the primary requirement for continued effectiveness of the OU01 RA.

Excavation of OU02 in the vicinity of Ruscitti Road would require long-term closure of the road and would require the relocation/realignment of multiple utilities including water lines, sewer lines, stormwater piping, and overhead power lines. Due to the depth of excavation, all utilities would require a temporary realignment during excavation before final replacement during backfill operations.

The LFP receive stormwater from OU01 (including the 36" reinforced concrete storm drain line that enters OU01 from the west and daylights on OU01 near the OU01 RA discharge), the properties along Ruscitti Road, the neighborhoods to the east of OU02, and from the commercial properties to the west of OU02. A stormwater bypass system would have to be designed to bypass all stormwater entering the LFP property during remedy implementation. The bypass system could be altered as required for different phases of the project but would need to be able to convey all stormwater around the LFP property. The temporary stormwater bypass system would be required to perform the same flood attenuation function as the LFP currently do for the regional stormwater. A design for stormwater management is beyond the scope of this AAR, however it would likely require at least sedimentation and/or filtration along with pollutant discharge elimination system permits.

Prior to the start of excavation in the LFP area, the ponds would need to be dewatered and approximately 9 acres of swamp soils and vegetation would need to be cleared and grubbed and substantial natural habitat would be destroyed. Temporary roads would need to be constructed within the LFP area and/or in the neighborhoods to the east of the LFP property to accommodate the truck traffic required to remove 980,000 cubic yards of soil. Following the completion of excavation, the swampy area would be restored to its current state to the extent practicable, but complete habitat restoration would likely take several years.

A Community Air Monitoring Plan (CAMP) would be required for all excavation activities. The magnitude of excavation would require major dust control measures to minimize fugitive dust, particularly in the neighborhoods to the east of OU02. The excavations and haul routes would need to be near continuously watered and brushed to reduce airborne dust.

6.3 Evaluation of Remedial Alternatives

The four remedial alternatives (no action, MNA with ICs, EISB with ICs, and E&D) were evaluated using the evaluation criteria set forth in 6 NYCRR 375-1.8(f) in conjunction with DER-10 section 4.2(b)-(j) including:

- Overall Protectiveness of the Public Health and the Environment
- Compliance with Standards, Criteria, & Guidance
- Long-term Effectiveness & Permanence
- Reduction of Toxicity, Mobility, or Volume
- Short-term Effectiveness & Impacts
- Implementability
- Cost Effectiveness
- Land Use

6.3.1 Overall Protectiveness of Human Health and the Environment

The BHHRA and SLERA published in 2008 did not identify any unacceptable human health or ecological risk posed by COCs in OU02 groundwater (JCO, 2008). MNA of the Facility Plume has since resulted in decreasing concentrations of COCs in OU02 groundwater and will continue to do so, particularly given the ongoing implementation of the OU01 RA that began in 2015/2016 which effectively isolates the source area of the Facility Plume. Therefore, MNA, in conjunction with ICs, will continue to be protective of human health and the environment.

If implemented effectively, EISB can accelerate the already occurring natural attenuation of COCs in OU02 groundwater; however, as noted in the NYSDEC-approved PDI Report (JCO, 2008) and in Stroo and Ward (2010), reactions may be incomplete if effective implementation is unable to be performed in all portions of the treatment area, resulting in creation of daughter products with higher risk profiles than the primary COCs - vinyl chloride is an example. Also, if South Plume #1 and South Plume #2 are not addressed, contamination unrelated to the Site would continue to migrate into the LFP property.

Following implementation and successful remediation of South Plume #1 and South Plume #2, an E&D remedy would be protective of human health and the environment, if implementable following final design. During implementation of an E&D remedy, human health and the environment may be at risk due to new exposure pathways associated with removal of OU02 soil and groundwater, and due to disruption of the flood attenuation provided by the LFP reservoirs.

Under the no action alternative, continued ongoing natural attenuation would occur, particularly given the ongoing implementation of the OU01 RA that began in 2015/2016 which effectively isolates the source area of the Facility Plume. In contrast with the MNA alternative, the no action alternative does not include ICs that would ensure protectiveness of human health in OU02 while the plume continues to attenuate.

6.3.2 Compliance with Standards, Criteria and Guidance

Table 6-2 provides an evaluation of each remedial alternative with regard to applicable standards, criteria and guidance (SCG), as referenced in NYSDEC's DER-10 and the NYSDEC website. The no action alternative does not fully comply with the SCGs. MNA, EISB, and E&D alternatives will comply with SCG; however, 6 CRR Part 703 Class GA groundwater standards will not be met in the short-term for the no action, MNA, and EISB alternatives. The no action alternative does not provide a means for measuring the ongoing effectiveness and compliance with SCGs.

If implemented effectively, EISB will attain the groundwater standards faster than by MNA alone; however, as noted above, it can take several months to years to grow the microbial population to suitable levels. The NYSDEC-approved OU01 AAR/RAWP acknowledged this and noted significant reductions in concentration of COCs may require multiple years and additional EISB augmentations (JCO, 2013).

The long-term success of an E&D alternative requires successful implementation. Additionally, the responsible parties for South Plume #1 and South Plume #2, or NYSDEC, will need to address the contamination of the South Plumes – without effective remediation of the South Plumes prior to undertaking the E&D alternative, the E&D activity is likely to substantially capture the groundwater contamination of the South Plumes and impede long-term success of the OU02 remedy.

6.3.3 Long-Term Effectiveness and Permanence

The no action alternative does not provide a means for verifying long-term effectiveness or permanence, though the ongoing natural attenuation in OU02 would continue, particularly given the ongoing effective operation of the OU01 RA.

MNA relies on natural processes, and its continuing effectiveness for OU02 groundwater was demonstrated even prior to implementation of the OU01 RA, as discussed in Section 4.2.2. Furthermore, with effective operation of the OU01 RA, the accelerated MNA of COC in OU02 groundwater will continue. The OU01 SMP and Environmental Easement requires continued effective operation of the OU01 RA, so the accelerated MNA will continue long-term.

As noted in the NYSDEC-approved AAR/RAWP (JCO, 2013), EISB has proven effective as a 'polishing' step for plumes of chlorinated volatile organic compounds downgradient of remediated source areas under many conditions, with moderate to high performance confidence for mass destruction. Significant concentration reductions may, however, require multiple years and additional augmentations (JCO, 2013). If implemented effectively to accomplish complete reductive dechlorination to ethene and ethane, EISB is expected to be effective in the long-term as an accelerant to MNA.

An E&D alternative will only be effective and permanent as a remedy if South Plume #1 and South Plume #2 are no longer commingling with the Facility Plume in OU02. E&D would include the clearing and grubbing of over 9 acres of OU02 and revegetation of that area following backfill operations, which would affect the habitat for vegetation and wildlife. The backfill of OU02 would need to be carefully designed in order to ensure there is no adverse impact to current land use, hydrogeology, or flood control.

6.3.4 Reduction of Toxicity, Mobility or Volume

As discussed in Section 4.2.2 and Section 6.3.1, and as demonstrated by **Figures 4-11** through **4-18**, natural attenuation is resulting in a decrease in the volume of the Facility Plume in OU02, and with effective operation of the OU01 RA, the decrease is expected to continue. However, the no action alternative has no means of measuring the ongoing reduction of toxicity, mobility or volume.

As discussed in Section 4.2.2 and Section 6.3.1, and as demonstrated by **Figures 4-11** through **4-18**, natural attenuation is resulting in a decrease in the volume of the Facility Plume in OU02, and with effective operation of the OU01 RA, the decrease is expected to continue and will be verified through ongoing sampling and analysis of OU02 with the MNA alternative.

The BHHRA and SLERA published in 2008 did not identify any unacceptable human health or ecological risk posed by COCs in OU02 groundwater (JCO, 2008); therefore, the no action, MNA, and EISB remedial alternatives are currently protective of human health and the environment, as determined by the BHHRA and SLERA in the NYSDEC-approved PDI Report (JCO, 2008). And, as presented in Section 4.2., concentrations of the two COCs that are the primary drivers of the calculations in the BHHRA, TCE and vinyl chloride, have declined significantly in groundwater and surface water since the BHHRA was performed.

If implemented effectively, EISB can accelerate the already occurring natural attenuation COCs in OU02 groundwater; however, as noted in the NYSDEC-approved PDI Report, reactions may be incomplete if effective implementation is unable to be performed in all portions of the treatment area, resulting in creation of daughter products with higher risk profiles than the primary COCs - vinyl chloride is an example. Also, the production of biomass or biogenic gases can reduce the permeability of portions of the aquifer, which may lead to redirection of groundwater flow and contaminant bypass (Stroo and Ward, 2010), which could result in an expansion of the Facility Plume volume.

After successful completion of the E&D alternative, and provided South Plume #1 and South Plume #2 are no longer commingling with the Facility Plume at the time of E&D implementation, the toxicity, mobility, and volume of COCs will be removed from OU02.

6.3.5 Short-Term Effectiveness & Impacts

Ongoing natural attenuation will continue with the no action alternative; however, the short-term effectiveness and impacts would not be measurable due to the lack of monitoring associated with the no action alternative.

MNA has already been implemented in OU02 as a component of the OU01 SMP and is attenuating the Facility Plume – its effectiveness has been demonstrated, as shown in Section 4.2.2. The effectiveness would continue to be demonstrated through ongoing OU02 monitoring. There are no known adverse impacts from continued implementation of MNA.

As described in Section 6.2.4, EISB is not an instantaneous process; the time required to develop the appropriate environmental conditions and to grow a microbial population capable of complete degradation may be on the order of several months to years at most sites (Stroo and Ward, 2010). The NYSDEC-approved OU01 AAR/RAWP acknowledged this and noted significant reductions in concentration of COCs may require multiple years and additional augmentations (JCO, 2013). Furthermore, as stated above, it is difficult to modify the biogeochemical conditions of the reaction zone after the initial injection; therefore, there is less flexibility and room for optimization with design. In addition to impacts to the design and schedule, there is potential for partial degradation and formation of higher risk daughter products such as vinyl chloride during the EISB implementation process, at least temporarily in some areas. Also, as noted above, the production of biomass or biogenic gases can reduce the permeability of portions of the aquifer, which may lead to redirection of groundwater flow and contaminant bypass (Stroo and Ward, 2010), potentially increasing the volume of the Facility Plume. And, degradation reactions or excessive changes in groundwater pH and oxidation-reduction potential (ORP) conditions resulting from biostimulation may lead to solubilization of metals (e.g., iron, manganese, and potentially arsenic), formation of undesirable fermentation products (e.g., aldehydes and ketones), and other potential impacts to secondary water quality (e.g., total dissolved solids or biochemical oxygen demand). Many of these changes are not easily reversed, and in the case of a slow-release source of organic carbon, it may take many years for the effects of the substrate addition to diminish (Stroo and Ward, 2010).

EISB requires installation of injection wells and supporting infrastructure. The swampy nature of the ground surface overlying the Facility Plume in OU02 limits access and constructability of EISB infrastructure. As stated in Section 6.2.4, the optimal spacing of injection wells parallel to the direction of groundwater flow for plume-wide treatment is 20 to 40 feet for the upper unconsolidated deposits (Suthersan et al., 2002), which would require a substantial number of injection wells. However, as shown on the conceptual design on **Figure 6-1**, due to the relative inaccessibility of portions of OU02, three injection zones were selected. The installation of the injection wells and the supporting infrastructure will result in increased truck and equipment traffic in the LFP Property and surrounding area and result in loss of some vegetated area for access roads and equipment pads and paths creating the need to obtain wetland construction permits. The process of obtaining wetland construction permits could delay the implementation of EISB for significant period of time – likely a year or more. Also, any construction carried out within the extents of OU02 will, consistent with the OU01 SMP for OU01, require a Community Air Monitoring Plan (CAMP).

Provided South Plume #1 and South Plume #2 are addressed beforehand, E&D would be effective in the short-term through the excavation and disposal of OU02 soil and the treatment of OU02 groundwater removed from the OU02 as part of the excavation dewatering. The implementation of the E&D alternative would have extensive short-term impacts; it would require closing Ruscitti Road for up to one year in order to excavate the OU02 soils below it. Temporary electric, water, and sewer closures along Ruscitti Road would be required to excavate the soils around them. E&D would require the clearing and grubbing of approximately 9 acres of the LFP property, much of which is swampy in nature or under water. Temporary haul roads would need to be established as the existing roads in the neighborhood to the east of OU02 could not accommodate the haul truck traffic required to transport the OU02 soil to a disposal facility. A temporary stormwater management system would be required to perform the stormwater retention characteristics of the LFP for the local stormwater management – the design of such a system is beyond the scope of this AAR, but would likely require filtration and/or sedimentation and a controlled discharge system. Any excavation and construction carried out within the extents of OU02 will, consistent with the SMP for OU01, require a Community Air Monitoring Plan (CAMP). The implementation of an E&D alternative would destroy approximately 9 acres of natural habitat, the restoration of which is likely to take several years.

6.3.6 Implementability

The no action alternative does not require any implementation.

MNA has already been effectively implemented in OU02 in accordance with the OU01 SMP, which included OU02 in the scope of monitoring in its SAP. No additional monitoring locations are necessary to continue to effectively implement MNA[1].

The approach for EISB is presented in Section 6.2.4. There are several potential challenges to successful implementation of EISB, including:

- The influx of COC into OU02 from South Plume #1 and South Plume #2, which comingle with the Facility Plume within its eastern and downgradient portion and may complicate design, implementation, and assessment of EISB effectiveness.

[1] As discussed in Section 6.2.3, the scope of monitoring associated with the proposed MNA alternative is specified in the OU01 SMP. As stated in the OU01 SMP, after the spring 2021 monitoring event, the scope of monitoring can be reduced. The proposed reduction in monitoring locations for the MNA alternative after the spring 2021 semi-annual monitoring event is shown in **Table 6-1**.

- For slow-release substrates, it is difficult to modify the biogeochemical conditions of the reaction zone after the initial injection; therefore, there is less flexibility and room for optimization with design. Also, the plumes of dissolved substrate created by the slow-release source generally do not extend more than a few tens of feet from the point of injection, which results in a requirement for a substantial number of injection points as shown on **Figure 6-1**.
- Small-scale natural heterogeneities that exist in the glacial unconsolidated deposits of OU02 present challenges for effective delivery of substrates to a target treatment zone, which may result in non-uniform distribution of an injected substrate and non-uniform geochemical conditions. The ability to create uniform reaction zones of optimal ORP for biodegradation of chlorinated solvents to occur is perhaps the biggest challenge for successful implementation of biostimulation (Stroo and Ward, 2010).
- There is a possibility, even after pilot testing, that the injection of substrate and chase water could result in an unanticipated mobilization of the Facility Plume beyond the OU02 boundary. Sampling of sentinel wells during the injections may be required to verify the Facility Plume is not mobilizing beyond the OU02 boundary.
- Access to the swampy portions of OU02 would be a challenge. Zone 1 and Zone 2 (see **Figure 6-1**) would require clearing and grubbing as well as temporary stabilization in order to mobilize a drill rig into the soft soils. The substrate and water tanks could be staged on the cul-de-sac at the end of Foley Avenue with hoses running to the injection locations. Once the injections are complete, the swampy area would be restored to current conditions.
- Due to the number of injection points within Ruscitti Road, the asphalt would be removed prior to the injections. The road closure would require a detour around Ruscitti Road for the duration of the Road Zone injections. Following completion of the injections, subgrade would need to be regraded and recompacted and new asphalt installed.

E&D is the least implementable remedial alternative. The approach for E&D is presented in Section 6.2.5. There are numerous major challenges associated with implementation of E&D, including, but not limited to, the following:

- The shoring required to complete excavations in excess of 40 feet would be substantial. It would likely require driving steel sheet piles to the full excavation depth. Then, as each lift of soil is removed (assumed 5-7 feet), a tieback would be installed to resist the lateral earth pressures on the outside of the shoring. The process would be continued to depth.
- Based on the high yield of the overburden, as well as upward hydraulic gradients from underlying bedrock, traditional methods of dewatering would not suffice. The dewatering system would likely require a vast network of extraction wells be installed within the extents of the excavation. All water generated from the dewatering system would have to be filtered for sediment and treated for dissolved low-level concentrations of VOCs before being discharged.
- A major stormwater bypass system capable of conveying stormwater from the 36" reinforced concrete pipe on OU01, the Ruscitti Road properties, the neighborhoods to the east of OU02, and the commercial properties to the west of OU02 would need to be designed and implemented. The stormwater bypass system would likely require treatment including, at a minimum, sedimentation and/or filtration. The bypass system would not provide an equivalent reservoir attenuation buffer for stormwater flow.
- Excavation adjacent to OU01 would require tiebacks on the OU01 Waterloo Barrier® as it is not designed to resist lateral earth pressure. The dewatering in the vicinity of OU01 would result in a loss of inward hydraulic gradients across the Waterloo Barrier® which, as stated in the OU01 SMP, is the primary indicator of effectiveness of the OU01 RA. Excavation in the vicinity of Ruscitti Road

would require major utility replacement as discussed in Section 6.2.5. Ruscitti Road would be closed and a traffic bypass plan would be required for the duration of the excavation in that area.

6.3.7 Cost Effectiveness

A net present value cost comparison of the implementation, five-years of monitoring, and the total cost of the four remedial alternatives is presented in **Table 6-3**. For the cost comparison a present value analysis was conducted assuming five-year duration (through 2024) with a 3% discount factor. The capital costs are estimated based on the assumptions presented herein.

Table 6-1 is a comparison of the current monitoring program specified in the OU01 SMP[1] and the monitoring scope for each OU02 remedial alternative. The no action alternative requires no long-term monitoring. For the cost comparison, it is assumed that the long-term monitoring scope for the MNA alternative is reduced from the current monitoring program specified in the OU01 SMP to only monitoring locations located within the Facility Plume, beginning in 2021 after the monitoring program specified in the OU01 SMP is open for review. The EISB alternative would utilize the same long-term monitoring scope as specified in the OU01 SMP with additional analytes. The E&D alternative has no long-term monitoring requirements.

MNA has already been implemented and is continuing in OU02 as required by the OU01 SMP; therefore, there is no additional implementation cost for the monitoring. The only implementation cost associated with MNA is for recording the ICs. Assuming the reduction of the monitoring scope in 2021 as shown in **Table 6-1**, the net present value of MNA through the year 2024,[2] including the implementation of ICs (see Section 6.2.1) is *$346,000.*

EISB would require additional assessment, pilot testing, design, permitting, implementation, and monitoring. The assessment, pilot testing, design, permitting, and implementation are considered as capital costs for the cost comparison. The implementation of the ICs are also included in the capital cost for EISB. The capital cost for EISB, including the implementation of ICs is estimated to be $1,538,000. As discussed in Section 6.2.4, the scope of monitoring is expanded slightly over the scope of monitoring for the MNA remedy. The present value of the monitoring costs through the year 2024 is estimated to be $468,000. The total net present value of the EISB alternative is *$2,006,000*. This estimate does not include costs associated with CWA Section 404 permit requirements including any investigation, permitting, or compensatory measures that may be required.

The E&D alternative is the least cost-effective alternative. The scope of the E&D is discussed in Section 6.2.5. The cost estimate for the E&D alternative is dependent on several major simplifying assumptions and is uncertain. The E&D alternative has no ICs or future monitoring associated with it. It is assumed that implementation of the E&D alternative occurs over five years and, as such, discounting was applied in the present value analysis. The net present value of the E&D alternative is at least approximately *$181,000,000* The transportation and disposal of the OU02 soil alone is estimated to be approximately $106,000,000, based on current assumptions. This estimate does not include costs associated with CWA Section 404 permit

[1] The OU01 SMP includes monitoring locations within OU01, within OU02, and boundary locations in the Little Falls Ponds property outside of OU01/OU02. The monitoring locations discussed herein do not include those located in OU01.

[2] The scope of the monitoring for OU01 and OU02 would be reviewed with NYSDEC following the Spring 2019 monitoring event. Monitoring in OU02 through 2024 is assumed for purposes of this alternative evaluation.

requirements, including the investigation, permitting, or compensatory measures that would likely be required – such costs would be a substantial addition to the $181,000,000 estimate.

6.3.8 Land Use

The no action alternative does not include any change in land use.

MNA has already been implemented and is demonstrating continued effectiveness. The existing monitoring wells will be maintained per the OU01 SMP, and no change in land use is required.

For EISB, the large number of injection points required for implementation will require additional temporary access paths for installation and operational equipment. The access paths and infrastructure would be located throughout the treatment zone, including some in the swampy areas between Ruscitti Road and the First LFP as shown in **Figure 6-1**. Once the injections are complete, the land in OU02 will be restored to its current condition, when and where practicable.

The existing land use would be changed drastically during the implementation of an E&D remedy. As stated in Section 6.2.5, the E&D alternative requires the excavation and disposal of the existing 980,000 cubic yards of OU02 soil. The excavation would disturb over 9 acres of swampy land including dendritic streams and two of the three Little Falls Ponds. The OU02 property is in close proximity to a neighborhood to the east. The implementation of an E&D remedy would disrupt the current residential setting proximal to OU02. Once backfill operations are completed, the disturbed area will be restored to the current conditions to the extent practical.

No change from the current zoning is planned for any of the remedial alternatives.

Table 6-1: Comparison of Current Monitoring Scope and Monitoring Scope for Each OU02 Remedial Alternative
Former Dennison/Monarch Systems Site
Operable Unit 02
New Windsor, New York

Remedial Alternative	Sampling Frequency	Groundwater		Surface Water		Sediment Pore Water		Total Number of Monitoring Locations
		Monitoring Locations	Analytes	Monitoring Locations	Analytes	Monitoring Locations	Analytes	
Current Monitoring Program[1] Per OU01 SMP	Semi-Annual	33	VOCs	14	VOCs	7	VOCs	54
No Action	--	--	--	--	--	--	--	--
Monitored Natural Attenuation[2]	Semi-Annual	12	VOCs	--	--	5	VOCs	17
Enhanced In-Situ Bioremediation[3]	Semi-Annual	33	VOCs TOC Nitrate Sulfate Dissolved Gases	14	VOCs	7	VOCs TOC Nitrate Sulfate Dissolved Gases	54
Excavation & Disposal	**--**	--	--	--	--	--	--	--

Notes:

[1]The OU01 SMP includes monitoring locations within OU01, within OU02, and boundary locations in the Little Falls Ponds property outside of OU01/OU02. The monitoring locations summarized herein do not include those located in OU01.

[2]Assumes the long-term monitoring scope is reduced from the current monitoring program to only monitoring locations located within the Facility Plume beginning in 2021, after the monitoring program specified in the OU01 SMP is open for review.

[3]This is the long-term monitoring scope as specified in the OU01 SMP with additional analytes, but does not include the monitoring locations within OU01.

Table 6-2: Compliance with Standards, Criteria, and Guidance

Former Dennison/Monarch Systems Site

Operable Unit 02

New Windsor, New York

Applicable Standards, Criteria, or Guidance	No Action		Monitored Natural Attenuation (MNA)		Enhanced In-Situ Bioremediation (EISB)		Excavation and Disposal (E&D) (As Specified by NYSDEC)	
	Compliance	Notes	Compliance	Notes	Compliance	Notes	Compliance	Notes
Standards and Criteria								
29 CFR Part 1910.120 – Hazardous Waste Operations and Emergency Response	Not applicable	There is no requirement for Site personnel.	Yes	All Site sampling personnel will be required to have documentation of appropriate OSHA HAZWOPER training before being allowed on Site.	Yes	All Site personnel performing remediation operations will be required to have documentation of appropriate OSHA HAZWOPER training before being allowed on Site.	Yes	All Site personnel performing remediation operations will be required to have documentation of appropriate OSHA HAZWOPER training before being allowed on Site.
40 CFR Part 144 – Underground Injection Control (UIC) Program	Not applicable	No underground injection is required.	Not applicable	No underground injection is required.	Yes	Any injection system utilized will be designed in accordance with the UIC program standards and criteria. A UIC permit or permit equivalent will be completed and approved prior to implementation of any injection system.	Not applicable	No underground injection is required.
33 U.S.C. 1344 - Section 404 of the Clean Water Act	Not applicable	The alternative will not impact to waters of the United States.	Not applicable	The alternative will not impact waters of the United States.	Yes	Permits will be obtained if necessary.	Yes	As a result of excavation and dewatering within the Little Falls Ponds footprint, permits will be obtained in accordance with Section 404 of the Clean Water Act. All stipulations set forth in such permits would be adhered to.
6 NYCRR Parts 700-706 – Water Quality Standards	Eventual	Groundwater concentrations within the Facility Plume in OU02 will continue to decrease but will not be monitored.	Eventual	Groundwater concentrations within the Facility Plume in OU02 will continue to decrease due to ongoing natural attenuation.	Eventual	Groundwater concentrations within the Facility Plume in OU02 will continue to decrease due to ongoing natural attenuation, though concentration decreases may occur at a faster rate if EISB is implemented effectively.	Yes, if South Plume #1 and South Plume #2 are also addressed.	Groundwater and potentially impacted soil within the plume footprint will be completely removed from the Facility Plume in OU02 and replaced with clean fill. All water generated as a result of excavation operations will be treated prior to discharge to maintain compliance. Following excavation and backfill, the future compliance of this SCG for groundwater quality is contingent on the effective remediation of South Plume #1 and South Plume #2.
6 NYCRR Part 371 – Identification and Listing of Hazardous Wastes	Yes	No waste will be generated.	Yes	No waste with hazardous characteristics is anticipated.	Yes	No waste with hazardous characteristics is anticipated.	Yes	All material removed from OU02 will be screened and/or sampled and disposed of at an appropriate disposal facility.
6 NYCRR Part 375 – Environmental Remediation Programs	No	This remedial alternative does not minimize risk to human health and the environment due to the lack of institutional controls	Yes	This remedial alternative will comply with these standards and criteria.	Yes	This remedial alternative will comply with these standards and criteria.	Yes	This remedial alternative will comply with these standards and criteria.
Guidance								
CP-43 – Groundwater Monitoring Well Decommissioning Procedures	Yes	When required, monitoring well decommissioning will be completed in accordance with the requirements of CP-43.	Yes	When required, monitoring well decommissioning will be completed in accordance with the requirements of CP-43.	Yes	When required, monitoring well decommissioning will be completed in accordance with the requirements of CP-43.	Yes	Monitoring well decommissioning will be completed in accordance with the requirements of CP-43.
DER-2 – Making Changes to Selected Remedies	Not applicable	A no action alternative does not require any changes to the selected remedy.	Yes, if necessary	If the selected remedy changes, DER-2 will be followed.	Yes, if necessary	If the selected remedy changes, DER-2 will be followed.	Yes, if necessary	If the selected remedy changes, DER-2 will be followed.
DER-10 – Technical Guidance for Site Investigation and Remediation	Not applicable	A no action alternative does not require any additional investigation or remediation.	Yes	The development and implementation of the remedial action will follow the provisions of DER-10, as applicable.	Yes	The development and implementation of the remedial action will follow the provisions of DER-10, as applicable.	Yes	The development and implementation of the remedial action will follow the provisions of DER-10, as applicable.
DER-33 – Institutional Controls: A Guide to Drafting and Recording Institutional Controls	Not applicable	Institutional controls for OU02 are not required.	Yes	Institutional controls for OU02 will be developed in accordance with the requirements of DER-33.	Yes	Institutional controls for OU02 will be developed in accordance with the requirements of DER-33.	Not applicable	Institutional controls for OU02 are not required.

Table 6-3: Cost Comparison of Remedial Alternatives
Former Dennison/Monarch Systems Site
Operable Unit 02
New Windsor, New York

	Total Net Present Value	Implementation Cost Net Present Value[1]	Monitoring Cost Net Present Value[2]
No Action	**$ -**	**$ -**	**$ -**
Monitored Natural Attenuation	**$ 346,000**	$ 20,000	$ 326,000
Institutional Control Implementation	**$ 20,000**	**$ 20,000**	
Semi-Annual Monitoring	**$ 326,000**		**$ 326,000**
Enhanced In-Situ Bioremediation	**$ 1,928,000**	$ 1,467,000	$ 461,000
Institutional Controls	**$ 20,000**	**$ 20,000**	
Studies, Design, Permitting, & Contracting	**$ 235,000**	**$ 235,000**	**$ -**
Additional Investigation Work Plan	$ 30,000	$ 30,000	
Laboratory & Field Studies	$ 35,000	$ 35,000	
Pilot Testing	$ 80,000	$ 80,000	
Remedial Design Report/Work Plan	$ 59,000	$ 59,000	
Permitting, Bidding, Contracting	$ 31,000	$ 31,000	
Road Zone Implementation	**$ 779,000**	**$ 779,000**	**$ -**
Oversight, Support, & Reporting		$ 189,000	
Driller/Injection Subcontractor		$ 296,000	
Utility Layout/Surveyor		$ 5,000	
Traffic Control		$ 62,000	
Substrate		$ 77,000	
Municipal Water		$ 2,000	
Mixing Tank Rental		$ 7,000	
Road Repair		$ 141,000	
Zone 1 Implementation	**$ 218,000**	**$ 218,000**	**$ -**
Oversight, Support, & Reporting		$ 74,000	
Driller/Injection Subcontractor		$ 112,000	
Utility Layout/Surveyor		$ 5,000	
Substrate		$ 23,000	
Municipal Water		$ 1,000	
Mixing Tank Rental		$ 3,000	
Zone 2 Implementation	**$ 215,000**	**$ 215,000**	**$ -**
Oversight, Support, & Reporting		$ 74,000	
Driller/Injection Subcontractor		$ 112,000	
Utility Layout/Surveyor		$ 5,000	
Substrate		$ 20,000	
Municipal Water		$ 1,000	
Mixing Tank Rental		$ 3,000	
Semi-Annual Monitoring	**$ 461,000**		**$ 461,000**

Table 6-3: Cost Comparison of Remedial Alternatives
Former Dennison/Monarch Systems Site
Operable Unit 02
New Windsor, New York

	Total Present Value	Implementation Cost Present Value[1]	Monitoring Cost Present Value[2]
Excavation & Disposal[3]	$ 174,669,000	$ 174,669,000	$ -
Studies, Design, Permitting, & Contracting	**$ 13,435,000**	**$ 13,435,000**	**$ -**
Prep and Shoring	**$ 9,300,000**	**$ 9,300,000**	**$ -**
Temp Office, Power, Toilets, etc		$ 275,000	
Relocate Power		$ 92,000	
Clearing & Grubbing		$ 71,000	
Sheet Piling & Tiebacks		$ 8,862,000	
Excavation, Disposal, Backfill, Restoration	**$ 121,083,000**	**$ 121,083,000**	**$ -**
Excavation		$ 7,170,000	
Stockpile		$ 896,000	
Load		$ 1,793,000	
Transportation & Disposal		$ 96,801,000	
Backfill		$ 13,445,000	
Compaction		$ 896,000	
Wetland Restoration		$ 82,000	
Road Work	**$ 482,000**	**$ 482,000**	**$ -**
Waterline		$ 101,000	
Sewerline		$ 46,000	
Manholes		$ 14,000	
Road Restoration		$ 137,000	
Traffic Control		$ 184,000	
Excavation Dewatering/Stormwater Bypass	**$ 3,499,000**	**$ 3,499,000**	**$ -**
Rental Pumps/Hoses/Fuel		$ 522,000	
Labor		$ 550,000	
Extraction Well/Pumps		$ 687,000	
Treatment System & Operation		$ 1,740,000	
Oversight, Support, Management, Reporting, Close-out	**$ 13,435,000**	**$ 13,435,000**	**$ -**
Contingency	**$ 13,435,000**	**$ 13,435,000**	**$ -**

Notes:

All costs are shown in present value using a 3% annual discount rate for a 5-year period

[1]Implementation costs include all costs not associated with routine monitoring, including implementing institutional controls. It is assumed that all implementation will occur within a 5-year period.

[2]Annual monitoring costs are based on the number of sampling locations shown in Table 6-1.

[3]The excavation and disposal alternative is presented at the request of NYSDEC. The cost estimate presented herein is based on a conceptual design. The actual costs will vary based on a more refined design.

LEGEND

○	Conceptual EISB Injection Location - Circle Indicates the Estimated Extent of the Substrate Radius of Influence (5') For Each Injection Location
— 130 —	Water Table Interpolated Potentiometric Isocontour (2 ft. interval, dashed where inferred) - May 15, 2018
	Approximate Parcel Boundary from Town of New Windsor, New York Tax Maps
	OU01 RA Sealed Sheet Pile Wall (Waterloo Barrier)
	OU02 Stream Extents
	OU01 Boundary
	1 μg/L < [TCE] < 10 μg/L
	10 μg/L < [TCE] < 50 μg/L
	50 μg/L < [TCE] < 500 μg/L
	500 μg/L < [TCE] < 1000 μg/L

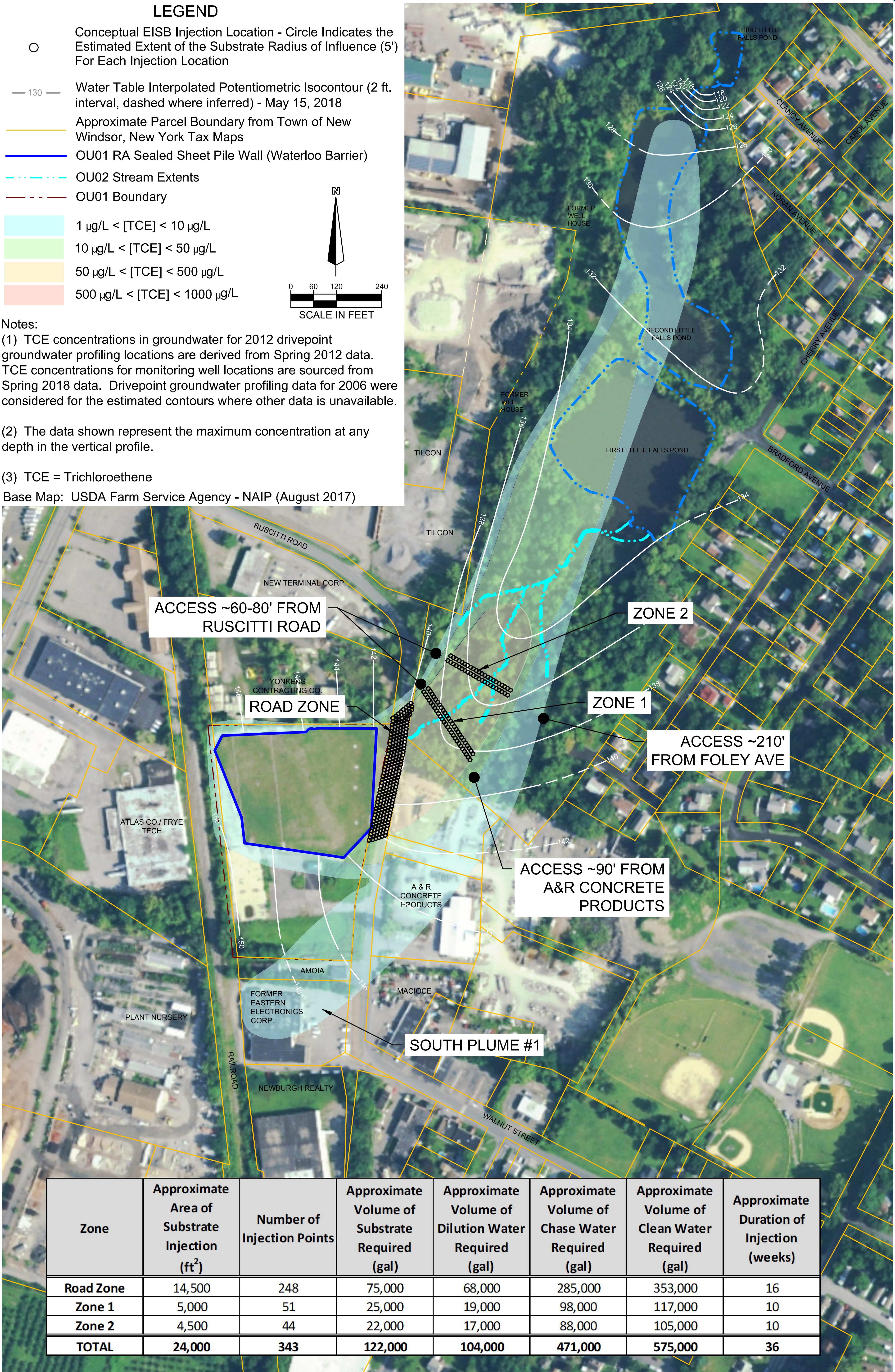
Notes:

(1) TCE concentrations in groundwater for 2012 drivepoint groundwater profiling locations are derived from Spring 2012 data. TCE concentrations for monitoring well locations are sourced from Spring 2018 data. Drivepoint groundwater profiling data for 2006 were considered for the estimated contours where other data is unavailable.

(2) The data shown represent the maximum concentration at any depth in the vertical profile.

(3) TCE = Trichloroethene

Base Map: USDA Farm Service Agency - NAIP (August 2017)



Zone	Approximate Area of Substrate Injection (ft^2)	Number of Injection Points	Approximate Volume of Substrate Required (gal)	Approximate Volume of Dilution Water Required (gal)	Approximate Volume of Chase Water Required (gal)	Approximate Volume of Clean Water Required (gal)	Approximate Duration of Injection (weeks)
Road Zone	14,500	248	75,000	68,000	285,000	353,000	16
Zone 1	5,000	51	25,000	19,000	98,000	117,000	10
Zone 2	4,500	44	22,000	17,000	88,000	105,000	10
TOTAL	**24,000**	**343**	**122,000**	**104,000**	**471,000**	**575,000**	**36**

FIGURE 6-1: CONCEPTUAL DESIGN
ENHANCED IN-SITU BIOREMEDIATION
FORMER DENNISON/MONARCH SYSTEMS SITE
NEW WINDSOR, NEW YORK

vhb

VHB Engineering, Surveying Landscape and Geology, P.C.
100 Great Oaks Blvd, Ste 118, Albany, NY

Drawn by: GWL Date: 06/17/19
Chk'd by: GAK Date: 06/26/19
Scale: As Shown Project: 58300.00

\\vhb\gbl\proj\Montpelier\58300.00 ADC New Windsor NY\JCOdata\CAD\AAR 2018\Cost Estimate 2019-06-13.dwg

7.0 RECOMMENDED REMEDY

MNA has already been implemented in OU02 as a component of the OU01 SMP, is protective of human health and the environment, and is attenuating the Facility Plume in OU02. There are no known adverse impacts from continued implementation of MNA. Therefore, MNA is the recommended remedial alternative for OU02, to be applied with the institutional controls discussed in Section 6.2.1.

8.0 REFERENCES

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