Revised Feasibility Study Report

ITT Automotive Fluid Handling System Site
Site # 8-28-112
Town of Gates, NY
3356 / 63224

Prepared for:

ITT Corporation

Prepared by:

O'Brien & Gere Engineers, Inc.

May 2, 2016

O'BRIEN & GERE

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I, Douglas M. Crawford, certify that I am currently a NYS registered professional engineer and that this Feasibility Study 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) and that all activities were performed in full accordance with the DER-approved work plan and any DER-approved modifications.

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4-4-DDE	1,1-Bis-(4-chlorophenyl)-2,2-dichloroethene
4-4-DDT	dichloro-diphenyl-trichloroethane
AMSF	Alliance Metal Stamping and Fabricating
amsl	above mean sea level
AOC	area of concern
ARAR	applicable or relevant and appropriate requirement
BJ	estimated value detected in blank
Batesville	Batesville Casket Company
BCA	Brownfield Cleanup Agreement
BCP	Brownfield Cleanup Program
BTEX	benzene, toluene, ethylbenzene, and xylene
bgs	below ground surface
BR	Bright Raven
°C	degrees Centigrade
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
Cinemark	Cinemark Tinseltown USA and IMAX movie theater complex
cis-1,2-DCE	cis-1,2-dichloroethene
cm/sec	centimeters per second
COCs	constituents of concern
COPCs	constituents of potential concern
CP	Commissioner Policy
CSM	conceptual site model
CVOC	chlorinated volatile organic compound
DCA	1,1-dichloroethane
DCE	1,1-dichloroethene
DCR	Declaration of Covenants and Restrictions
DER	Division of Environmental Remediation
DNAPL	dense non-aqueous phase liquid
DUSR	Data Usability Summary Report
Erdle	Erdle Perforating Company

ESTCP	Environmental Security Technology Certification Program
FS	Feasibility Study
ft	feet
ft/day	feet per day
ft/ft	feet per foot
g/kg	gram per kilogram
Golder	Golder Associates, Inc.
GRA	General Response Action
HHRA	Human Health Risk Assessment
IRM	Interim Remedial Measure
ISCO	In-Situ Chemical Oxidation
ISMP	Interim Site Management Plan
ISTD TCH	*In situ* Thermal Design with Thermal Conductive Heating
ITT	ITT Corporation
J	estimated value
µg/g	micrograms per gram
µg/l	micrograms per liter
µm	micrometer
MFP	Maguire Family Properties, Inc.
mg/kg	milligrams per kilogram
NAPL	non-aqueous phase liquid
NCP	National Oil and Hazardous Substances Contingency Plan
ND	not detected
NPL	National Priority List
NYCRR	New York Codes, Rules, and Regulations
NYS	New York State
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
NYSDOT	New York State Department of Transportation
O&M	Operation & Maintenance
OSHA	Occupational Safety and Health Administration
OSWER	Office of Solid Waste and Emergency Response

OU	Operable Unit
PCE	tetrachloroethene
PGWS	periodic groundwater sampling
PRAP	Proposed Remedial Action Plan
QHHEA	Qualitative Human Health Exposure Assessment
RAO	remedial action objective
RCRA	Resource Conversation and Recovery Act
RFM	Rochester Form Machine
RI	Remedial Investigation
RIR	Remedial Investigation Report
ROD	Record of Decision
SCO	Soil Cleanup Objective
SVE	soil vapor extraction
Stantec	Stantec Consulting Services, Inc.
SVOC	semi-volatile organic compound
TAGM	Technical Administrative Guidance Document
TCA	1,1,1-trichloroethane
TCE	trichloroethene
TCS	TCS Industries
TOGS	Technical and Operational Guidance Series
TPH	total petroleum hydrocarbon
ULSD	ultra low sulfur diesel
USEPA	United States Environmental Protection Agency
USGS	United State Geological Survey
$\mu g/m^3$	micrograms per cubic meter
µg(VOC)/g(Rock)	microgram of volatile organic compound per gram of rock
UST	underground storage tank
UV	ultraviolet
VOC	volatile organic compound

EXECUTIVE SUMMARY

This *Revised Feasibility Study* (FS) *Report* of the ITT Automotive Fluid Handling System (also known as the Former Rochester Form Machine [RFM] Facility Site) (Site # 8-28-112) located at 30 Pixley Industrial Parkway in the Town of Gates, New York (Site) was developed by O'Brien & Gere Engineers, Inc. (OBG) and ITT Corporation (ITT). This FS was conducted pursuant to an Order on Consent (Index # B8-0614-02-05) executed between the New York State Department of Environmental Conservation (NYSDEC) and ITT Automotive on August 19, 2003 (NYSDEC 2003). A modification to the Consent Order, dated November 2, 2006, substitutes ITT Corporation for ITT Automotive, Inc. In addition, at the time the remedial investigation (RI) began, the Site name was changed from ITT Automotive, Inc. to Former ITT Rochester Form Machine Facility, the former RFM Facility, or the former RFM Site, as referred to henceforth in this report. The FS was completed in accordance with the NYSDEC-approved *Remedial Investigation/ Feasibility Study (RI/FS) Project Work Plan* (RI/FS Work Plan; O'Brien & Gere 2004) prepared by O'Brien & Gere and incorporated into the Order on Consent. The FS was documented in a *FS Report* submitted to NYSDEC on April 24, 2015 (OBG 2015). NYSDEC provided comments on the report on March 29, 2016. This *Revised FS Report* reflects the March 2015 NYSDEC comments.

For the purposes of this report, the former RFM Site is considered the "Site" and the adjacent former Alliance Metal Stamping and Fabricating (AMSF), Cinemark Tinseltown USA and IMAX movie theater complex (Cinemark), and Batesville Casket Company (Batesville) properties are presently considered "off-Site" properties. The neighboring AMSF property, located directly to the east of the Site, is the subject of a separate investigation and remedy evaluation effort being conducted concurrently by Maguire Family Properties, Inc., the owners of the property.

The current RFM Site zoning is industrial and it is reasonable to anticipate that the Site will continue to be used for industrial purposes. No unacceptable risks were identified for current or future receptors potentially exposed via ingestion, dermal contact, and ambient air inhalation to constituents of concern (COCs) in soil at the RFM Site. Given the developed nature of the Site and the adjacent properties, no ecological receptors were identified and ecological pathways are considered incomplete. Based on isolated detections of COCs in soil, there is a potential that COCs present at concentrations greater than the soil cleanup objectives (SCOs) for the protection of groundwater may leach to groundwater. With respect to groundwater, though bedrock groundwater is not currently used as a potable water source and the area is serviced by a public water supply, potentially unacceptable risks to human health were identified related to exposures to groundwater. Bedrock groundwater concentrations have been detected at concentrations above the Class GA standards. Though the building at the Site was recently demolished, a comparison of the New York State Department of Health (NYSDOH) Guidance matrices and the 1,1,1-trichloroethane (TCA), 1,1-dichloroethane (DCA), tetrachloroethene (PCE), 1,1-dichloroethene (DCE) and trichloroethene (TCE) concentrations detected in the sub-slab soil and indoor air vapors, vapor intrusion mitigation is indicated should a new building be constructed on Site. Accordingly, media addressed in this FS for the Site are soil, bedrock groundwater, and future indoor air/sub-slab soil vapor. The following remedial action objectives (RAOs) were developed to address these media:

RAOs for the Protection of Human Health

- Mitigate, to the extent necessary and practicable, impacts to public health resulting from existing, or the potential for, soil vapor intrusion into any new building on Site. Prevent, to the extent necessary and practicable, unacceptable risks to human health associated with ingestion and direct exposure with untreated bedrock groundwater.
- Prevent, to the extent necessary and practicable, unacceptable risks to human health associated with inhalation of volatile organic compounds (VOCs) in untreated bedrock groundwater.

RAO for protection of the environment:

- Restore bedrock groundwater to predisposal/pre-release conditions, to the extent necessary and practicable.
- Prevent, to the extent necessary and practicable, migration of contaminants in soil that would result in groundwater contamination.

Technology and process options to address the RAOs in the various media were identified, screened and evaluated. As part of this FS, physical and technical limitations resulting from Site-specific conditions were discussed and documented in the report. Specifically, the presence of fractured sedimentary bedrock, the associated bedrock matrix diffusion of chlorinated volatile organic compounds (CVOCs) that has been documented at the Site, and the documented groundwater flow in Site fractured bedrock are conditions that limit the technical practicability of subsurface remediation technologies at this Site. Given these limitations, it is anticipated that it is technically impractical to restore bedrock groundwater to pre-disposal conditions using active remediation technology in a timeframe that would be shorter than relying on the documented natural attenuation processes already operative in the Site groundwater.

Following the evaluation of technologies, five remedial alternatives were developed. These were:

- Alternative 1: no further action
- Alternative 2: institutional controls, limited soil excavation and disposal, containment, natural attenuation, and groundwater monitoring
- Alternative 3: institutional controls, limited soil excavation and disposal, *in-situ* soil treatment, natural attenuation, and groundwater monitoring
- Alternative 4:institutional controls, soil excavation and disposal, natural attenuation, and groundwater monitoring
- Alternative 5: limited soil excavation and disposal, *in-situ* thermal treatment aimed at restoring the Site to pre-disposal conditions.

Common elements of the active alternatives include abandonment of the surface water recharge well ITT-W-1, modification of the existing environmental easement/deed restrictions to comply with current NYSDEC policy, a Site Management Plan, and groundwater monitoring,

Following the development of remedial alternatives, the five remedial alternatives were subjected to screening against the criteria of effectiveness, implementability and cost. Due to Site-specific conditions including matrix diffusion of CVOCs in the Site fractured bedrock system and the presence of large fractures and associated high groundwater flows, Alternative 5 was screened from further consideration due to anticipated limited effectiveness and implementability. Alternative 5 was also an order of magnitude greater in cost as compared to the other active alternatives. The four remaining alternatives were advanced to the detailed analysis of alternatives phase of the FS.

Based on a detailed evaluation of the four alternatives developed in the FS using eight specific evaluation criteria consistent with NYSDEC's Division of Environmental Remediation (DER) *Technical Guidance for Site Investigation and Remediation (DER-10)* (NYSDEC 2010b) and the *Guidance for Conducting Remedial Investigation and Feasibility Studies Under CERCLA* (Comprehensive Environmental Response, Compensation, and Liability Act; USEPA 1988) (USEPA 1988), Alternative 2 is recommended as the final remedy for the Site. Alternative 2 is recommended because it satisfies the two threshold criteria, overall protection of human health and the environment, and compliance with applicable or relevant and appropriate requirements (ARARs), to the extent practicable, and provides the best balance with respect to the primary balancing criteria (long-term and short-term effectiveness and permanence, reduction in toxicity, mobility and volume, implementability and cost). Alternative 2 includes the following remedial elements:

- Modification of the existing environmental easement/deed restrictions to comply with current NYSDEC policy. These restrictions would limit land use, groundwater use and would provide for protection of the surface covers included in this alternative.
- Natural attenuation of CVOCs in soil and bedrock groundwater over time.
- Long-term groundwater monitoring for CVOCs.
- Limited excavation and disposal of approximately 14 cubic yards of soil in the south lawn area (in the vicinity of SS-8)

- Maintenance of Site surface covers, including repair of damaged parking lot (approximately 100 square feet) in vicinity of SS-3 and SS-4. The existing low permeability areas (asphalt and building slab) cover those soils that exceed protection of groundwater standards, therefore, addressing interaction of infiltration with soils that exceed SCOs.
- Site Management Plan to guide future activities at the Site by documenting institutional and engineering controls and define requirements for the groundwater monitoring, periodic Site reviews, operation and maintenance activities for remedial elements, and future development on the Site. In addition, consistent with 6 NYCRR Part 375-1.8(h)(3) (NYSDEC 2006), annual certification of institutional and engineering controls would be required in the Site Management Plan. The Site Management Plan would also aid in developing the requirements and emplacement of a means for vapor intrusion mitigation, should a new building be constructed on the Site.
- Periodic site reviews conducted in accordance with the Site Management Plan to evaluate the Site remedy with regard to continuing protection of human health and the environment.

Figure 7-1 presents a conceptual plan of Alternative 2.

As documented in this Revised FS Report, Alternative 2 is protective of human health and environment and addresses soil ARARs. Alternative 2 utilizes limited soil excavation to address soil ARARs and natural attenuation to achieve groundwater ARARs. It should be noted that given Site-specific conditions, it is technically impractical to restore bedrock groundwater to pre-disposal conditions using active remediation technologies in a timeframe that would be shorter than relying on the documented natural attenuation processes already operative in the Site groundwater. Alternative 2 is effective at addressing RAOs in the long-term. Maintenance of low permeability covers included in Alternative 2 limits mobility of CVOCs in soil to bedrock groundwater, and natural attenuation provides for a reduction in toxicity, mobility and volume of CVOCs in soil and bedrock groundwater at the Site. Groundwater monitoring provides a means of evaluating groundwater conditions. Alternative 2 would be implemented in such a manner as to adequately control short-term risks to workers and the community. Alternative 2 is a cost-effective means of addressing protection of human health and the environment, and implementation of Alternative 2 is consistent with current and reasonably anticipated land use.

1.0. INTRODUCTION

1.1 General

This *Feasibility Study (FS) Report* has been developed by O'Brien & Gere Engineers, Inc. (OBG) on behalf of the ITT Corporation (ITT) for ITT Automotive Fluid Handling System (also known as the Former Rochester Form Machine [RFM] Facility Site) (Site # 8-28-112) located at 30 Pixley Industrial Parkway in the Town of Gates, New York (former RFM Site). The former RFM Site is currently listed in the New York State Registry of Inactive Hazardous Waste Disposal Sites (Site No. 8-28-112) as a Class 2 site. The FS was conducted pursuant to an Order on Consent between the New York State Department of Environmental Conservation (NYSDEC) and ITT, dated August 19, 2003 (Consent Order), with an effective date of August 29, 2003 (Index # B8-0614-02-05). The FS was completed in accordance with the NYSDEC-approved *Remedial Investigation/ Feasibil*ity *Study* (RI/FS) *Work Plan* (O'Brien & Gere 2004), 6NYCRR Part 375 (NYSDEC 2006), NYSDEC's Division of Environmental Remediation (DER) *Technical Guidance for Site Investigation and Remediation (DER-10)* (NYSDEC 2010b) and the *Guidance for Conducting Remedial Investigation and Feasibility Studies Under CERCLA* (Comprehensive Environmental Response, Compensation, and Liability Act; USEPA 1988) (USEPA 1988). The RI/FS Work Plan dated May 2004 (O'Brien & Gere, 2004) was prepared in response to the Consent Order and approved by NYSDEC in a letter dated June 17, 2004 (Sowers, 2004). The FS was documented in a *FS Report* submitted to NYSDEC on April 24, 2015 (OBG 2015). NYSDEC provided comments on the report on March 29, 2016. This *Revised FS Report* reflects the March 2015 NYSDEC comments. A Site location map is included as **Figure 1-1**.

For the purposes of this report, the former RFM Site is considered the "Site" and the adjacent former Alliance Metal Stamping and Fabricating (AMSF), Cinemark Tinseltown USA and IMAX movie theater complex (Cinemark), and Batesville Casket Company (Batesville) properties are presently considered "off-Site" properties. The Site and off-Site properties are presented in **Figure 1-2**. The combined Site and off-Site properties will be discussed as the "RI Study Area."

1.2 Purpose

The purpose of the FS is to identify and screen remedial technologies and evaluate remedial alternatives for constituents of concern (COCs) that exceed remedial action objectives (RAOs) in soil, bedrock groundwater and indoor air/sub-slab vapor at the Site.

1.3 Project Objectives and Scope

The Consent Order required the implementation of the 2004 *RI/FS Work Plan* (O'Brien & Gere 2004). Development of this FS is consistent with Section 7 of the NYSDEC-approved *RI/FS Work Plan*. The objective of the FS is to develop, screen and evaluate remedial alternatives regarding the Site to present sufficient information for decision makers to compare alternatives and select a remedy.

The RI Report (RIR) (O'Brien & Gere 2014b) was submitted to NYSDEC on October 20, 2014. In a letter dated January 6, 2015, the RIR was deemed acceptable for development of the FS (Sowers 2015). Additionally, a *RIR Soil Addendum* (O'Brien & Gere 2014c) was submitted to NYSDEC in November 2014, and a *RIR Surface Soil Addendum* (O'Brien & Gere 2016) was submitted to NYSDEC in March 2016.

1.4 Document Organization

The remainder of the FS Report is organized into the following sections:

Section 2 – Site Description and History
Section 3 – Summary of Remedial Investigation and Exposure Assessment
Section 4 – Remedial Goals and Remedial Action Objectives
Section 5 – General Response Actions
Section 6 – Identification and Screening of Remedial Technologies
Section 7 – Development and Analysis of Remedial Alternatives
Section 8 – Recommended Remedy

2.0. SITE DESCRIPTION AND HISTORY

The former RFM Site, 30 Pixley Industrial Parkway in the Town of Gates, New York, previously consisted of a 45,500 square foot single story building located on approximately three acres of land. The building was demolished and removed in November/December 2015 and currently a 45,500 square foot concrete pad remains on Site (**Figure 1-2**). The former RFM Site is located approximately ¾-mile north of the Little Black Creek and 2 ¼-miles to the southwest of the Erie Canal.

The former RFM Site was dedicated to agricultural activities until approximately 1973 when the facility was constructed. Building additions were completed in 1979 and 1984 resulting in the current building layout. Operations at the former RFM included the manufacture of aluminum components for automotive air conditioning and various general applications. This work involved drilling and machining, alkali cleaning, tube forming, aluminum brazing and welding (Golder Associates, Inc. [Golder], 2000a), and included the use of 1,1,1-trichloroethane (TCA) as a degreaser, and 1,4-dioxane as a stabilizing agent for TCA (NYSDEC, 2001). RFM conducted operations at the former RFM Site until its purchase by ITT-Higbie Baylock in 1979. The plant was closed and building vacated in 2003, and the building was demolished in 2015.

The Site is surrounded by commercial, industrial, and mixed land use properties (**Figure 1-2**). To the north of the Site is Cinemark at 2291 Buffalo Road. To the immediate west is the Batesville property at 40 Pixley Industrial Parkway (**Figure 1-2**). Pixley Industrial Parkway is to the immediate south of the Site. Across the parkway there are vacant lots and several properties zoned for light industrial and/or manufacturing use, including the Erdle Perforating Company (Erdle) property at 100 Pixley Industrial Parkway, which is a State Superfund project (Site Number 828072) and is listed as a Class 2 Site in the Registry of Inactive Hazardous Waste Disposal Sites. Reportedly, as part of the manufacturing process, numerous degreasing agents, including trichloroethene (TCE), were used at the Erdle site (NYSDEC 2001).

The former AMSF building is located immediately to the east of the former RFM Site and covers approximately 125,000 square feet (**Figure 1-2**) of the approximately 7-acre former AMSF Site. The original AMSF building was constructed in 1967 (NYSDEC, 2001) and expanded in several phases to its current layout in 1972, 1979, and 1988 (GeoServices, 1992a) (**Figure 1-2**). During its operation, the AMSF Site conducted stamping, forming, cleaning, grinding, painting, and deburring of metals. The exact date AMSF ceased operations was not reported, but the air permits for the site were surrendered with the sale of the former AMSF Site in 1995. The former AMSF Site is currently owned by Maguire Family Properties, Inc. (MFP) and subdivided to accommodate commercial businesses. Site operations at the former AMSF Site used TCA as a cleaning product. To date, there are no known records available regarding the manufacturer/supplier of TCA used at the former AMSF Site.

Site and Off-Site Investigations

A RI of the former RFM Site (Site # 8-28-112) was completed by ITT pursuant to a Consent Order with an effective date of August 29, 2003 (Index # B8-0614-02-05).

As part of that RI, several adjacent properties were investigated including the adjacent former AMSF, Cinemark, and Batesville properties. As noted in **Section 1**, these properties are considered "off-Site" properties and the former RFM Site is considered the "Site." The Site and off-Site properties are presented in **Figure 1-2**. The combined Site and off-Site properties are considered the "RI Study Area."

RI activities were conducted at the former RFM Site and the adjacent off-Site properties from August 2004 through March 2011. Soil, groundwater, bedrock, indoor air/sub-slab vapor and soil vapor sampling have been conducted by ITT. Results of the RI were integrated with results from historical investigations (pre-2004) and presented in a *RIR* (O'Brien & Gere 2014b) that was submitted to NYSDEC on October 20, 2014 and deemed acceptable for development of the Feasibility Study in a January 6, 2015 letter (Sowers 2015). Additionally, a *RIR Soil Addendum* (O'Brien & Gere 2014c) was submitted to NYSDEC in November 2014 and a *RIR Surface Soil Addendum* (O'Brien & Gere 2016) was submitted to NYSDEC in March 2016.

A separate RI is being conducted on the neighboring former AMSF Site (**Figure 1-2**) under the New York State (NYS) Brownfield Cleanup Program (BCP) and in accordance with a Brownfield Cleanup Agreement (BCA) entered into by the current property owner MFP. Soil, groundwater, indoor air/sub-slab vapor, and soil vapor sampling have been conducted by MFP. Data from MFP's sampling activities have been reported to date in monthly reports from MFP to NYSDEC and in a RIR dated October 2014 (Stantec 2014). The MFP RIR was rejected by NYSDEC in a letter dated January 23, 2015 (NYSDEC 2015). As identified in *Progress Report #36* (Stantec 2015). MFP conducted additional field investigations at the former AMSF Site and resubmitted the RIR in December 2015 (Stantec 2015).

3.0. SUMMARY OF REMEDIAL INVESTIGATION AND EXPOSURE ASSESSMENT

3.1 GEOLOGY/HYDROGEOLOGY

This section presents a summary of the RI Study Area geology and hydrogeology. A detailed description of the geology and hydrogeology is presented in Section 4 of the RFM RIR.

3.1.1 Geologic Conditions

In the RI Study Area (**Figure 1-1**), unconsolidated overburden deposits include topsoil, surficial fill, glaciolacustrine silt and clay, and sand and gravel. The total thickness of the unconsolidated materials overlying the bedrock ranges from 4 feet (ft) to 20 ft. The top of bedrock surface is likely an irregular surface due to the erosion and subsequent weathering of bedrock with varying rock hardness. The surface of the top of the competent bedrock slopes downward from the former AMSF Site (east) to the former RFM Site (west).

The bedrock units in the surrounding area are subdivided into several groups, formations and members. The stratigraphic groups include the middle Silurian Lockport Group and underlying Clinton Group. The Lockport Group is subdivided into the Eramosa Dolomite (Formation) and Penfield Formation. The stratigraphically lower Clinton Group is subdivided into the Decew Dolomite and the underlying Gates Member of the Rochester Shale.

These bedrock units, as observed during the RI, consist of sub-horizontally bedded and fracture dolostone, arenaceous dolostone, and shaley dolostone. The stratification of the bedrock units is nearly flat lying with an east-northeast strike and a dip of less than 1% to the southeast. The strike and dip are generally consistent with the regional geologic structure.

The Eramosa directly underlies the overburden. The Eramosa is a medium gray, fossiliferous dolostone with an average thickness of approximately 45 ft. Within the Eramosa, individual fractures or groups of fractures were often separated by sections of competent unfractured rock. Three elevation zones of solution enlarged fractures were observed. The first and uppermost zone (upper Eramosa) included fractures, aperture up to 4.4 inches, between the top of the bedrock and an average elevation of 540 ft above mean sea level (amsl) (approximately 20 to 34 ft below ground surface [bgs] across the RI Study Area). The second zone (middle portion of the Eramosa) spans from 537 to 532 ft amsl (approximately 23 to 42 ft bgs) with an aperture up to 1 inch. The third, and stratigraphically lowest fracture zone (lower Eramosa), spans from 528 to 519 ft amsl (approximately 32 to 55 ft bgs) with an aperture up 1.6 inches. Throughout the bedrock cores completed during the RI, the greatest frequency of solution enlarged fractures was observed in the Eramosa strata.

The Penfield Formation was encountered below the Eramosa. This formation was observed as a medium gray, fossiliferous dolostone to arenaceous dolostone with an average thickness of 52 ft. Fewer bedding fractures were observed in the Penfield Formation than the Eramosa and solution modification of the bedding planes and fractures in the Penfield Formation was less common than in the Eramosa. A prominent solution enlarged fracture was observed in the upper portion of the Penfield Formation between 504 to 499 ft amsl (approximately 56 to 75 ft bgs). Within the Penfield Formation, few solution enlarged fractures were observed below 495 ft amsl (approximately 65 to 79 ft bgs).

The Decew Dolomite occurs below the Penfield Formation. The Decew Dolomite consists of a medium gray, fine grained, sparsely stylolitic, dolostone. The thickness of the Decew Dolomite ranged from 9 to 17 ft. The Decew Dolomite exhibited fewer solution enlarged fractures than the Eramosa and Penfield Formation.

The deepest bedrock unit encountered during the RI, the maximum investigation depth was 159 ft bgs (404 ft amsl), was the Gates Member of the Rochester Shale. The Gates Member is a medium dark gray, fine grained, argillaceous dolostone with naturally occurring petroleum. Horizontal bedding fractures and shale partings were common in the Gates Member. Solution modification of the fractures was less common than in the overlying formations. Natural gas was encountered in this formation during RI drilling. Because of the presence of the natural gas and associated risks, characterization of the deep bedrock was limited during the RI.

3.1.2 Hydrogeologic Conditions

Groundwater was intermittently observed in the overburden in certain areas on the former RFM Site. The RI data suggest that the overburden is generally unsaturated except for those locations and times when the groundwater elevations extend above the elevation of the top of bedrock. The estimated hydraulic conductivity from overburden monitoring well (ITT-MW-1) is 8.1×10^{-4} centimeters per second (cm/sec).

The water table was observed in the Eramosa across the RI Study Area. Bedrock groundwater primarily flows through the sub-horizontal, solution enlarged, and bedding plane fractures. Based on the distribution of observed fractures, the bedrock can be subdivided into three general hydrogeologic units: the Eramosa, the upper Penfield, and the Deep Bedrock. The Deep Bedrock includes the lower Penfield, Decew Dolomite, and Rochester Shale formations.

The Eramosa is monitored by 45 monitoring wells across the former RFM, former AMSF and Cinemark properties. The upper Penfield is monitored by three monitoring wells on the former AMSF property only. The Deep Bedrock is monitored by three monitoring wells on the former RFM property and one monitoring well on the former AMSF property. (**Figure 3-1**)

The primary focus of this section and the RI characterization is the Eramosa and upper Penfield Formations, because natural gas was encountered in the deep bedrock during the installation of deep bedrock borings in 2008 and 2010. With NYSDEC approval, subsequent RI activities and characterization were constrained to the upper 80 ft of bedrock, specifically focusing on the Eramosa and upper Penfield.

Hydraulic conductivity estimates for the Eramosa ranged from $>5.4\times10^{-3}$ to $>6.4\times10^{-1}$ cm/sec. The estimated Eramosa hydraulic conductivities are up to three orders of magnitude greater than the overburden zone. The upper Penfield hydraulic conductivity estimates range from 3.7×10^{-5} to 3.8×10^{-2} cm/sec, which are similar to, but lower than, hydraulic conductivity estimates for the Eramosa. The hydraulic conductivity estimates for the Deep Bedrock varied by orders of magnitude ranging from 5.4×10^{-8} to 1.5×10^{-4} cm/sec. Relative to the Eramosa and upper Penfield units the hydraulic conductivity of the Deep Bedrock was 2 to 5 orders of magnitude lower.

Groundwater elevation data indicate that the groundwater horizontal hydraulic gradient in the Eramosa generally slopes down toward northeast and east, with the exception of the northern portion of the Cinemark property where the horizontal hydraulic gradient generally slopes down to the southeast. The magnitude of the horizontal hydraulic gradient varies between areas across the RI Study Area. The hydraulic potential likely reflects overall site-wide horizontal groundwater flow patterns in the Eramosa across the RI Study Area. While the hydraulic gradients represent overall groundwater flow patterns, smaller scale groundwater flow is expected to be more complex due to variations in fracture aperture and interconnectivity. The horizontal hydraulic gradient in the Eramosa ranged from 0.0004 to 0.0061 feet per foot (ft/ft). The estimated horizontal groundwater velocity under non-recharge conditions in the Eramosa ranges from 3.5×10^{-4} to greater than 1.4×10^{-1} cm/sec (approximately 1 to greater than 390 feet per day [ft/day]).Calculation of the horizontal hydraulic gradients based on the groundwater elevation data from the upper Penfield and the Deep Bedrock wells was not conducted because of the limited number of wells and spatial distribution of the wells in these formations.

As part of the storm water management program, active and inactive recharge wells are present on both the former RFM (inactive recharge well) and former AMSF (active recharge wells) Sites. The recharge wells are present in the bedrock to depths as deep as 149 ft bgs and provide a mechanism for the vertical flow of water and the transport of COCs. Five recharge wells are present on the former AMSF Site and one is present on the former RFM Site. The drain lines leading to the recharge well on the former RFM Site (ITT-W-1) were sealed off during the demolition of the former RFM building in November 2015. Recharge well AMSF-RW-2, a 149 ft deep open borehole recharge well located in the northwestern portion of the former AMSF Site, receives runoff from the northwestern roof of the former AMSF building and portions of nearby paved and non-paved surfaces. AMSF-RW-2 is located in the area where the highest TCA and related degradation product concentrations were observed in groundwater and bedrock matrix samples during the RI. The recharge well rapidly transmits tens to hundreds of thousands of gallons of water from precipitation events into the bedrock system. This very large runoff flux into the bedrock system through transmissive solution-enlarged fractures results in variable groundwater COC concentrations. In addition, the deep recharge wells provide vertical conduits for vertical groundwater flow between the Eramosa, Penfield and Deep Bedrock groundwater units.

Groundwater elevation monitoring of Eramosa and Penfield monitoring wells documented groundwater elevation responses to precipitation runoff recharge events in the Site and off-Site recharge wells. The groundwater elevation responses showed that radial hydraulic gradients and groundwater flow develop around the recharge wells during groundwater recharge events. In addition, the recharge wells provide vertical conduits for vertical groundwater flow between the Eramosa, upper Penfield and Deep Bedrock groundwater units. Groundwater elevations in the Deep Bedrock monitoring wells showed limited to no response to the recharge events in the recharge wells.

3.2 SURFACE WATER HYDROLOGY

This section presents a summary of the RI Study Area surface water hydrology. A detailed description of surface water hydrology is presented in Section 2.4 of the RFM RIR.

3.2.1 Surface Water Bodies

There are no surface water bodies in the RI study area. Little Black Creek, which flows to the east through the Town of Gates, New York, is located approximately ¾ miles south of the former RFM Site and is the closest surface water body to the Site. The Erie Canal, a man-made water way connecting Lake Erie to the Hudson River in Albany, New York, is located approximately 2¼ miles northeast of the Site. In addition, the Site is located south of Lake Ontario in New York. No federal or state wetlands are located on or adjacent to the Site.

3.2.2 Management of Surface Runoff

Roof and impervious surface drainage from the former RFM Site was partially managed until November 2015 through a groundwater recharge well on the RFM Site (ITT-W-1). The installation date of the single recharge well on the former RFM Site is unknown. The drain lines leading to recharge well (ITT-W-1) were sealed off in November 2015. Roof and impervious surface drainage from the former AMSF Site is partially managed through five groundwater recharge wells located on the former AMSF Site. The recharge wells on the former AMSF Site are believed to have been installed at the time of the 1979 AMSF building addition. It is our understanding that the Town of Gates purportedly allowed the installation of the recharge wells for stormwater management, but documentation of this is not available. The NYSDEC did not regulate these types of injection wells at the time they were installed. As of April 5, 2000, stormwater management wells in New York State are considered Class V Injection Wells and are defined and regulated by the EPA under 40 CFR 147.1651.

RFM

Roof drainage from the southwestern two-thirds of the former RFM building roof was transported by gravity through subsurface drain lines (until November 2015 when the lines were sealed) to recharge well ITT-W-1, which has a depth of 137 ft bgs. The drainage that previously flowed from the northwestern third of the former RFM building roof was discharged (until November 2015) through a pipe to the northeastern corner of building (RFM RIR Figure 2-1b). Roof drainage from the eastern third of the former RFM building previously sheet flowed to ground surface along the eastern wall of the building. Currently stormwater flows as sheet flow from the building slab to the surrounding ground.

Drainage swales collect runoff from the paved and grassy areas on the north and west sides of the former RFM Site and drain into a roadside drainage ditch located on the north side of Pixley Industrial Parkway. On the east side of the former RFM building slab, a broken drain pipe discharges runoff from the east side of the concrete slab into a drainage swale along the west side of the former AMSF Site (Golder, 2000a).

AMSF

Surface water and roof drainage on the former AMSF Site are directed to five recharge wells (AMSF-RW-1 through AMSF-RW-5) that are present on the former AMSF Site and range in depth from 12 to 149 ft bgs (GeoServices, 1994). A drainage swale on the west side of the former AMSF Site drains to recharge well AMSF-RW-1 (95 ft bgs) at the southwest portion of the Site (GeoServices, 1994).

Stormwater from the northern portion of the former AMSF building roof drains are directed to recharge wells AMSF-RW-4 (19 ft bgs), AMSF-RW-3 (19 ft bgs), and AMSF-RW-2 (149 ft bgs). Recharge wells AMSF-RW-4 and AMSF-RW-3 are interconnected by subsurface lateral drainage lines. Stormwater from the east-central portion of the former AMSF building roof drains to AMSF-RW-5 (12 ft bgs) while roof drainage from the southwestern portion of the roof drains to the swale along the north side of Pixley Industrial Parkway. The grated covers on each of the recharge wells at the former AMSF Site also allow for the capture of overland stormwater runoff.

3.3 SUMMARY OF ENVIRONMENTAL ACTIVITIES

As outlined in Section 2.5 of the RFM RIR (O'Brien & Gere 2014b), between 1992 and 2003, environmental investigations and remedial activities were performed at the former RFM and former AMSF Sites. Between 2004 and 2011 the remedial investigation of the former RFM site encompassed the properties in the RI Study Area.

A tabular summary of the Pre-RI investigations is presented in Table 2-1 of the RFM RIR (O'Brien & Gere 2014b).

Volatile organic compounds (VOC) and 1,4-dioxane analytical methods used in pre-remedial investigations and in the RFM RI varied. While all of the historic analytical data for VOCs are considered definitive data, it is important to note that all 1,4-dioxane data that were not conducted using USEPA 8270 methods of analysis are considered screening data.

3.3.1 Former RFM Site

Pre-Remedial Investigation

In 1993, TCA and 1,4-dioxane were detected in soils from two areas (in the southwest and northeast portions) of the former RFM Site (H2M Group, 1993). Further soil and groundwater investigations (Golder, 2000a) detected VOCs, predominated by TCA, in both soil and groundwater beneath the Site. The highest groundwater concentrations were detected in upper Eramosa groundwater at the northeast portion of the former RFM Site, but TCA and 1,1-dichloroethane (1,1-DCA) were also detected above the groundwater standard in Deep Bedrock groundwater. Benzene, toluene and xylenes, attributed to natural sources, were also detected in Deep Bedrock wells (Golder, 2000a). The highest soil concentrations were detected off the northeast corner of the building. Subsequently, an interim remedial measure was implemented to address impacted soil, which is further discussed in **Section 3.5**.

An investigation of the effects of the stormwater recharge well on groundwater conditions (O'Brien & Gere, 2003) revealed that groundwater head and temperature in the upper Eramosa bedrock responded quickly to precipitation runoff that discharged to recharge well AMSF-RW-2 on the former AMSF Site. Groundwater elevation measured during peak head response evidenced an east to west hydraulic gradient across the northern portion of the RFM Site (O'Brien and Gere, 2003).

Remedial Investigation

Between 2004 and 2011, a RI was completed at the RI Study Area. RI activities included investigation and characterization of overburden soil, bedrock matrix, bedrock groundwater, soil vapor, and the potential for vapor intrusion. A variety of field methodologies were employed including advancing soil borings, bedrock coring, sampling bedrock matrix, packer testing, borehole geophysical logging, hydraulic conductivity testing, groundwater elevation monitoring, installation of monitoring wells, non-aqueous phase liquid (NAPL) monitoring with a FLUTe® liner and oil water interface probes, and natural gas mitigation. Additional details on implementation of these methodologies are presented in Section 3.0 of the RFM RIR. A summary of nature and extent can be found in **Section 3.4**, below.

Periodic Groundwater Sampling

Between June 17 and July 1, 2013, a Periodic Groundwater Sampling (PGWS) event was completed to document the distribution of dissolved COCs in groundwater across the RI Study Area coincident with sampling completed at the former AMSF Site (discussed in **Section 3.3.2**). Thirty three wells were sampled and analyzed for VOCs and 1,4-dioxane. The day prior to commencing the June 2013 groundwater monitoring event (on June 16, 2013), approximately 2.4 inches of rainfall was recorded at the Greater Rochester International Airport. Results of sampling reflected this rainfall event with elevated groundwater concentrations and a general decrease of concentrations of TCA and related compounds in the vicinity of ASMF-RW-2. Likewise, concentrations of TCA and related compounds in groundwater monitoring wells further away from AMSF-RW-2, but still in the hydraulic influence of the recharge well, generally increased due to transport of higher concentrations of TCA and related compounds away from AMSF-RW-2. The highest TCA concentration was observed in a sample from AMSF-MW-16I, south-southwest of AMSF-RW-2. Results of this event were reported to NYSDEC in a letter dated August 12, 2014 (O'Brien & Gere 2014).

3.3.2 Former AMSF Site

Pre-Remedial Investigation

The history of documented remedial work at the former AMSF Site began with removal of three underground storage tanks (USTs) in 1989. These tanks included one 10,000-gallon #2 fuel oil storage tank, and two 285-gallon hazardous waste storage tanks that received spilled material from the waste storage area and paint mixing room inside the building. Indications of leaks were identified when the second 285-gallon UST (Tank #2) was removed. AMSF's consultant reported that subsequent limited analysis of soil from beneath this area did not detect any VOCs or semi-volatile organic compounds (SVOCs) (GeoServices, 1992b). Additional discussion of VOC analysis conducted on the remaining liquid contents present in UST (Tank#2) is presented in **Section 3.4.2** of this FS. Analytical results indicate NAPL concentrations of VOCs were present in this leaking tank.

During the Phase I environmental assessment conducted in 1991 (GeoServices 1992a), chlorinated volatile organic compounds (CVOCs), including TCA, tetrachloroethene (PCE), TCE and associated degradation products, were detected in soil, soil vapor and groundwater in two areas: the southwest portion of the former AMSF Site and the area near the loading dock on the south facing wall of the building. No SVOCs were detected in soil or groundwater but total petroleum hydrocarbon (TPH) was detected in one soil sample. Aromatic compounds, including acetone, toluene, ethylbenzene and xylenes were detected in soil and soil vapor. Subsequent soil and groundwater analysis in 1992 detected additional PCE and TCA in these areas, including in additional water-table monitoring wells as well as deep piezometer wells. During this investigation, the highest VOC concentrations were in AMSF-MW-3S in the loading dock area; AMSF-MW-10 in the southern portion of the former AMSF Site; and AMSF-MW-7 and AMSF-MW-1S in the northwestern portion of the former AMSF Site. While TCA and PCE accounted for the majority of total VOC concentrations in water-table wells (65%), the degradation products of TCA and PCE accounted for the majority of VOC concentrations in the deep piezometer wells (GeoServices, 1992b).

In 1993 and 1994, soil samples were collected deeper than the interval previously tested at sample location SS-B. The deeper soil sample results indicated that VOCs, specifically TCA, PCE and 1,1,2-trichloroethane, were present. Six additional borings were completed along the western boundary of the former AMSF Site west of AMSF-MW-7. TCA was detected in two samples from these borings. Two existing stormwater recharge wells, AMSF-RW-1 and AMSF-RW-2, were sampled along with other site monitoring wells and analytical results indicated that VOCs were detected in many of the monitoring and recharge wells, with TCA being the predominant VOC detected (GeoServices, 1994).

In May 1994, approximately 28 tons of soil with elevated VOC concentrations was excavated from four locations in the southeast portion of the former AMSF building, the northeast portion of the former AMSF building, and the south central portion of the former AMSF Site (GeoServices, 1994).

Remedial Investigation

Between March 2012 and September 2014, a RI was performed at the former AMSF Site. RI activities included investigation and characterization of overburden soil, bedrock groundwater, soil vapor, and the potential for vapor intrusion. A variety of field methodologies were employed including advancing soil borings, bedrock coring, groundwater elevation monitoring, installation of monitoring wells, and video inspection of storm sewers. Additional investigation activities are planned at the former AMSF Site. Details on implementation of these methodologies are presented in AMSF RIR (Stantec 2015). A summary of groundwater and sub-slab nature and extent can be found in **Section 3.4**, below.

3.3.3 Former RFM/AMSF Sites

NYSDEC's 2001 investigation of soil and groundwater in the northeast portion of the former RFM Site and the adjacent northwest portion of the former AMSF Site concluded that, based on the amounts of CVOC hazardous waste that had been disposed of at the former RFM Site and potentially at the former AMSF Site, both properties should be considered for inclusion in the New York State Listing of Inactive Hazardous Waste Disposal Sites.

3.4 SUMMARY OF SITE AREA IMPACTS

This section presents a summary of the RI Study Area nature and extent of impacts. A detailed description of nature and extent is presented in Section 5 of the RFM RIR and further augmented by the RFM RIR Soil Addendum (O'Brien & Gere 2014c) and the RFM RIR Surface Soil Addendum (O'Brien & Gere 2016).

3.4.1 Constituents of Concern

The COCs associated with the former RFM Site include TCA, associated degradation products (DCA and chloroethane), and 1,4-dioxane. The VOCs, TCA and associated degradation products, are also referred to as Site-related VOCs or RFM related compounds[1]. Other compounds including PCE and associated degradation products (TCE and cis-1,2-dichloroethene [cis-1,2-DCE]), have been historically detected but are not considered to be related to activities at the former RFM facility. Additionally, the RFM RIR Surface Soil Addendum (O'Brien & Gere, 2016) identified SVOCs and pesticides in soil.

3.4.2 Soil

RFM Remedial Investigation

Subsurface soil samples were collected and analyzed as part of the RFM RI to investigate soil impacts associated with Areas of Concern (AOCs) on the former RFM Site and other selected locations. The AOCs were identified based upon historical use and former RFM Site infrastructure. Detected compound concentrations were compared to three criteria. The New York State (NYS) Part 375 Restricted Commercial Use Soil Cleanup Objectives and NYS Commissioner Policy (CP)-51 Restricted Commercial Use Soil Cleanup Objectives (Commercial Use SCOs) were used as the criteria to identify soil impacts potentially posing a risk for human exposure. The NYS Part 375 Restricted Use Soil Cleanup Objectives for the Protection of Groundwater Resources and NYS CP-51 Restricted Use Soil Cleanup Objectives for the Protection of Groundwater Resources (Protection of Groundwater SCOs) were used as criteria to identify soil impacts potentially affecting groundwater quality. NYS Part 375 Restricted Use Soil Cleanup Objectives for Unrestricted use were evaluated in connection with pre-existing conditions.

Compound detections within overburden soil samples were generally below regulatory screening criteria with a few isolated exceptions (RFM RIR Figure 5-1a and 5-1b). None of the RFM RI soil sample detections exceeded the Commercial Use SCOs. Under the former RFM building, isolated detections of TCA, 1,1-DCE, acetone, and 1,4-dioxane exceeded the Unrestricted and Protection of Groundwater SCOs. Concentrations of 1,4-dioxane (definitive data as defined in RFM RIR) exceeded the Unrestricted and Protection of Groundwater SCOs beneath the north and southern end of the former RFM building.

Compound detections within surface soil samples were generally below regulatory screening criteria with a few isolated exceptions (RIR Surface Soil Addendum Figure 3-1). RFM RIR Surface Soil Addendum soil sample detections of PAHs in and near the front parking lot exceeded the Commercial Use SCOs, although the PAHs are likely associated with asphalt rather than soil. Isolated detections of 1,1-Bis-(4-chlorophenyl)-2,2-dichloroethene (4-4-DDE) and dichloro-diphenyl-trichloroethane (4-4-DDT) exceeded the Unrestricted and Protection of Groundwater SCOs. RFM RIR Surface Soil Addendum soil sample detections of iron in and near the front parking lot are considered naturally occurring.

1999 RFM Soil Remediation Area at the former RFM Site

Subsequent to submittal of the RFM RIR to NYSDEC, an addendum to the RFM RIR was submitted to NYSDEC on November 21, 2014, entitled *Remedial Investigation Report Soil Addendum* (O'Brien & Gere, 2014c) (RFM RIR Soil Addendum), and is included in **Appendix A**. (Both the RFM RIR and the RFM RIR Soil Addendum were placed in the public repository on March 5, 2015.) The RFM RIR Soil Addendum provided an expanded

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[1] RFM related compounds are those that have been found at the former RFM Site, but not necessarily the result of a source at the former RFM Site.

presentation of soil sampling results obtained from the former RFM Site, particularly soil conditions that existed prior to a 1999 excavation that took place immediately north of the former RFM building (1999 RFM Soil Remediation Area). Soil sampling results presented in the RFM RIR did not include those data obtained from the soil sampling that took place within the boundaries of the 1999 RFM Soil Remediation Area prior to excavation. A major focus of the RFM RIR Soil Addendum was on the northern portion of the former RFM building and property because of its proximity to the significant groundwater impacts in and around the northeast portion for the former RFM Site and the northwest portion of the former AMSF Site and proximity to recharge well AMSF-RW-2 located on the former AMSF Site. Additionally, the greatest number of historic soil borings collected at the former RFM Site were from within the boundaries of the former 1999 RFM Soil Remediation Area.

Approximately 968 tons of soil with VOCs above the NYSDEC Technical Administrative Guidance Document (TAGM) 4046 recommended soil cleanup objectives were removed from the northeastern area of former RFM Site on November 17-24, 1999. Soil excavation occurred adjacent to the building foundation, down to the top of bedrock. This excavation area was defined and based on pre-RI investigations that identified TCA-impacted soils immediately north of the former RFM building (Golder, 2000a and 2000b), (H2M Group [H2M], 1993). Soil sampling results presented in the RFM RIR did not include those data obtained from the soil sampling that took place within the boundaries of the 1999 RFM Soil Remediation Area prior to excavation. The focus of the presentation of soil sampling results in the RFM RIR was to provide information on conditions that existed on the former RFM Site during the RI to address the nature, extent, fate and transport of the COCs associated with the former RFM Site. However, based on comments provided to NYSDEC and ITT on the RFM RIR, further discussion of concentrations of the soil that was excavated in 1999 is necessary to provide a complete conceptual site model (CSM) for the northeast portion of the former RFM Site. Site related COCs were identified as TCA, associated degradation products, and 1,4-dioxane.

Surface and subsurface soil sampling locations from pre-RI and RI investigations at the former RFM Site are presented in Figure 2-1 of the RFM RIR Soil Addendum (**Appendix A**). Locations of the AOCs on the former RFM Site are also presented in this figure. An expanded view of the 1999 RFM Soil Remediation Area (Golder, 2000b) is also presented in Figure 2-2 of the RFM RIR Soil Addendum (**Appendix A**), indicating soil sampling locations conducted prior to and following excavation. A summary of various soil sampling activities conducted on the former RFM Site, along with details of soil sampling methods, dates of sampling, soil sample identifiers, soil vapor screening methods and analytical methods, is presented in Table 2-1 of the RFM RIR Soil Addendum (**Appendix A**). While analytical methods for VOCs in soils were well established during the timeframe when soil sampling was conducted at the former RFM Site from 1991 through 2004, 1,4-dioxane analyses were only just emerging.

Based on definitions of screening, definitive and research data established in the RFM RIR, the RFM RIR Soil Addendum established that the VOC measurements of chlorinated and non-chlorinated compounds in soils are considered to be definitive data, even though VOC analyses reported by H2M (1993), Golder (2000a and Golder 2000b) and NYSDEC (2001) did not undergo data validation and a Data Usability Summary Report (DUSR) analysis.

Additionally, it was established in the RFM RIR Soil Addendum that the only definitive soil 1,4-dioxane data are those analyzed by USEPA Method 8270. These definitive data include 1,4-dioxane results reported by NYSDEC (2001) and O'Brien & Gere (2014b). Prior 1,4-dioxane analyses performed by H2M (1993) and Golder (2000a and 2000b) are considered screening data. Discussion of 1,4-dioxane analysis of soils at the former RFM Site will focus on the use of the definitive data only.

As a result of the above analysis conducted in the RFM RIR Soil Addendum, Figure 5-1C of the RFM RIR was corrected to include only definitive 1,4-dioxane and TCA soil results and is shown in RFM RIR Soil Addendum Figure 3-2 of this (**Appendix A**). With a few isolated exceptions, concentrations of organic compounds in the former RFM Site soils were generally within regulatory criteria applicable to the current and anticipated future use of the properties. Following the 1999 excavation, none of the RI or pre-RI soil sample concentrations exceeded the Commercial Use SCOs. There are no exceedances of the Protection of Groundwater SCO for TCA in any soils collected from outside of the former RFM building. There are only two exceedances of the Protection of Groundwater SCO for TCA (0.680 milligrams per kilogram [mg/kg]) in soil samples collected from under the building concrete slab floor and all these samples were from AOC-2 with results of BH-99-44 (8 to 10 ft bgs) at 0.920 mg/kg and OBG-SB-13 (9.5 to 10.5 ft bgs) at 0.710 mg/kg. There were several exceedances of the Protection of Groundwater SCO for acetone (0.100 mg/kg) with the highest being 0.200 BJ mg/kg. There are no exceedances of the Protection of Groundwater SCO for 1,4-dioxane in any soils collected from outside of the former RFM building. Using the definitive 1,4-dioxane soil data, there were four exceedances of the Protection of Groundwater SCO for 1,4-dioxane (0.100 mg/kg) in the following four samples; OBG-SB-8 (7 to 9 ft bgs) at 0.110 J mg/kg, OBG-SB-18 (6 to 7 ft bgs) at 0.690 mg/kg, OBG-SB-20 (2 to 4 ft bgs) at 0.170 J mg/kg and 0.930J mg/kg (duplicate), OBG-SB-20 (6 to 7 ft bgs) at 0.600 mg/kg. These exceedances were in AOC-3 (OBG-SB-20), AOC-5 (OBG-SB-8) and AOC-6 (OBG-SB-18).

With respect to all TCA soil results from the former RFM Site, including soils sampled prior to the 1999 excavation, depth discrete analyses were presented in the RFM RIR Soil Addendum in Figure 3-1a (0 to 4 ft bgs depth interval), Figure 3-1b (4 to 6 ft bgs depth interval) and Figure 3-1c (greater than 6 ft bgs depth interval) **(Appendix A)**.

An additional emphasis in the RFM RIR Soil Addendum was to investigate the potential for dense non-aqueous phase liquids (DNAPLs) to be present on the former RFM Site, based on both sampling during the RFM RI and on historic soil sampling, including from the 1999 RFM Soil Remediation Area. USEPA (1994) provided guidance on DNAPL site characterization methods, including soil sampling, to determine the presence of DNAPLs at a site. The USEPA (1994) guidance is provided for the determinant, inferential and suggestive indications of DNAPL presence as follows: 1) determined directly by visual examination of subsurface samples; 2) inferred by interpretation of chemical analysis or subsurface samples; and/or 3) suspected by interpretation of anomalous chemical distribution or hydrogeologic data. USEPA (1993) provided guidance on the likelihood of finding DNAPLs at National Priority List (NPL) Sites and included similar criteria for the inference of DNAPLs based on soil and groundwater concentrations. USEPA (1994) lists ultraviolet (UV) fluorescence as a method to enhance inspection of a soil sample for DNAPL. Golder (2000a and 2000b) screened 220 discrete subsurface soil samples on the former RFM Site using UV fluorescence for the potential presence of NAPL and each of the samples was reported as negative for the presence of NAPLs. O'Brien & Gere (2014b) also tested 114 subsurface soil samples on the former RFM Site for the presence of NAPLS using UV fluorescence and each of the samples were reported as negative for the presence of NAPLs.

The USEPA (1994) guidance on inferring DNAPL presence by interpretation of soil concentrations of DNAPL constituents is established at 10,000 mg/kg and higher concentrations. The highest concentration of TCA measured in any soil sample collected from the former RFM Site was reported at 570.000 E mg/kg from BH-99-19 (6 to 8 ft bgs depth interval) located in and sampled prior to the 1999 excavation. This value is more than a factor of 17 times lower than the USPEA (1994) guidance value of 10,000 mg/kg for the potential presence of DNAPL in soils. Additionally, no other VOC compounds were detected in sample BH-99-19 (6 to 8 ft bgs depth interval). At the BH-99-19 (6 to 8 ft bgs depth interval) location in the 1999 RFM Soil Remediation Area, with the highest TCA reported concentration in overburden soils at the former RFM Site, this sample location is surrounded above and adjacent to other sample locations with lower or non-detected TCA concentrations in overburden soils at the sampled depth intervals, indicating a localized and isolated impact.

Based on USEPA (1993 and 1994) guidance for the determination whether DNAPLs are inferred to be present at a Site, the fact that no soil sample was visually identified as having DNAPLs present, the fact that all of the soil samples collected were negative for the presence of DNAPL based on UV fluorescence screening and the fact that all soil samples collected at the site had less than 10,000 mg/kg TCA in soils leads to the logical conclusion that no DNAPL was present in soil samples at the former RFM Site when these soil samples were collected during the 1991 to 2001 timeframe.

Furthermore, the distribution of TCA concentrations in overburden soil at greater than 10 mg/kg (based on RFM RIR Soil Addendum Figure 3-1a, Figure 3-1b and Figure 3-1c [**Appendix A**]) indicates limited and sporadic areal distributions in the 1999 RFM Soil Remediation Area on the former RFM Site. Results of the analysis of TCA in overburden soils at the former RFM Site in and around the former excavation area, prior to excavation, indicate that no continuous distribution of TCA concentrations indicative of NAPL level concentrations existed in the overburden soil. Similarly, no continuous distribution of TCA concentrations indicative of NAPL level concentrations existed in the overburden soil in the former RFM excavation area away from the location at BH-99-19 in any direction, and particularly in an easterly direction towards the former AMSF Site and particularly towards the TCA groundwater impacts located at AMSF-MW-7 and AMSF-RW-2.

Prior to the 1999 excavation on the former RFM property there was only one sample in the dense array of soil borings that was observed with a TCA concentration greater than the NY CP-51 Commercial Use SCO of 500 mg/kg (BH-99-19 [6 to 8 ft bgs] at 570E mg/kg). In the same boring but above this sample, BH-99-19 (4 to 6 ft bgs depth interval) was reported with a TCA soil concentration of 51 mg/kg. Several adjacent borings to BH-99-19 in the 4 to 6 ft bgs depth interval had TCA soil concentrations less than 2 mg/kg as follows: BH-99-22 (1.5 mg/kg); BH-99-25 (0.2 mg/kg); BH-99-35 (0.015 mg/kg); BH-99-36A (0.65 mg/kg); and ITT-SBW-3 (0.93 mg/kg). These borings were adjacent to BH-99-19, between 5 to 15 feet away, and indicate a localized areal impact of TCA in soils associated with the immediate area of BH-99-19. Several adjacent borings to BH-99-19, in the greater than 6 ft bgs depth interval, had TCA soil concentrations less than 10 mg/kg. BH-99-6 (6 to 8 ft bgs depth interval) and BH-99-23 (8 to 10 ft bgs depth interval) were reported with TCA soil concentrations of 4.2 E mg/kg and 0.37 mg/kg, respectively. Both of these borings were located within 3 ft of BH-99-19. BH-99-18 (6 to 8 ft bgs depth interval), BH-99-23 (8 to 10 ft bgs depth interval), BH-99-37 (6 to 8 ft bgs depth interval), BH-99-38 (6 to 8 ft bgs depth interval) and ITT-SBW-3 (8 to 10 ft bgs depth interval) all were reported with TCA concentrations less than 0.37 mg/kg. These additional adjacent borings to BH-99-19 were between 5 to 10 feet away indicating a localized area impact of TCA in soils associated with the immediate area of BH-99-19. The overburden soil data do not indicate a TCA source sufficient to cause the high TCA groundwater and bedrock matrix concentrations observed on either the former RFM Site or the former AMSF Site.

In the RFM RIR, metals concentrations from AOC-4 soil boring samples were reported to be below the Protection of Groundwater SCOs. There are no Commercial Use or Protection of Groundwater SCOs for total chromium; however, the total chromium concentrations were compared to the hexavalent chromium Commercial Use SCO. The total chromium concentrations from RI soil samples were not compared to the Protection of Groundwater SCOs as the chromium concentrations from pre-RI groundwater samples collected across the RI Study Area did not contravene the groundwater Class GA Standards as discussed in RFM RIR Section 5.1.1. Subsurface soil analytes exceeding the Unrestricted Use SCOs for VOCs and 1,4-dioxane are updated from the RFM RIR and are provided in the RFM RIR Soil Addendum in Table 3-1 and Table 3-2 **(Appendix A)**, respectively. Metals in soils exceeding Unrestricted Use SCOs are provided in RFM RIR **Table 5-1c**.

Soil sampling results obtained from soils that were subsequently removed during the 1999 excavation on the former RFM Site provide an important component to the CSM, enabling a more detailed interpretation for the potential of these soils to serve as source material for impacts to shallow bedrock groundwater Data presented in the RFM RIR Soil Addendum indicate that these soils were not a source of TCE or other CVOC groundwater impacts found in the northwest corner of the former ASMF Site in and around recharge well AMSF-RW-2.

Soil from the Tank 2 UST Removal at the Former AMSF Site

Details of an UST removal along the western side of the former AMSF building are presented in a GeoServices (February 26, 1992) report (GeoServices Ltd. 1992a). The location of this former UST is also identified in the AMSF RIR Figure 4. Appendix B of the Geoservices (1992) report includes a letter from NYSDEC to Alliance Metal and Stamping Division (understood to be AMSF) (October 2, 1989) that states: "One excavation was significantly contaminated as a result of a hole in one of the tanks." Liquid from the tank was analyzed and NAPL concentrations of toluene and ethylbenzene were reported at concentrations of 446 grams per kilogram (g/kg) and 57.2 g/kg, respectively. This tank was reportedly part of ongoing operations going back as early as 1972 and reportedly functioned as secondary containment for spills that occurred in the waste storage/paint mixing room. Grate-covered floor drains were reported to receive spills and convey the spillage to this UST. There were no records presented by GeoServices or subsequently in the AMSF RIR if this tank had ever been pumped out, what the past composition of liquids that were in the tank, or if the tank had ever been leak tested. No sample of the impacted soils visually identified under the tank were ever collected immediately following removal of the tank in 1989, so there is no way to presently determine the composition of chemicals that were visually identified under the tank prior to excavation of soils under the tank. No overburden or shallow bedrock monitoring wells were ever installed in the location of the formerly leaking UST. Additionally, it appears that no records were kept of the elevations of the top and bottom of the tank, dimensions of the tank, or how close to the bedrock surface that the bottom of the tank was located. This tank is a documented source of NAPL released on an ongoing basis to the subsurface. Because there is no presentation in the AMSF RIR regarding this leaking UST, nor of the potential impacts of the released NAPLs from this tank for up to a 17 year period, it is impossible at this time to assess the extent of the source of NAPLs to the soil and the bedrock system as a result of this leaking UST at the former AMSF Site. Prior to the 1972 installation of this UST and another UST located on the southern portion of the former AMSF Site, there is no mention in the AMSF RIR how floor drain spillage was managed and where the spillage was directed.

AMSF Remedial Investigation

The data presented in the AMSF RIR (Stantec 2015) indicates that 1,4-dioxane, PCE, 1,1-DCA, and c-1,2-DCE were observed exceeding Unrestricted and Protection of Groundwater SCOs in four general areas: former degreaser (AOC 1), former storage shed area (AOC 5B), 1994 soil remediation Area A, and former paint shop with trench drain (AOC 6). 1,4-Dioxane, analyzed by USEPA Method 8260 (screening data per RFM RIR), was observed above SCOs in one or more samples at each location. PCE was observed above SCOs in one sample adjacent to the former degreaser. TCA was detected in soil at six locations at concentrations below SCOs, most notably 0.120 J mg/kg in AOC 6 in the southwest corner of the former AMSF building adjacent to a trench drain (PS-TB-1) at 8 ft bgs. This is also the only location where 1,1-DCA and c-1,2-DCE exceeded SCOs at 2-4 ft bgs.

3.4.3 Bedrock Matrix

Bedrock matrix sampling and analysis was conducted by a research team headed by Dr. Beth Parker of the University of Guelph to characterize the horizontal distribution and vertical extent of the impacts within the bedrock. The bedrock matrix samples were collected adjacent to fractures and from intact (unfractured) sections of the bedrock. The results from the RI matrix sampling were used to evaluate the vertical and horizontal extent of COCs in the bedrock and to provide a better understanding of the distribution of the COC mass between groundwater in fractures and dissolved/sorbed CVOC mass in the bedrock matrix. Specifically, the high density of vertically distributed rock core COC data over the entire length of continuously cored boreholes was used in conjunction with other physical, geophysical, and analytical (screening and definitive) data, to determine the nature, extent, fate, and horizontal and vertical COC transport in the bedrock system across the RI Study Area. The rock core concentration profiles were used in the RI to help spatially identify the solution enlarged fractures, in which active COC transport occurs in the bedrock. During the RI, the COC analyses of bedrock core samples were used in the RI to confirm the mechanism of matrix diffusion.

Bedrock Matrix Diffusion

The physical and chemical processes associated with bedrock matrix diffusion control and retard the groundwater COC migration at the Site. In the absence of bedrock matrix diffusion processes, COCs would be expected to migrate further downgradient through hydraulically conductive solution-enlarged fractures. Rock core samples were used in the RFM RI to provide the longest-time integrated measurement of the spatial position of CVOCs in the fractured bedrock. Therefore, the combination of the high vertical density of bedrock matrix samples, proximate to the most transmissive primary fractures (already selected based on physical and geophysical examination and data from the rock core and borehole), coupled with the inherent insensitivity of this sampling method to short-term recharge events and seasonal hydrologic variations, enables use in this RI of these data to provide a more refined CSM for VOCs in this bedrock system than with traditional groundwater sampling alone.

Generally the transport and fate of dissolved COCs in fractured sedimentary bedrock is affected by the bedrock matrix because the primary porosity of the bedrock matrix is significantly larger than the secondary porosity, or the bedrock fractures. This bedrock matrix porosity can store significantly more COC mass than is present in the bedrock fractures. Consequently, this matrix storage potential affects the transport, fate and remediation of dissolved COCs in a sedimentary bedrock aquifer. While the porosity of the bedrock matrix is high relative to the fracture porosity, the hydraulic conductivity of the bedrock matrix is significantly lower than the hydraulic conductivity of bedrock fractures that are involved in groundwater flow. Consequently groundwater flow and COC transport in bedrock in the RI Study Area primarily occurs within the fractures. When a NAPL or a dissolved

COC is released to a bedrock aquifer, COC transport initially occurs by groundwater or NAPL flow in the bedrock fractures because of their higher hydraulic conductivity. Therefore, initially COCs are present in the fracture, as either NAPL or impacted groundwater, and are not present in the surrounding bedrock matrix. This difference in COC concentrations creates a concentration gradient between the COCs in the fracture and the porewater in the matrix. This concentration gradient causes diffusion of COCs from the fracture into the bedrock matrix. The rate of matrix diffusion is governed by the bedrock matrix physical properties and the COC concentration gradient. The presence of naturally occurring carbon in the matrix acts to increase the sorbed constituent mass in the matrix. RI data indicate that matrix diffusion has occurred in the RI Study Area and therefore, has played a role in strongly attenuating and retarding the downgradient migration of CVOCs in the bedrock groundwater.

The COCs stored in the matrix have the potential to contribute to impacts to groundwater in the bedrock fractures. When COC concentrations in the bedrock fractures begin to decline, a reverse COC concentration gradient, from the matrix to the fracture, will develop. This reverse concentration gradient will cause the stored COCs in the matrix to diffuse from the matrix to the fracture. COCs that back diffuse into the fractures will migrate downgradient with groundwater flow until the groundwater COC concentration in the fracture is greater than the concentration in the matrix. Then the COCs diffuse into the matrix and the process is repeated. The result of this repetitious diffusion into and back diffusion out of the matrix is that the downgradient migration of the COC concentrations is significantly slower than groundwater flow (Lipson etal, 2005 and Chapman etal, 2015). However, Darlington *et al.* (2009) showed evidence for abiotic degradation of chlorinated compounds in sandstone samples from the Santa Susana Field Laboratory site. Pierce *et al.* (2009) showed field evidence for both biotic and abiotic TCE degradation in sandstone at the Santa Susana Field Laboratory site. Lima *et al.* (2012) showed occurrence of dechlorinating microorganisms in the rock matrix at the Wisconsin site described by Parker *et al.* (2012). Parker *et al.* (2010, 2012) allude to the importance of even slow biotic and/or abiotic degradation processes in the matrix. The attenuation mechanisms (diffusion, sorption, degradation) of the bedrock matrix combine to create stabilized conditions where the COC concentrations no longer increase downgradient. While measurements of reduced iron (Fe^{2+}) as a measure of abiotic activity in the bedrock matrix and the presence of dechlorinating bacteria in the bedrock matrix as a measure of biotic activity were beyond the scope of the RFM RI and FS, the documented presence of low Oxidation Reduction Potential (ORP) reducing zones in and about the northwest corner of the former AMSF site and the northeast corner of the former RFM site clearly indicate that biotic activity and reduced iron is present in the bedrock fractures. This supports the conceptual model that either biotic and/or abiotic CVOC degradation mechanisms are present in the bedrock fractures.

This back diffusion process has the ability to cause COC concentrations in fracture groundwater (at much lower concentrations) to last for a much longer period time than if there were no COCs in the matrix. The rate of back diffusion will be governed by the physical properties of the matrix, COC concentration gradient and the presence of biotic and/or abiotic degradation mechanisms. The available groundwater data document that the northwestern portion of the former AMSF Site and northeastern portion of the former RFM Site have been the areas of high TCA concentrations for over a decade. Given the groundwater velocity and the continued presence of the highest TCA concentrations in the northwestern portion of the former AMSF Site, it can be concluded from RI data that the highest COC concentrations in the bedrock groundwater continue to be on the northwestern portion of the former AMSF Site.

While bedrock matrix and groundwater concentrations suggest that DNAPL may have existed in the subsurface, DNAPL has not been documented in monitoring wells or borings during the RI. Literature suggests that if DNAPL was present in the past, it may have diffused into the bedrock matrix over time. The RI data suggest that back diffusion from the bedrock matrix may be the likely cause for current bedrock groundwater concentrations. Bedrock matrix data in the northwestern portion of the former AMSF Site suggest that COC concentrations in the bedrock are sufficiently high for back diffusion to cause the groundwater concentrations observed in the monitoring wells in that area. High COC concentrations in bedrock matrix were detected in the northwestern portion of the former AMSF Site and the northeastern portion of the former RFM Site. During the RI, the highest COC concentrations in bedrock groundwater are located in the northwestern portion of the former AMSF Site. TCA concentrations in the Eramosa groundwater decline by orders of magnitude within 500 ft downgradient from the northwestern portion of the former AMSF Site. Groundwater with dissolved TCA will migrate downgradient unless processes act to attenuate the TCA migration. Eramosa groundwater flow velocities and the presence of impacted groundwater for at least two decades suggest that TCA transport would be expected to have migrated much further than has been observed unless attenuation processes were acting to reduce TCA concentrations and retard TCA migration. The distribution of TCA in the bedrock matrix, with the majority of the mass located in the vicinity of the northwestern portion of the former AMSF Site and northeast portion of the former RFM Site, the order of magnitude decline in TCA concentrations in downgradient groundwater, and the generally limited downgradient extent of TCA in bedrock groundwater, suggest that natural attenuation processes (diffusion, sorption, degradation) are significant in the RI Study Area. For the RI Study Area, matrix diffusion has resulted in the order of magnitude downgradient decline in COC concentrations in the groundwater and the limited downgradient extent of groundwater impacts. Matrix diffusion provides containment of TCA and other CVOCs in the RI Study Area similar to hydraulic control remedial actions. Diffusion of TCA into the bedrock matrix will continue to attenuate and contain the downgradient migration of COCs.

The transport mechanism controlling the movement of an aqueous phase CVOC between low volume fractures where nearly all groundwater flow occurs and the high volume matrix which comprises the bulk of the storage capacity is molecular diffusion. Sorption in the matrix further enhances matrix diffusion and increases the storage capacity. If the aqueous phase VOC concentration is high in the fracture relative to the bedrock matrix, then transport from the fractures to the bedrock matrix will take place (forward diffusion). In contrast, if the aqueous phase VOC concentration is low in the fracture relative to the bedrock matrix, then transport from the bedrock matrix to the fracture will take place (reverse or back diffusion). Based on these phenomena, Parker et al., (1994) developed a conceptual model for the fate and transport of immiscible phase DNAPLs in fractured geologic media including three distinct times resulting in three distinct chemical distribution stages, as follows:

- Early time shortly after releases occurred when the continuous phase nonwetting DNAPL invades and spreads out in suitably sized fractures and eventually becomes immobilized as driving forces dissipate, with the DNAPL constituents dissolving into the water film (i.e., the wetting fluid) with subsequent dissolved solute diffusive transport taking place from the fracture water film into the adjacent bedrock matrix along with DNAPL dissolution in groundwater flowing in fractures causing a downgradient plume to begin to develop;
- Intermediate time when the DNAPL becomes discontinuous and present in the rock fractures as disconnected blobs, the result of DNAPL dissolution and mass transfer by diffusion into the rock matrix, while the downgradient plume continues to expand but is also strongly attenuated by matrix diffusion; and
- Later time when all of the DNAPL originally present in the fractures is gone and is now present predominantly in the rock matrix and a diffusion halo exists around the formerly DNAPL filled fractures. At this stage there is no differentiation between the source and plume zones. Plume transport downgradient continues to be affected by matrix diffusion, and at some stage the plume may become essentially stable with reduced source input. The majority of sites where releases occurred decades ago are likely now in this stage. Further refinement of the conceptual model described by Parker et al., 1994 was graphically presented by Parker et al., 2012, shown in the image (**Figure 3-2**) below.

Figure 3-2: Conceptualization of Source Zone and Plume Evolution in Fractured Sedimentary Rock

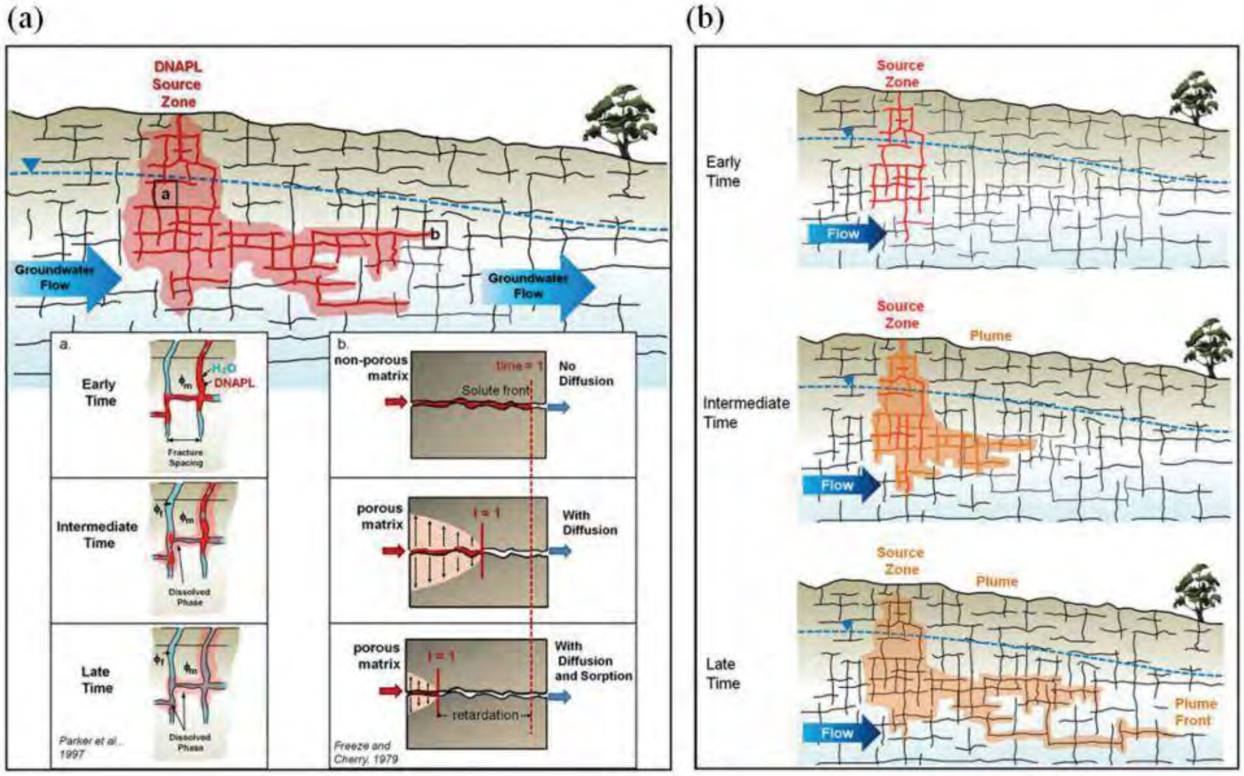

Fig. 1: *Conceptualization of source zone and plume evolution in fractured sedimentary rock: (a) schematic cross-section showing DNAPL release with formation of a downgradient plume, with insets showing source zone evolution (adapted from Parker et al., 1997) and diffusion effects on contaminant migration (adapted from Freeze and Cherry, 1979), and (b) conceptual stages of source zone and plume evolution (adapted from Parker et al., 2010).*

Vertically, TCA, DCA, PCE, and TCE were most frequently detected in the uppermost and lowermost of the three fracture zones within the Eramosa. The uppermost fracture zone spans between the top of bedrock and 540 ft amsl (approximately 4 to 34 ft bgs), while the lowermost zone spans between 528 to 519 ft amsl (approximately 32 to 55 ft bgs). TCA concentrations ranged from 0.0291 to 9.7496 micrograms of VOC per gram of rock (µg[VOC]/g[Rock]). Most of these constituent detections were observed in samples near prominent solution enlarged fractures. Isolated detections of TCA and PCE were observed in an upper Penfield matrix sample near a solution enlarged fracture. TCA, DCA, PCE, and TCE were not detected in the bedrock matrix samples collected from the more competent intervals of bedrock cores where there were few or no solution enlarged fractures. TCA was detected in the vicinity of recharge well AMSF-RW-2 in the Deep Bedrock.

Horizontally, concentrations of TCA and DCA were greatest in bedrock core matrix samples from the Eramosa in the northwestern portion of the former AMSF Site and the northeastern portion of the Former RFM Site. Downgradient of recharge well AMSF-RW-2 at ITT-MPBW-22 (located on the Cinemark property and approximately 220 ft from AMSF-RW-2), TCA was only detected in Eramosa matrix samples from the lower portion of the formation. Upgradient of recharge well AMSF-RW-2, TCA was only detected in the upper portion of the Eramosa upgradient of recharge well AMSF-RW-2, to the southwest (ITT-MPBW-21 located adjacent to deep recharge well ITT-W-1 and approximately 470 ft from AMSF-RW-2), but not to the southeast (AMSF-MW-19MP located approximately 570 ft from AMSF-RW-2).

Analyses were conducted on the TCA bedrock matrix concentrations from AMSF-MW-17MP and ITT-IBW-20 and are presented in **Table 3-1 and Table 3-2**, respectively. Data used to generate these tables are presented in the RFM RIR Appendix E. Data analyses presented in **Table 3-1 and Table 3-2** include depth discrete TCA bedrock matrix concentrations, a calculation of average TCA concentrations in adjacent bedrock matrix samples used to estimate a measure of TCA mass in the bedrock cores, and calculations of the mean, median and geometric mean of the TCA bedrock matrix concentrations in each of the two bedrock cores.

In the 13.5 ft bgs (551.6 ft amsl) to 24.7 ft bgs (540.4 ft amsl) depth interval, the highest TCA bedrock matrix concentrations were reported in the Upper Eramosa formation. The mean, median and geometric mean TCA bedrock matrix concentrations in ITT-IBW-20 (**Table 3-2**) were calculated to be 0.9786 micrograms of VOCs per gram of rock (µg (VOC)/g (rock)), 0.0014 µg (VOC)/g (rock) and 0.0107 µg (VOC)/g (rock), respectively (14 data points total). In the 11.75 ft bgs (551.69 ft amsl) to 24.95 ft bgs (538.49 ft amsl) depth interval, where the highest TCA bedrock matrix concentrations were reported in the Upper Eramosa formation, the mean, median and geometric mean TCA bedrock matrix concentrations in AMSF-MW-17MP (**Table 3-1**) were calculated to be 1.2127 µg (VOC)/g (rock), 0.0291 µg (VOC)/g (rock) and 0.0249 µg (VOC)/g (rock). In each case, the mean, median and geometric mean TCA bedrock matrix concentrations were greater in AMSF-MW-17MP than in ITT-IBW-20.

Additionally, the total areas under the TCA bedrock matrix concentration versus depth curves were calculated for AMSF-MW-17MP (11.8 ft bgs to 25 ft bgs) and ITT-IBW-20 (13.5 ft bgs to 24.7 ft bgs) at 20.21 and 13.66, respectively. This is an important calculation in that it is analogous to the mass of TCA present in the bedrock matrix in the zones of highest concentrations in each borehole. It is evident that the area under the curve TCA bedrock matrix concentration versus depth is 1.5 times greater at AMSF-MW-17MP than at ITT-IBW-20, indicating a significantly greater TCA mass in the bedrock at the AMSF-MW-17MP location on the former AMSF Site.

To provide information regarding vertical or lateral sources of CVOCs in the bedrock matrix in and around AMSF-RW-2, comparisons were made between the depth discrete TCA bedrock matrix concentrations and the acoustic televiewer log from AMSF-MW-17MP (**Figure 3-3**). An acoustic televiewer log was not collected from ITT-IBW-20 consistent with the RFM RI Work Plan (O'Brien & Gere 2004). AMSF-MW-17MP is located approximately 27 ft in a northwesterly direction from AMSF-RW-2. For reference ITT-IBW-20 is located approximately 100 ft in a west-southwesterly direction from AMSF-RW-2. It can be seen from examination of **Figure 3-3** and **Tables 3-1 and 3-2** that the elevations of the two highest TCA bedrock matrix concentrations in AMSF-MW-17MP are at 545.2 ft amsl and 543.1 ft amsl. The single highest TCA bedrock matrix concentration reported in ITT-IBW-20 was located at 543.5 ft amsl.

Examination of the acoustic televiewer logs in Appendix F of the RFM RIR clearly indicates the existence of larger and more transmissive fractures at depths shallower than the zone of the highest TCA bedrock matrix concentrations reported in both ITT-IBW-20 and AMSF-MW-17MP. For example, there are 1.65 inch and 3.31 inch fracture apertures at approximately 552.4 ft amsl and 551.3 ft amsl in AMSF-MW-17MP. However, the TCA bedrock matrix concentrations adjacent to these shallower more transmissive fractures were reported to be very low in ITT-IBW-20. In AMSF-MW-17MP TCA bedrock matrix concentrations adjacent to these transmissive fractures were higher, particularly at the 551.7 ft amsl depth with a bedrock matrix concentration at 1.0119 micrograms per gram (µg/g). Additionally, another large fracture at approximately 547.7 ft amsl (2.52 inch) was recorded in AMSF-MW-17MP and the TCA bedrock matrix concentrations in the adjacent bedrock matrix from AMSF-MW-17MP was 0.5030 µg/g, while the TCA bedrock matrix concentration in ITT-IBW-20 was reported at 1.9892 µg/g. This type of distribution of TCA bedrock matrix concentrations, with the highest bedrock matrix concentrations being deeper than the in the shallow bedrock matrix, points to a lateral migration from a source of TCA in the bedrock. If a shallow source of TCA was from the overburden, then it would be expected that the shallower more transmissive fractures would be preferred flow fractures for either NAPLs or TCA in groundwater and the result would be that the highest TCA bedrock matrix concentrations would be in the bedrock matrix adjacent to the overburden and the shallower fractures. This is clearly not the case with respect to the distribution of TCA in the bedrock matrix at both ITT-IBW-20 and AMSF-MW-17MP. Depths to bedrock surface at ITT-IBW-20 and AMSF-MW-17MP were reported in boring logs (O'Brien and Gere, 2014b) at 10.5 ft bgs (554.6 ft amsl) and 8.0 ft bgs (555.4 ft amsl), respectively. Clearly, there is a zone of much lower TCA bedrock matrix concentrations between the top of bedrock at both ITT-IBW-20 (~11 ft) and AMSF-MW-17MP (~10 ft) and the depths at which the highest TCA bedrock matrix concentrations were reported with much lower TCA bedrock matrix concentrations. These data clearly do not indicate an overburden source of TCA in the soil in the areas of these borings on either the former RFM Site or the former AMSF Site.

PCE and TCE were observed in Eramosa and upper Penfield matrix samples collected from the vicinity of recharge well AMSF-RW-2 and at some downgradient and upgradient locations. Benzene, toluene, ethylbenzene, and xylene (BTEX) constituents were detected in matrix samples from each of the bedrock cores. Below 495 ft amsl (approximately 65 to 79 ft bgs) BTEX concentrations were higher and more frequently detected than in bedrock matrix samples collected above 495 ft amsl (approximately 65 to 79 ft bgs). Naturally occurring BTEX compounds are reported in the professional literature in the deeper bedrock formations in the region.

3.4.4 Bedrock Groundwater

During the RFM RI, groundwater impacts by COCs were observed in samples collected from monitoring wells screened in the Eramosa, upper Penfield, and Deep Bedrock. Constituent concentrations were compared to the NYS Technical and Operational Guidance Series (TOGS) 1.1.1 Ambient Water Quality Standards and Guidance Values for Class GA groundwater (Class GA Standards) (RFM RIR Figure 5-5a to 5-5l in **Appendix A**). The Eramosa and upper Penfield bedrock groundwater impacts were dominated by CVOCs. TCA was the primary CVOC detected in groundwater samples collected in the Eramosa, and upper Penfield formations. The degradation products of TCA, PCE, TCE, as well as BTEX were also regularly detected in RFM RI groundwater samples. As a result of TCA being the primary CVOC detected in groundwater during the RFM RI, results presented in the AMSF RIR and the PGWS report are presented in **Figure 3-4** for discussion.

Based on the RFM RI data, TCA and other VOCs in the bedrock groundwater are also distributed upgradient and side gradient from the northwestern portion of the former AMSF Site. TCA was detected in bedrock monitoring wells on the former RFM Site. TCA concentrations in bedrock groundwater on the former RFM Site appear to be influenced by radial flow from recharge well AMSF-RW-2, which is located in the northwestern portion of the former AMSF Site.

Concentrations of TCA in bedrock groundwater samples from the RI High/Low Groundwater Events ranged from ND to 95,000 micrograms per liter (µg/l). During the RFM RI, the highest sustained TCA and DCA concentrations were observed in groundwater samples from Eramosa monitoring wells in the northwestern portion of the former AMSF Site, specifically in the vicinity of recharge well AMSF-RW-2 (AMSF-MW-7, AMSF-MW-12S, and AMSF-MW-13S). During the 2013 PGWS event, the highest concentrations were observed further south, east, and west from AMSF-RW-2 (AMSF-MW-13S, AMSF-MW-15I, AMSF-MW-16I, ITT-IBW-20), a reflection of the radial influence of recharge events on groundwater concentrations (**Figure 3-4**). The highest groundwater TCA concentration (110,000 µg/l) within the RI Study Area was detected in a pre-RI (May 4 1999) AMSF-MW-7 sample. This concentration is close to 10% of the TCA solubility in water, suggesting that DNAPL may have been present in the past in the bedrock in this area. Literature suggests that if DNAPL was present in the past, it may have completely dissolved and diffused into the bedrock matrix over time and caused locally high and persistent groundwater concentrations without DNAPL persistence. DNAPL was not observed during the installation or monitoring of RFM RI soil borings and bedrock monitoring wells.

From the northwestern portion of the former AMSF Site, TCA groundwater concentrations decline rapidly downgradient to the north and east. Concentrations decline by orders of magnitude within a distance of 500 ft indicating that natural attenuation processes are limiting the migration of the VOCs, particularly in the conductive primary fractures of the Eramosa Formation. These attenuation processes have also limited the extent of downgradient TCA migration in the bedrock groundwater. During April-May 2010 and September 2010 Events, TCA was not detected in downgradient Eramosa monitoring wells along the northern portion of the Cinemark property and concentrations ranged from below Class GA Standards (5 µg/l) to 24 µg/l in the Eramosa monitoring well located furthest downgradient to the east. Similar downgradient concentrations and natural attenuation effects were observed during the 2013 PGWS event (**Figure 3-4**).

Based on the most recent RFM RI groundwater monitoring and recharge well data (during 2010) the extent of TCA concentrations in groundwater that do not exceed Class GA Standards has been defined in the upper and lower Eramosa formations. The eastern boundary is defined by AMSF-RW-5, the southern boundary is defined by AMSF-MW-3S, AMSF-MW-10, ITT-SBW-4, and ITT-SBW-8, the western boundary is defined by ITT-SBW-4, ITT-SBW-23, and the northern boundary is defined by ITT-SBW-16, ITT-SBW-13, and ITT-SBW-14. There is one well (ITT-SBW-15) just north of the northeast corner of the former AMSF Site that still exceeded the Class GA TCA Standard at 24 µg/l in the most recent RFM RI sampling (September 2010). Review of 2013 PGWS and AMSF RIR June 2013 sample results indicates that the eastern boundary is not defined where AMSF-MW-30 (northeast corner of former AMSF property), AMSF-RW-5, ITT-SBW-15 exceeded Class GA Standards (**Figure 3-4**).

The 2013 PGWS (O'Brien and Gere 2104a) and AMSF RIR data (Stantec 2015) indicates that TCA concentrations exceeding Class GA Standards are present within the foot print of and east of the former AMSF building. September 2013 data presented on Figure 13a in the AMSF RIR identifies TCA along the eastern side of the former AMSF building (AMSF-MW-21) at higher concentrations than locations to the west (upgradient or cross gradient) and interior to the building (AMSF-MW-23). The 2015 data presented on Figure 13a in the AMSF RIR identifies TCA along the eastern property boundary (AMSF-MW-34) an order of magnitude higher than nearby locations within the footprint of the building (AMSF-MW-22). Recently installed well AMSF-MW-33, along the western building edge, also had TCA concentrations nearly three orders of magnitude greater than the Class GA Standard when sampled in May 2014 and August 2015. All sources contributing to TCA in groundwater at the former AMSF Site may not be known at this time.

Based on the most recent RFM RI data, the above monitoring wells also define the limits of other groundwater CVOCs in the upper and lower Eramosa, with the exception of PCE in the southeastern portion of the former AMSF Site with Class GA exceedances in AMSF-MW-3S and AMSF-MW-10 with PCE concentrations of 96 µg/l (September 2010) and 417 µg/l (October 2005), respectively. These PCE groundwater concentrations in the southeastern portion of the former AMSF Site correspond to detections of PCE in bedrock matrix samples from AMSF-MW-19MP. These limits were unchanged when reviewed against the 2013 PGWS and AMSF RIR June 2013 sample results.

Pre-RI investigations identified TCA-impacted soils immediately north of the former RFM building. These soils were excavated in 1999. Bedrock monitoring wells ITT-IBW-20, ITT-SBW-2, and ITT-SBW-9 are located in the immediate vicinity of this excavation. During the RFM RI, concentrations of TCA in shallow wells ITT-SBW-2 and ITT-SBW-9 declined to below Class GA Standards; however, while intermediate well ITT-IBW-20 TCA concentrations decreased they remained above Class GA Standards. During the 2013 PGWS event, TCA concentrations increased in these wells (**Figure 3-4**). This is likely a result of the recharge event immediately preceding the 2013 PGWS event and further explained below.

RFM RI data have documented that recharge well AMSF-RW-2 induces radial groundwater flow during recharge events. This radial flow of groundwater transports TCA and other VOCs radially away from the recharge well causing TCA concentrations in groundwater to increase upgradient and side gradient from the recharge well. As presented in the RFM RIR, the hydraulic gradient during recharge events, with respect to distance from AMSF-RW-2, was reported to be approximately 0.3 feet per foot (ft/ft) (in all directions) and hydraulic gradients in the absence of recharge events varied from 0.006 ft/ft to 0.0008 ft/ft, which is a factor of 50 to 375 times less than during recharge events. The very large volumes of water that enter AMSF-RW-2 during a recharge event, coupled with a very high hydraulic gradient in highly permeable bedrock fractures, results in a significant transport mechanism of CVOCs that were present in the shallow bedrock groundwater in and around the AMSF-RW-2 area. Importantly, as presented in the RFM RIR, the hydraulic gradient generally returns to normal conditions within approximately 24 hours following a recharge event, again a testimony to the very pervious bedrock fractures in the Upper Eramosa. Therefore, the recharge driven transport of CVOCs in groundwater can take place rapidly and at significant distances away from recharge well AMSF-RW-2. However the migration of the recharge-displaced CVOCs takes much longer, by a factor of 50 to 375 times slower, during non-recharge conditions. In other words, a recharge event can very rapidly transport CVOCs hundreds of feet from the highly contaminated groundwater zone in and around AMSF-RW-2 onto the former RFM Site and the Cinemark property, but it can take up to months for the distribution of CVOCs to return to pre-recharge conditions. Also, given the rate of bedrock matrix diffusion, while recharge event transport is too rapid for matrix diffusion to occur, a high percentage of those transported CVOCs can diffuse into the bedrock matrix during the slower transport of non-recharge conditions.

This radial groundwater flow of TCA and other VOCs from recharge well AMSF-RW-2 is responsible for detected TCA and VOCs on the former RFM Site upgradient and side gradient from the northwestern portion of the former AMSF Site. Similarly, concentrations of TCA and related compounds in groundwater monitoring wells on the Cinemark property, away from AMSF-RW-2, but still in the hydraulic influence of the recharge well, increased following recharge events. For instance, COCs in one or more southern Cinemark wells downgradient of AMSF-RW-2 sampled on February 11, 2005, September 28, 2005 and September 8, 2010 exceeded Class GA standards. However, 0.5 to 1.5 inches of rainfall were received in the preceding 3 days in 2005, which caused higher than normal concentrations to be observed. During the September 8, 2010 sampling, 1.1 inches of rainfall was recorded approximately 17 days prior. This caused higher than normal concentrations to be observed in the downgradient wells, but due to the time elapsed since recharge it was only reflected in the furthest downgradient well (AMSF-MW-15). Without recharge events, it would be expected that migration would be slowed when the mass in the fractures is overwhelmed by dilution and bedrock diffusion effects. Results from 2013 PGWS reinforce this observation where a large rainfall event preceded sampling and a general decrease of concentrations of TCA and related compounds were observed in the vicinity of ASMF-RW-2 (O'Brien & Gere 2014a).

TCA concentrations in the Eramosa decline by orders of magnitude within 500 ft downgradient from the northwestern portion of the former AMSF Site. Groundwater TCA concentrations on the Cinemark property decline by orders of magnitude, to below Class GA Standard, within 150 ft from the northwestern portion of the former AMSF Site. Groundwater with dissolved TCA will migrate downgradient from the northwestern portion of the former AMSF Site at the velocity of the groundwater unless other processes act to retard the TCA migration, such as matrix diffusion, sorption, and/or abiotic and biotic degradation. In addition, given the groundwater velocity in the primary fractures, TCA concentrations would be expected to remain high downgradient from the northeastern portion of the former RFM Site and northwestern portion of the former AMSF Site unless natural attenuation processes acted to reduce the concentrations. Eramosa groundwater flow velocities and the presence of impacted groundwater for at least two decades suggest that TCA transport would be expected to have migrated much further than has been observed unless natural attenuation processes were acting to reduce TCA concentrations and retard TCA migration. As discussed in **Section 3.4.3**, these attenuation processes, including matrix diffusion, sorption, and/or abiotic and biotic degradation, can be expected to significantly reduce the rate of downgradient migration of the TCA concentrations and will at some point result in the stabilization and eventual contraction of the extent of TCA downgradient migration. Given the documented reduction of TCA concentrations downgradient from the northwest corner of the former AMSF Site, it is likely that stabilization has already taken place.

Recharge wells AMSF-RW-1, AMSF-RW-2, and ITT-W-1 are constructed as open bedrock wells connecting bedrock fractures from the Eramosa to the Deep Bedrock. Recharge well AMSF-RW-2 is located in the area of the highest groundwater TCA concentrations. TCA concentrations exceeding the Class GA Standard were detected in AMSF-RW-2 and ITT-W-1 vertical profiling samples within the Deep Bedrock; however, the highest TCA concentrations detected in RFM RI samples from ITT-W-1 vertical profiling were three orders of magnitude lower that the highest concentration in AMSF-RW-2. TCA and other VOCs have been documented at the bottom of recharge well AMSF-RW-2 and at similar Deep Bedrock depths in groundwater and bedrock matrix samples collected adjacent to the recharge well. The presence of TCA in AMSF-RW-2 and ITT-W-1 Deep Bedrock groundwater samples indicates that the recharge wells provide open vertical pathways for facilitated groundwater flow and COC transport to the Deep Bedrock.

TCA and its degradation products were detected in the upper Penfield groundwater samples during the RI High/Low Groundwater Events and 2013 PGWS (**Figure 3-4**). These COCs were detected in monitoring wells across the southern portion and in the northeastern portion of the former AMSF Site. TCA concentrations exceeded Class GA Standard in the northeastern portion of the former AMSF Site during the RFM RI sampling events. All sources contributing to TCA in upper Penfield at the former AMSF Site may not be known at this time because all portions of the former AMSF Site were not required to be investigated during the RFM RI.

During the RFM RI, the distribution of TCA concentrations in groundwater was generally consistent with distribution of TCA concentrations in the bedrock matrix. TCA was detected in groundwater samples from wells screening solution enlarged fractures in the Eramosa and upper Penfield, and TCA was detected in the bedrock matrix adjacent to these solution enlarged fractures. The highest bedrock groundwater concentrations and the area of high COC mass in the bedrock matrix are both located in the northwestern portion of the former AMSF Site.

The COC 1,4-dioxane was detected sporadically during the RI High/Low Groundwater Events. Concentrations ranged from not detected to 250 µg/l with the highest concentrations, by an order of magnitude, observed in Eramosa monitoring well AMSF-MW-9S, located along the western side of the former AMSF building. In addition, TCA concentrations in this monitoring well increased from 200 µg/l to 800 µg/l during the April-May 2010 and September 2010 Events. Similar sporadic detections of 1,4-dioxane were observed during the 2013 PGWS event. Samples collected during implementation of the AMSF RIR were analyzed for 1,4-dioxane by USEPA Method 8260 and subsequently rejected during the data validation process. As a result, all sources contributing to 1,4-dioxane in groundwater at the former AMSF Site may not be known at this time.

During the RFM RI, the highest concentrations of PCE and cis-1,2-DCE were documented in wells along the western and southern edges of the former AMSF building. The highest concentration of PCE observed to date was reported in the AMSF RIR in the eastern portion of the building at AMSF-MW-20 (700 µg/l), adjacent to the former degreaser. The highest concentration of cis-1,2-DCE observed to date was reported in the AMSF RIR at AMSF-MW-9S (83 µg/l), which is consistent with the previous highest concentration location. The distribution of PCE, and its degradation product cis-1,2-DCE, on the former AMSF Site do not appear to be related to sources associated with the former RFM Site.

Similar to TCA, 2013 PGWS and AMSF RIR data (Stantec 2015) indicates that PCE concentrations exceeding Class GA Standards are present within the footprint of the former AMSF building. These data identify PCE along the eastern side of the former AMSF building (AMSF-MW-20) at a higher concentration than locations to the west (upgradient or cross gradient) and interior to the building (AMSF-MW-23). All sources contributing to PCE in groundwater at the former AMSF Site may not be known at this time.

Detections of BTEX compounds in groundwater samples from the Eramosa, upper Penfield, and Deep Bedrock correlated with distribution of BTEX compounds in bedrock matrix samples. Concentrations of BTEX compounds in groundwater samples were generally not detected in April-May 2010 and September 2010 Events, with the exception of Deep Bedrock wells where concentrations exceeded Class GA Standards. These groundwater data are consistent with the distribution of BTEX compounds detected in the bedrock matrix sampling and consistent with the professional literature reports of petroleum occurring in the Deep Bedrock units.

3.4.5 Indoor Air/Sub-slab Vapor

As part of the RI, sub-slab and indoor air samples were collected at the former RFM Site. The soil vapor results indicated that concentrations of VOCs were present in the sub-slab vapor samples and indoor air samples. Based on review of the sample results, NYSDEC (Sowers 2004a) requested the completion of an interim remedial measure (IRM) in the building prior to any re-occupancy of the building (further discussed in **Section 3.5**). The former RFM building had remained vacant since 2003 until being demolished and removed in November/December 2015; therefore, no IRM has been completed.

Sub-slab and indoor air samples were also collected in the former AMSF building as part of the RI. The three highest sub-slab concentrations of TCA were detected within the former AMSF building in the southeast corner of the E-Z Movers tenant space (AMSF-05 at 55,000 micrograms per cubic meter [µg/m^3]), west central TCS Industries (TCS) tenant space (AMSF-16 at 34,000 µg/m^3) and the central portion of the building in the TCS tenant space (AMSF-19 at 13,000 µg/m^3). Adjacent sample results were generally an order of magnitude lower than these three highest results. The maximum concentration of DCA (6,100 µg/m^3), was detected in a sub-slab sample collected from within the former AMSF building in the southeast corner of the Bright Raven (BR) tenant space at sample location AMSF-22.

During the RI, the highest PCE sub-slab concentration was detected within the central portion of the former AMSF building at sample location AMSF-19 (1,400,000 µg/m^3) (RFM RIR Figure 5-10b) in the vicinity of the former degreaser location used by AMSF (RFM RIR Figure 2-1). Nearby PCE sample results in the former ASMF building are at least an order of magnitude lower.

As required by NYSDEC, sub-slab and indoor air sampling was conducted at the adjacent off-Site Cinemark and Batesville properties. Based upon the results of the sub-slab and indoor air sampling no further action was required by the NYSDEC or New York State Department of Health (NYSDOH) for either the Cinemark and Batesville properties.

3.5 INTERIM REMEDIAL MEASURES

3.5.1 Former RFM Property

1999 RFM Soil Remediation Area

In November 1999, approximately 968 tons of soil containing VOCs above the NYSDEC TAGM 4046 (NYSDEC, 1994) (which was replaced in 2010 by Cleanup Guidance CP-51) recommended SCOs were excavated down to bedrock from the northeastern area of the former RFM Site (RFM RIR Figure 2-1a). Prior to installation, a concrete gravity wall was installed along the northern side of the building to reinforce the building foundations. Soil excavation occurred adjacent to building foundation down to the top of bedrock, which was fractured resulting in large portions of bedrock ripped during excavation to allow for removal of as much soil as possible. TCA and 1,4-dioxane were detected beneath the slab but not excavated. None of the detections exceeded the criteria at that time.

The excavation was backfilled with suitable materials and the asphalt surface was replaced. The 1999 Soil Remediation is reported in the *Supplemental Subsurface Investigation, Risk Assessment, Natural Attenuation Evaluation and Soil Remediation* report (Golder 2000b).

Deed Restriction

Restrictions to the deed that relate to groundwater and soil are as follows:

- Groundwater: Prohibition of the use of the groundwater underlying the Property without treatment rendering it safe for drinking water or industrial purposes, as appropriate, unless the user first obtains permission to do so from the Relevant Agency.
- Soil: Prohibition of disturbing, excavating, relocating or removal of soils from the Property unless the person doing so determines that the soil can be lawfully disturbed, excavated, relocated or removed without posing a threat to the public health, safety or welfare, or the environment and the owner first obtains permission to do so from the Relevant Agency.

3.5.2 Former AMSF Property

UST Removals

Several IRMs were completed at the former AMSF property. Three USTs were removed from the former AMSF property in 1989. The tanks included one 10,000-gallon #2 fuel oil storage tank and two 285-gallon hazardous waste storage tanks (NYSDEC 2001). Leaks from one of the hazardous waste tanks (tank #2) were observed during removal (NYSDEC 2001). Subsequent to tank removal, approximately 14.8 tons of contaminated soils were removed from beneath tank #2, which functioned as secondary containment for spills that occurred in a waste storage/paint mixing room (NYSDEC 2001).

1994 Excavations

Shallow soils at four locations on the former AMSF property were excavated in May 1994. The four locations (SS-A, SS-B, SS-E, and SS-F) were identified as areas with elevated VOC and/or mercury concentrations (GeoServices 1994). An area of TCA impacted soil (1.3 mg/kg) was identified in the former AMSF parking lot west of the former AMSF building as location SS-B (NYSDEC 2001). AMSF removed approximately 5 cubic yards of soil from SS-B (NYSDEC 2001).

Interim Site Management Plan

An IRM Interim Site Management Plan (ISMP) was prepared in August 2011 by ITT and implemented at the former AMSF building (O'Brien & Gere, 2011b). Specifically, the IRM consists of annual vapor intrusion sampling and building inspection at the BR and E-Z Movers tenant spaces located in the northwest portion of the former AMSF building. Vapor intrusion sampling consists of sub-slab vapor from under the building's concrete slab (sub-slab) at 5 to 6 locations, from within the building (indoor air) co-located with sub-slab sample, and from outside and upwind of the building (ambient air). Vapor intrusion monitoring has been performed annually by ITT since the 2010-2011 Heating Season and reported in results letters to the property owner and Technical Memorandums to regulatory agencies. To date, results have not suggested that mitigation was necessary.

3.6. EXPOSURE PATHWAYS

A qualitative human health exposure assessment (QHHEA) (O'Brien & Gere 2014b) was completed to evaluate potential human exposure to Site-related COCs under current and reasonably anticipated future use scenarios. The QHHEA for off-Site former AMSF Site and Cinemark property was limited to data collected as part of this RI. At the time the QHHEA was completed, the former RFM Site was an unused, vacant property characterized by a preponderance of impermeable surfaces including asphalt parking lots and an unoccupied building that was formerly used for manufacturing of automotive components. The former RFM building was demolished and removed in November/December 2015 but the concrete slab remains in place with no current plans for removal. Human exposure under current land use conditions was considered minimal due largely to the high degree of impermeable surface at the Site and the former RFM building being unoccupied. Since demolition of the building and collection of additional soil data, an updated QHHEA was included in the RFM RIR Surface Soil Addendum (O'Brien & Gere 2016).

Based on the current former RFM Site zoning and a 2004 Declaration of Covenants and Restrictions (DCR) (Monroe 2004) that stipulates industrial land use, it was reasonable to anticipate the former RFM Site will continue to be used for industrial purposes. The most likely near future exposure scenario assumes that the slab of the former RFM building and the pavement will remain in place. The exposures evaluated for future receptors in the QHHEA were based on the hypothetical scenario assuming that the soils currently under the existing building slab and paved surfaces are exposed to characterize the potential exposure associated with soils that are currently under the existing building and paved areas.

The following bullets summarize the exposure pathways evaluated.

Groundwater:

- Direct exposure to groundwater is considered an incomplete exposure pathway in the RI Study Area.
- Vapors from the groundwater are addressed below.

Soil:

- Former RFM Site: Potential receptors and potentially complete exposure pathways under the hypothetical future scenario at the former RFM property include exposure to COCs in soil, where soil is impacted, through incidental ingestion, dermal contact, and inhalation of fugitive dust
- Former AMSF Site: Human exposure to Site-related COCs in former AMSF Site soils is negligible based upon the limited extent of soils characterized on the former AMSF Site during the RFM RI.
- Cinemark and Batesville properties: During the RI, soils at the Cinemark and Batesville properties were not characterized. As a result, the potential completeness of soil exposure pathways at the Cinemark and Batesville properties could not be evaluated.

Vapors:

- Former RFM Site: Potential receptors and potentially complete exposure pathways under the hypothetical future scenario at the former RFM Site include exposure to COCs via inhalation of groundwater-derived and/or soil-derived vapors in the interior space of the former RFM building. Industrial workers that are anticipated to work in a future on-Site building potentially exposed to COCs via inhalation of soil vapors in the interior space of the building is not considered a complete exposure pathway because anticipated institutional controls and the Site Management Plan would require measures to eliminate potential vapor intrusion at any future building constructed on the Site.
- Former AMSF Site: Commercial workers, industrial workers, and commercial business patrons represent viable receptor populations that could be potentially exposed to COCs via the vapor intrusion pathway at the

former AMSF Site. Former AMSF Site vapor intrusion data collected during the RI indicates that sub-slab vapors are not impacting indoor air quality at or above NYSDOH guideline levels. However, given that sub-slab TCA concentrations under the northwestern portion of the building exceed NYSDOH guidance criteria, vapor intrusion monitoring is presently conducted under the IRM ISMP (O'Brien & Gere, 2011b) at two tenant spaces in the former AMSF building.

- Cinemark and Batesville properties: Based on vapor intrusion sampling conducted at the Cinemark and Batesville properties, no complete vapor intrusion exposure pathways exist for the Cinemark or Batesville properties.

The potentially complete exposure pathways evaluated in the QHHEA were further evaluated for the former RFM Site in a quantitative human health risk assessment (HHRA) (O'Brien & Gere 2014b). The results of this quantitative HHRA support the following conclusions:

- No unacceptable non-carcinogenic hazards are posed to current/future receptors potentially exposed via ingestion, dermal contact, and ambient air inhalation to constituents of potential concern (COPCs) in soil at the former RFM Site.
- No unacceptable carcinogenic risks are posed to current/future receptors potentially exposed via ingestion, dermal contact, and ambient air inhalation to COPCs in soil at the former RFM Site.
- Concentrations of specific CVOCs in soil gas beneath the former RFM building are elevated to levels that warrant mitigation if any new building is constructed or that would need to be addressed during potential redevelopment.

Given the physical nature and use of the Site and off-Site properties, no complete ecological pathways were identified and therefore no ecological risk assessment has been completed for the RI Study Area.

Further details of the QHHEA are provided in Section 7.4 of the RFM RIR (O'Brien & Gere 2014b) and Section 4 of the RFM RIR Surface Soil Addendum (O'Brien & Gere 2016). Further details of the HHRA are provided in Section 7.6 and Appendix R of the RFM RIR (O'Brien & Gere 2014b).

3.7. UPDATED CONCEPTUAL SITE MODEL

The RFM RIR (O'Brien & Gere, 2014b) submitted to NYSDEC on October 21, 2014 presented a CSM developed for the RI Study Area based on data collected during and prior to the RI. Because of the on-going RI being conducted at the adjacent former AMSF Site (part of the RFM RI Study Area) under the Brownfields Cleanup Program (BCP), the RFM RIR indicated that the CSM for the RI Study Area may be updated in the FS, if warranted. In October 2014, MFP submitted an RIR for the adjacent former AMSF Site (AMSF RIR) (Stantec Consulting Services, Inc. [Stantec] 2014). Upon review of the October 2014 AMSF RIR, NYSDEC required additional RI work be conducted on the former AMSF Site. MFP submitted a revised AMSF RIR dated December 18, 2015 (Stantec 2015). The data collected during the AMSF RI did warrant an update to the RI Study Area CSM; however, because the AMSF RI was limited to the upper and lower Eramosa formation, the CSM is updated only for the upper and lower Eramosa formation. The CSM presented in the RFM RIR for those formations below the Eramosa remains the same and is not repeated here, except as related to recharge wells.

In June 2013, after submittal of an earlier version of the RFM RIR, O'Brien & Gere conducted groundwater monitoring over the RI Study Area. Results were reported in a *2013 Periodic Groundwater Sampling Report* of the former RFM Site dated August 12, 2014 (O'Brien & Gere 2014a) that was submitted to NYSDEC. Results from the groundwater sampling conducted in 2013 by O'Brien & Gere are also incorporated into the updated CSM.

Subsequent to submittal of the final version of the RFM RIR (dated October 20, 2014), two addenda to the RFM RIR were submitted to NYSDEC; the *Remedial Investigation Report Soil Addendum* on November 21, 2014 (O'Brien & Gere 2014c) and the *Remedial Investigation Report Surface Soil Addendum* on March 31, 2016 (O'Brien & Gere 2016). The RFM RIR Soil Addendum provided an expanded presentation of soil sampling results obtained from the former RFM Site, and particularly to soil conditions that existed prior to a 1999 excavation that took place immediately north of the former RFM building. Soil sampling results presented in the

RFM RIR did not include those data obtained from the soil sampling that took place within the boundaries of the 1999 RFM Soil Remediation Area prior to excavation. A major focus of the RFM RIR Soil Addendum was on the northern portion of the former RFM building and property because of its proximity to the significant groundwater impacts in and around the northeast portion for the former RFM Site and the northwest portion of the former AMSF Site and proximate to recharge well AMSF-RW-2 located on the former AMSF Site. Soil sampling results obtained from soils that were subsequently removed during the 1999 excavation on the former RFM Site provide an important component to the CSM, enabling a more detailed interpretation for the potential of these soils to serve as source material for impacts to shallow bedrock groundwater. Analyses, interpretations and conclusions drawn and presented subsequently in this CSM regarding soil sampling results from the 1999 RFM Soil Remediation Area indicate that these soils were not a source of groundwater impacts found in the northwest corner of the former ASMF Site in and around recharge well AMSF-RW-2. Discussions from the RFM RIR Soil Addendum are incorporated into this updated CSM.

The RFM RIR Surface Soil Addendum provided a presentation of surface soil sampling results obtained from the former RFM Site at the request of NYSDEC. Surface soil samples were collected from disturbed areas in the southern portion of the Site where activities were completed for utility disconnection during demolition of the former RFM building. Discussions from the *RFM RIR Surface Soil Addendum* are incorporated into this updated CSM.

This updated CSM is intended to be a high level presentation and will summarize key elements presented in the RFM RIR, as well as the above referenced reports.

3.7.1 Geology

Geology at the former RFM and former ASMF Sites consists of a surficial layer of generally low permeability, minimally and intermittently saturated, overburden soils comprised of fill and glaciolacustrine deposits (ranging from 4 ft to 20 ft thick) underlain by carbonate bedrock. The glaciolacustrine deposits are composed of silt and clay and well graded sand and gravel.

The occurrence of higher permeability layers of sands than the fine grained silts and clays in the overburden soils is variable at the former RFM and former AMSF Sites. Under the northern portion of the former RFM building, soil borings reported in the RFM RIR generally consisted of sands in the overburden in a layer above the bedrock with thicknesses varying from approximately 2 ft to 7 ft, overlain by low permeability clays and silts and clays. Under the southeastern portion of the former RFM building, the occurrence of sand overlying the top of bedrock is generally more variable with thicknesses typically less than 2 ft. Under the southwestern portion of the former RFM building sands are more variable and either absent or to a maximum of 2.5 ft thick. In the vicinity of the 1999 RFM Soil Remediation Area prior to excavation, as well as outside of the 1999 RFM Soil Remediation Area of the building on the northern portion of the former RFM Site, typically there are no sands present in the overburden soils, with few exceptions on the northwestern portion of the property outside of the former RFM building.

In the open area outside and between the former RFM building and former AMSF building, the occurrence of sand overlying the top of bedrock is present in nearly all soil borings with thickness varying from 3 to 7 ft thick, with the exception of a single boring, OBG-SB-31, that only had a 0.5 ft thick sand layer above the top of bedrock.

The occurrence of sand layers on the remainder of the former AMSF Site and under the former AMSF building is variable. Along the former drainage swale extending from SW-TB-1, SW-TB-2, AMSF-MW-23 and SW-TB-3 located inside of the former AMSF building and SW-TB-4 located outside of the former AMSF building, there is a sand layer above the top of bedrock varying in thickness from approximately 1.4 ft to 10.6 ft thick. Additionally along the former drainage swale under the former AMSF building there occur layers of interbedded sand or sand and gravel layers as well as immediately under the concrete pad. In the area of the former degreaser at the former AMSF Site, there are interbedded layers of sand and silt layers on the top of bedrock. However, the sand layers are variable in occurrence reflective of heterogeneous and anisotropic overburden conditions. Under the northwest portion of the former AMSF building, soil borings advanced as part of AMSF RI appear to be limited to AMSF-MW-32. At this location there is a 4.7 ft thick sand layer above the top of bedrock, as well as a thin interbedded sand layer from 1.1 ft bgs to 1.5 ft bgs. In the northeast portion of the former AMSF building, overburden soils are characterized in soil borings SEW-TB-1 and AMSF-MW-21 with a higher permeability sand layer located from approximately 1.0 ft bgs to 3.0 ft bgs and a deeper sand layer on top of bedrock varying in thickness from 0.5 ft to approximately 3.0 ft. In the southwest corner of the former AMSF building overburden soils generally have sand layers overlying the top of bedrock varying in thickness from 0.3 ft to 3.8 ft thick. The exception to this was the soil boring AMSF-MW-26 in which no sand layer was present.

The overburden overlies a weathered bedrock surface that slopes from the east (former AMSF Site) gently downward to the west (former RFM Site). The uppermost bedrock unit is the Eramosa Dolomite, which extends from the soil/bedrock interface to a depth of approximately 55 to 65 ft bgs (approximately 510 ft amsl). The top of bedrock surface is an irregular surface due to the differential erosion and weathering of a dolomite with varying rock hardness (**Figure 3-5**). Much of the Eramosa Dolomite is characterized as highly fractured with hydraulic conductivities generally > 10^{-3} to > 10^{-1} cm/sec range. Many of the fractures in the Eramosa show evidence of solution enlargement which has increased the fracture aperture and hydraulic conductivity. The fracture density and hydraulic conductivity in the Eramosa Dolomite appear to generally decrease with depth such that the Eramosa is less fractured and has a lower hydraulic conductivity near the base than in the upper portions. Within the Eramosa Dolomite, individual fractures or groups of fractures were often separated by sections of competent unfractured rock (RFM RIR Figure 4-2). Prominent fracture apertures were estimated from the borehole geophysical acoustic televiewer logs. A prominent solution enlarged bedding fracture in the upper Eramosa fracture zone was consistently observed between 548 and 543 ft amsl (approximately 12 to 31 ft bgs) (RFM RIR Figures 3-5b-e and RFM RIR Appendix F). Fracture apertures for this solution enlarged fracture ranged from 1.6 to 4.4 inches. The Penfield Formation underlies the Eramosa Dolomite, extends to a depth of approximately 100 to 110 ft bgs (approximately 465 to 455 ft amsl), and is less fractured with lower hydraulic conductivity (10^{-2} to the 10^{-6} cm/sec range) than the Eramosa. The Decew Dolomite underlies the Penfield Formation, extends to a depth of approximately 120 ft bgs (approximately 445 ft amsl), and is significantly less fractured with much lower hydraulic conductivity (10^{-4} to the 10^{-8} cm/sec range). The Rochester Shale underlies the Decew Dolomite and extends to depths greater than 159 ft bgs (404 ft amsl), which is the maximum depth at which borings were completed during ITT's RI. Fracture density in the Rochester Shale formation is low and the formation has pockets of natural gas and naturally occurring petroleum hydrocarbons.

3.7.2 Hydrogeology

Groundwater generally is first encountered in the shallow bedrock, the Eramosa Dolomite. Groundwater flow predominantly occurs in the secondary porosity of the bedrock, such as solution enlarged bedding plane fractures. Solution enlarged bedding plane fractures were observed in bedrock cores and borehole acoustic televiewer logs at similar elevations within the bedrock across the former RFM and former AMSF Sites. Solution enlarged fractures are more common in the Eramosa Dolomite than the Penfield and Decew formations and therefore the Eramosa Dolomite is a preferential zone for groundwater flow in the bedrock. Of the bedrock units, the Eramosa Dolomite is the most fractured and has the highest hydraulic conductivity and it is expected that the groundwater flow in the bedrock predominantly occurs in the Eramosa Dolomite. During periods of non-recharge, bedrock groundwater flow is generally to the north/northeast at a hydraulic gradient ranging from 0.0004 to 0.0061 ft/ft. Groundwater flow rates in the fractures are generally estimated to range between >1 and >390 ft/day. Hydraulic conductivity data and hydraulic responses to groundwater recharge (discussed in subsequent sections below) suggest that the bedding plane fractures allow rapid horizontal and non-uniform radial flow in the Eramosa during recharge events.

Open bedrock recharge wells on the former RFM Site and at the adjacent former AMSF Site are used for storm water runoff management. Storm water runoff from roof and surface drains is directed to these recharge wells where the storm runoff recharges the bedrock groundwater. There is a single recharge well on the southwest portion of the former RFM Site that receives runoff from a portion of the roof of the former RFM building. There are five recharge wells on the former AMSF Site, which receive storm water from both roof top drains and parking lot runoff. Recharge well AMSF RW-2 is an approximately 149 ft deep open borehole recharge well located in the northwestern portion of the former AMSF Site between the former RFM Site and the former AMSF building proximate to the highest concentrations of TCA detected in groundwater. During precipitation runoff events, large volumes (tens to hundreds of thousands of gallons) of runoff water can be rapidly introduced into the bedrock through these recharge wells. The highly fractured and permeable Eramosa Dolomite allows the bedrock to readily accept runoff in these recharge wells This rapid infiltration of water into the bedrock provides an episodic pressure gradient to push groundwater radially away from the recharge wells, particularly in the Eramosa. The occurrence of solution enlarged fractures, the relatively high estimated hydraulic conductivity, similar groundwater elevation trends, the responses to recharge events, and similar groundwater geochemistry suggest that the upper and lower Eramosa are hydrogeologically similar and can be considered as one hydrogeologic unit. During groundwater recharge events, the hydraulic gradient increases around the recharge wells resulting in non-uniform radial groundwater flow that affects groundwater elevations and chemistry across portions of the RI Study Area in a transient manner. The functioning of the recharge wells in general, and of recharge well AMSF-RW-2 specifically, and the influence of recharge well AMSF-RW-2 on the hydrogeology and the nature and extent of horizontal distributions of CVOCs in the Eramosa formation have been presented in the ITT RIR in great detail. Surface runoff discharging to the recharge wells results in near instantaneous groundwater recharge. Data presented in the RMF RIR also documented how the runoff events change groundwater flow directions and rates. As discussed in later sections of this FS document, precipitation runoff entering recharge well AMSF-RW-2 pushes the high CVOC concentrations present in groundwater (during non-recharge periods) in and around the recharge well away from the recharge well onto the former RFM Site, onto the Cinemark property and onto other areas of the former AMSF Site. During non-recharge periods, groundwater elevations observed in the recharge wells may be lower than surrounding upper Eramosa groundwater elevations. Vertical hydraulic gradients between the upper and lower Eramosa, upper Penfield and Deep Bedrock are consistently downward, ranging from 0.008 to 0.163 ft/ft. As a result, during non-recharge events, groundwater could potentially flow from the upper Eramosa toward the recharge wells and subsequently to the lower Eramosa, upper Penfield, and Deep Bedrock via the recharge wells.

3.7.3 Nature and Extent of COCs

Soil

With a few isolated exceptions, concentrations of organic compounds in soils at the former RFM and former AMSF Sites were generally within regulatory criteria applicable to the current and anticipated future use of the properties.

As described in **Section 3.4.2** above and in Section 5.1.4 of the RFM RIR, to define the limits of the excavation immediately north of the former RFM building, soil samples were analyzed prior to conducting the 1999 excavation in which 968 tons of soil were excavated. Based on definitions of screening, definitive and research data established in the RFM RIR, the RFM RIR Soil Addendum documented that the VOC measurements of chlorinated and non-chlorinated compounds in soils are considered to be definitive data, even though VOC analyses reported by H2M (1993), Golder (2000a and Golder 2000b) and NYSDEC (2001) did not undergo data validation analysis. Based on the definitive analytical results, the distribution of TCA concentrations in overburden soil at greater than 10 mg/kg (based on RFM RIR Soil Addendum Figure 3-1a, Figure 3-1b and Figure 3-1c provided in **Appendix A**) indicates limited and sporadic areal distributions in the 1999 excavation area on the former RFM Site. The highest concentration of TCA measured in any soil sample collected from the former RFM Site was reported at 570 E mg/kg from BH-99-19 (6 to 8 ft bgs depth interval) sampled prior to and located within the footprint of the 1999 excavation. This value is more than a factor of 17 times lower than the USPEA (1994) guidance value of 10,000 mg/kg for the potential presence of DNAPL in soils. This soil sample with the highest TCA reported concentration in overburden soils at the former RFM Site is surrounded above and adjacent to other sample locations with lower or non-detected TCA concentrations in overburden soils at the sampled depth intervals, indicating a localized and isolated impact. Soil samples collected from the 1999 excavation area and also from under the former RFM building were screened for NAPLs using an in-field ultraviolet (UV) fluorescence method recommended by USEPA (1994). The results for NAPL screening were negative. Results of the analysis of TCA in overburden soils at the former RFM Site in and around the former excavation area, prior to excavation, indicate that no continuous distribution of TCA concentrations indicative of NAPL level concentrations existed in the overburden soil. Similarly, no continuous distribution of TCA concentrations indicative of NAPL level concentrations existed in the overburden soil in the former RFM excavation area away from the location with the highest concentration of TCA (BH-99-19) in any direction, and particularly in an easterly direction towards the former AMSF Site and, more specifically, towards the TCA groundwater impacts located at AMSF-MW-7 and AMSF-RW-2.

Following the 1999 soil excavation, none of the RI or pre-RI soil sample concentrations from any location on the former RFM Site exceeded the Commercial Use SCOs for TCA. There is only one exceedance of the Protection of Groundwater SCO for TCA in any soil sample collected from outside of the former RFM building (SB-10 [2 to 3 ft bgs] at 1.000 mg/kg) and was located on the northern property boundary. SB-10 was sampled on 08/31/2004. There are only two exceedances of the Protection of Groundwater SCO for TCA (0.680 mg/kg) in soil samples collected from under the building concrete slab floor and these samples were from AOC-2 with results of BH-99-44 (8 to 10 ft bgs) at 0.920 mg/kg and OBG-SB-13 (9.5 to 10.5 ft bgs) at 0.710 mg/kg. BH-99-44 and OBG-SB-13 were sampled on 10/01/1999 and 08/31/2004, respectively.

It was established in the RFM RIR Soil Addendum that the only definitive soil 1,4-dioxane data are those analyzed by USEPA Method 8270. These definitive data include 1,4-dioxane results reported by NYSDEC (2001) and O'Brien & Gere (2014b). Prior 1,4-dioxane analyses performed by H2M (1993) and Golder (2000a and 2000b) are considered screening data. Discussion of 1,4-dioxane analysis of soils at the former RFM Site used in this CSM will focus on the use of the definitive data only. As a result of the above analysis conducted in the RFM RIR Soil Addendum, Figure 5-1C of the RFM RIR was corrected to include only definitive 1,4-dioxane and TCA soil results and is shown in Figure 3-2 of the RIR Soil Addendum (**Appendix A**). Using the definitive 1,4-dioxane soil data, there were four exceedances of the Protection of Groundwater SCO for 1,4-dioxane (0.100 mg/kg) in the following four samples; OBG-SB-8 (7 to 9 ft bgs) at 0.110 J mg/kg, OBG-SB-18 (6 to 7 ft bgs) at 0.690 mg/kg, OBG-SB-20 (2 to 4 ft bgs) at 0.170 J mg/kg and 0.930J mg/kg (duplicate), OBG-SB-20 (6 to 7 ft bgs) at 0.600 mg/kg. These exceedances were AOC-3 (OCBG-SB-20), AOC-5 (OBG-SB-8) and AOC-6 (OBG-SB-18). OBG-SB-8 was sampled on 8/31/-2004 and OBG-SB-18 and OBG-SB-20 were sampled on 9/01/2004.

As presented in the *RFM RIR Surface Soil Addendum*, VOCs, inorganics and pesticides were detected in surface soils but did not exceed Commercial SCOs or Protection of Groundwater SCOs. No PCBs were detected in surface soils. PAHs were detected above Commercial SCOs and Protection of Groundwater SCOs in two samples (SS-3, SS-4) collected from the parking lot and one sample (SS-8) along the parking lot pavement edge. Two of the surface soil samples (SS-3, SS-4) exceeding SCOs were collected from areas disturbed during disconnection and sealing of the drain lines leading to recharge well ITT-W-1 on the former RFM Site during building demolition and soil sample records indicated the presence of asphalt fragments in the samples. Additionally, the one sample (SS-8) exceeding SCOs along the pavement edge was located where snow removal activities commonly deposited snow and pieces of asphalt. Elevated PAHs at these locations would be expected, and likely represent asphalt rather than soil conditions.

Bedrock Matrix

The transport and fate of dissolved COCs in fractured sedimentary bedrock is affected by the bedrock matrix because the total primary porosity of the bedrock matrix is typically significantly higher than the typical total secondary porosity of the fractures. The RI Study Area average matrix (primary) porosity for bedrock is 0.06 with a range from 0.01 to 0.17. This bedrock matrix porosity can store significantly more COC mass than is present in the bedrock fractures and consequently affects the transport and fate of dissolved COCs in a sedimentary bedrock aquifer.

Significant advances have been made in the past 35 years to understand the nature of matrix diffusion in geologic media. Bedrock core sampling in the RI Study Area was conducted by a research team headed by Dr. Beth Parker of the University of Guelph, formerly of the University of Waterloo, and supported by Stone Environmental, Inc. to characterize the COC mass diffused into the bedrock matrix. The results from the RI matrix sampling were used to evaluate the vertical and horizontal extent of COCs in the bedrock and to provide a better understanding of the distribution of the CVOC mass between groundwater in fractures and dissolved/sorbed CVOC mass in the bedrock matrix. Specifically, the bedrock matrix CVOC data were used in the RFM RIR, in conjunction with other physical, geophysical, and analytical (screening and definitive) data, to evaluate the nature, extent, fate and transport of CVOCs in the various geologic units present across the RI Study Area. The rock core concentration profiles were used in the RFM RIR to help spatially identify the solution enlarged fractures, in which active COC transport occurs in the bedrock units. During the RI, the CVOC analyses of bedrock core samples were used to confirm the mechanism of matrix diffusion. The physical and chemical processes associated with bedrock matrix diffusion control and retard groundwater COC migration. In the absence of bedrock matrix diffusion processes, COCs would be expected to migrate further downgradient through hydraulically conductive solution enlarged fractures. The high density of vertically distributed rock core CVOC data over the entire length of continuously cored boreholes, in conjunction with other physical, geophysical, and analytical (screening and definitive) data, were used to make assessments in the RFM RIR regarding horizontal and vertical transport of COCs in the bedrock system.

Rock core samples were also used to provide a time integrated measurement of the spatial position of CVOCs in the fractured bedrock. Diffusion into the bedrock matrix is a very slow process that can take decades to reach or approach stabilized conditions. Because of this, the effects of variations of bedrock groundwater CVOC concentrations over time are integrated into bedrock matrix concentrations providing the most accurate assessment of historical groundwater impacts in a fractured sedimentary rock system. This is particularly true in the RI Study Area because of the presence of recharge wells that rapidly transmit tens to hundreds of thousands of gallons of water from precipitation events into the bedrock system, and that have been shown to affect groundwater CVOC concentrations measured in monitoring wells. Bedrock matrix concentrations of TCA, DCA, PCE, and TCE were most frequently detected in the Eramosa and upper Penfield formations in the vicinity of recharge well AMSF-RW-2 and proximate to ITT-IBW-20 and MW-AMSF-17MP. This area, the northwestern portion of the former AMSF Site and the northeastern portion of the former RFM Site, is the area of the highest bedrock matrix concentrations. Because rock core samples provide a time integrated measurement of the spatial position of CVOCs in the fractured bedrock, and because the highest historic and current groundwater concentrations are in the northeast corner of the former RFM Site and the northwest corner of the former AMSF site, the analysis of the bedrock matrix is key in providing insight into sources of CVOCs to the groundwater.

Recharge well AMSF-RW-2 on the former AMSF Site is an open bedrock well that provides a vertical pathway between each of the prominent horizontal fractures in the Eramosa and upper Penfield. In the vicinity of recharge well AMSF-RW-2 bedrock matrix sampling documented that concentrations of TCA, DCA, PCE, and TCE were most frequently detected in the Eramosa Dolomite. Most of these constituents were detected in samples collected adjacent to or near prominent solution enlarged fractures. Isolated detections of TCA and PCE were also documented in the upper Penfield Formation near a solution enlarged fracture. In sections of bedrock between solution enlarged fractures, TCA, DCA, PCE, and TCE were generally not detected, indicating predominant COC transport took place in the horizontally oriented solution enlarged bedrock fractures in the Eramosa formation.

The horizontal distribution of TCA, DCA, PCE, and TCE differed in the Eramosa and upper Penfield. At the one location downgradient of recharge well AMSF-RW-2, ITT-MPBW-22 (located on the Cinemark property and approximately 220 ft from AMSF-RW-2), TCA, DCA, PCE, and TCE bedrock matrix concentrations were only detected in the lower Eramosa associated with one prominent fracture. TCA, DCA, PCE, and TCE concentrations were not detected in the upper Eramosa and upper Penfield bedrock matrix at this downgradient location from recharge well AMSF-RW-2. Concentrations of TCA were detected in Eramosa matrix samples upgradient of recharge well AMSF-RW-2, to the southwest (ITT-MPBW-21 located adjacent to deep recharge well ITT-W-1 and approximately 470 ft from AMSF-RW-2), but not to the southeast (AMSF-MW-19MP located approximately 570 ft from AMSF-RW-2). PCE was sporadically detected in the Eramosa bedrock matrix upgradient and southwest of recharge well AMSF-RW-2 (ITT-MPBW-21), while PCE, TCE, and cis-1,2-DCE were detected in the Eramosa bedrock matrix upgradient and southeast of recharge well AMSF-RW-2 to the south of the former AMSF building (AMSF-MW- 19MP).

BTEX constituents were highest and most frequently detected in bedrock matrix samples below an elevation of 495 ft amsl (approximately 65 to 79 ft bgs). These data, in conjunction with the occurrence of natural gas, support the hypothesis that naturally occurring petroleum-related compounds occur in these deeper bedrock strata.

Analyses were conducted on the TCA bedrock matrix concentrations from AMSF-MW-17MP and ITT-IBW-20 and are presented in **Table 3-1 and Table 3-2**, respectively. Data used to generate these tables are presented in the RFM RIR Appendix E. Data analyses presented in **Table 3-1 and Table 3-2** include depth discrete TCA bedrock matrix concentrations, a calculation of average TCA concentrations in adjacent bedrock matrix samples used to estimate a measure of TCA mass in the bedrock cores, and calculations of the mean, median and geometric mean of the TCA bedrock matrix concentrations in each of the two bedrock cores.

In the 13.5 ft bgs (551.6 ft amsl) to 24.7 ft bgs (540.4 ft amsl) depth interval, the highest TCA bedrock matrix concentrations were reported in the Upper Eramosa formation. The mean, median and geometric mean TCA bedrock matrix concentrations were significantly greater in bedrock matrix located on the former AMSF Site in AMSF-MW-17MP than on the former RFM Site in ITT-IBW-20 (**Table 3-1 and Table 3-2**). Additionally, the total areas under the TCA bedrock matrix concentration versus depth curves were greater in AMSF-MW-17MP (11.8 ft bgs to 25 ft bgs) than in ITT-IBW-20 (13. 5 ft bgs to 24.7 ft bgs). It is evident that the area under the curve TCA bedrock matrix concentration versus depth is 1.5 times greater at AMSF-MW-17MP than at ITT-IBW-20, indicating a significantly greater TCA mass in the bedrock at the AMSF-MW-17MP location on the former AMSF Site. This is indicative that the source of the TCA present in the bedrock matrix in and around the northwest corner of the former AMSF Site and the northeast corner of the former RFM Site originated from the former AMSF Site.

To provide information regarding vertical or lateral sources of CVOCs in the bedrock matrix in and around AMSF-RW-2, comparisons were made between the depth discrete TCA bedrock matrix concentrations and the acoustic televiewer log from AMSF-MW-17MP (**Figure 3-6**). An acoustic televiewer log was not collected from ITT-IBW-20 consistent with the RFM RI Work Plan (O'Brien & Gere 2004). AMSF-MW-17MP is located approximately 27 ft in a northwesterly direction from AMSF-RW-2. For reference ITT-IBW-20 is located approximately 100 ft in a west-southwesterly direction from AMSF-RW-2. It can be seen from examination of **Figure 3-6 and Table 3-1 and Table 3-2** that the elevations of the two highest TCA bedrock matrix concentrations in AMSF-MW-17MP are at 545.2 ft amsl and 543.1 ft amsl. The single highest TCA bedrock matrix concentration reported in ITT-IBW-20 was located at 543.5 ft amsl.

Examination of the acoustic televiewer logs in Appendix F of the RFM RIR clearly indicates the existence of larger and more transmissive fractures at depths shallower than the zone of the highest TCA bedrock matrix concentrations reported in both ITT-IBW-20 and AMSF-MW-17MP. For example, there are 1.65 inch and 3.31 inch fracture apertures at approximately 552.4 ft amsl and 551.3 ft amsl in AMSF-MW-17MP. However, the TCA bedrock matrix concentrations adjacent to these shallower more transmissive fractures were reported to be very low in ITT-IBW-20. In AMSF-MW-17MP TCA bedrock matrix concentrations adjacent to these transmissive fractures were higher, particularly at the 551.7 ft amsl depth with a bedrock matrix concentration at 1.0119 µg/g. Additionally, another large fracture at approximately 547.7 ft amsl (2.52 inch) was recorded in AMSF-MW-17MP and the TCA bedrock matrix concentrations in the adjacent bedrock matrix from AMSF-MW-17MP was 0.5030 µg/g, while the TCA bedrock matrix concentration in ITT-IBW-20 was reported at 1.9892 µg/g. This type of distribution of TCA bedrock matrix concentrations, with the highest bedrock matrix concentrations being deeper than the in the shallow bedrock matrix, points to lateral migration from a source of TCA in the bedrock. If a shallow source of TCA was from the overburden, then it would be expected that the shallower more transmissive fractures would be preferred flow fractures for either NAPLs or TCA in groundwater and the result would be that the highest TCA bedrock matrix concentrations would be in the bedrock matrix adjacent to the overburden and the shallower fractures. This is clearly not the case with respect to the distribution of TCA in the bedrock matrix at both ITT-IBW-20 and AMSF-MW-17MP. Depths to bedrock surface at ITT-IBW-20 and AMSF-MW-17MP were reported in boring logs (O'Brien and Gere, 2014b) at 10.5 ft bgs (554.6 ft amsl) and 8.0 ft bgs (555.4 ft amsl), respectively. Clearly, there is a zone of much lower TCA bedrock matrix concentrations between the top of bedrock at both ITT-IBW-20 (~11 ft) and AMSF-MW-17MP (~10 ft) and the depths at which the highest TCA bedrock matrix concentrations were reported with much lower TCA bedrock matrix concentrations. These data clearly do not indicate an overburden source of TCA in the soil in the areas of these borings on either the former RFM Site or the former AMSF Site.

These TCA bedrock matrix data are consistent with the TCA soil concentrations measured in the 1999 excavation area prior to soil removal. Prior to the 1999 excavation on the former RFM property there was only one sample in the dense array of soil borings that was observed with a TCA concentration greater than the NY CP-51 Commercial Use SCO of 500 mg/kg (BH-99-19 [6 to 8 ft bgs] at 570E mg/kg). The TCA bedrock matrix data from ITT-IBW-20 from under the 1999 excavation area clearly show a lateral source of TCA in the groundwater approximately 10 vertical ft into the fractured bedrock, with the shallow bedrock matrix with either non-detected or with much lower TCA concentrations. Similarly, the overburden soil data do not indicate a TCA source sufficient to cause the high TCA groundwater and bedrock matrix concentrations observed on either the former RFM Site or the former AMSF Site.

To further investigate possible sources of the high TCA groundwater and bedrock matrix concentrations observed on the former RFM Site and the former AMSF Site a comparison of the TCA bedrock matrix data from AMSF-MW-17MP was made with the construction detail of the recharge well AMSF-RW-2 (from GeoServices (1994) Figure 8) and presented in **Figure 3-6c**. It is clear that the depth of the bottom of the casing of AMSF-RW-2 directly corresponds to the depths of the highest TCA bedrock matrix concentrations detected in AMSF-17MP. Based on low Oxidation Reduction Potential (ORP) values recorded during groundwater sampling in the Eramosa formation, it is likely that CVOCs with mixtures of oil and grease (from degreasing operations) or non-chlorinated VOCs were released into the bedrock. The RFM RIR and the RFM RIR Soil Addendum detailed the very low ORP values reported for groundwater. These very low ORP values cannot be caused by the aerobic biological degradation of CVOCs present in the bedrock and groundwater system, because of the lack of aerobic respiration pathways for these compounds. Therefore, it is likely that the aerobic biological degradation of the oils and grease associated with spent CVOCs resulted in the deoxygenation of the Upper Eramosa in and around the northwest corner of the former AMSF Site and the northeast corner of the former RFM Site. The presence of low ORP values in and around recharge well AMSF-RW-2 further supports this area as a source of the high concentrations of CVOCs in the groundwater and in the bedrock matrix on the former AMSF and RFM Sites. As a result, operations at the former AMSF facility, waste VOC solvents with mixtures of oil and grease (from degreasing operations) likely contained both LNAPL as well as DNAPL CVOCs. It is likely that once present in recharge well AMSF-RW-2, the NAPL mixtures would migrate horizontally in the very conductive fractures located in the Upper Eramosa formation.

The fact that the corresponding depths at which the highest concentrations of TCA in the bedrock matrix occur with the same depth of the bottom of the casing in recharge well AMSF-RW-2 clearly indicates that AMSF-RW-2 was a source for the high concentrations of TCA observed in the groundwater on the former AMSF Site, as well as the former RFM Site. Higher ORP values in Eramosa groundwater were reported in the RIR Soil Addendum and in the RFM RIR in areas beyond the impacts of AMSF-RW-2. As discussed below, there are data which suggest other sources of TCA on the former AMSF property.

Groundwater

The nature and extent of CVOC, VOC, and 1,4-dioxane groundwater impacts were characterized with a variety of methods as presented in the RFM RIR. Across the RI Study Area, the primary method used to determine the spatial extent of groundwater COC impacts was the placement of groundwater monitoring wells in various bedrock strata (RFM RIR Table 3-8). The existing groundwater monitoring well network sampled during the RFM RI includes wells within the overburden, the Eramosa Dolomite, the Penfield Formation and the Decew Dolomite. Typically, these groundwater monitoring wells were screened or open over 5- to 15-ft depth intervals. Groundwater monitoring wells provide samples representing a mixture of groundwater contributed by the hydraulically transmissive fractures intersected by a particular well. Subsequent to the completion of the RFM RI, O'Brien and Gere conducted a round of groundwater sampling in the RI Study Area in 2013 (O'Brien and Gere 2014a). Also subsequent to the submittal of the RFM RIR, Stantec, on behalf of MFP, submitted a revised RIR on the adjacent former AMSF Site (AMSF RIR) under the BCP to NYSDEC in December 2015. In the revised AMSF RIR, Stantec reported the installation of 15 Upper Eramosa groundwater monitoring wells that were sampled from one to five times each in either June 2013, September 2013, May 2014, June 2015, and/or August 2015.

The nature and extent of CVOCs in groundwater on the former RFM Site and the former AMSF Site are already presented in detail in the RFM RIR which should be referenced for this information and will only be summarized in this FS. Similarly, the CSM presented for groundwater in the RFM RIR still applies to both the former RFM Site and the former AMSF Site with some modifications based on the 2013 periodic groundwater monitoring event (O'Brien and Gere 2014a) and the AMSF RIR (Stantec 2015).

TCA and other VOCs were detected in the bedrock groundwater in the RI Study Area. TCA is the predominant VOC and as such its distribution in groundwater is generally representative of VOC distributions, with the exception of BTEX concentration detections and PCE concentrations on the former ASMF Site (Stantec 2015). The concentrations of TCA in the RI Study Area bedrock groundwater are highest on the former AMSF Site and in the northeast portion of the former RFM Site (RFM RIR Figure 5-5a), with the highest TCA concentrations in groundwater occurring in the northwestern portion of the former AMSF Site. From the northwestern portion of the former AMSF Site, TCA groundwater concentrations decline rapidly downgradient to the north and east. Concentrations decline by orders of magnitude within a distance of 500 ft indicating that natural attenuation processes are limiting the migration of the VOCs, particularly in the conductive primary fractures of the Eramosa Dolomite. These attenuation processes have also limited the extent of downgradient TCA migration in the bedrock groundwater.

The bedrock matrix COC concentrations, and this rapid downgradient decline in groundwater concentrations, indicate that attenuation processes, such as bedrock matrix diffusion, sorption and/or abiotic and biotic degradation processes, have strongly limited the migration and downgradient extent of TCA and associated CVOCs in the bedrock groundwater. During RI sampling events, the distributions of DCA, TCE, and 1,1-DCE in Eramosa groundwater were similar to the distribution of TCA. As discussed in **Section 3.4.3**, these attenuation processes, including matrix diffusion, sorption, and/or abiotic and biotic degradation, can be expected to significantly reduce the rate of downgradient migration to the Cinemark property of the TCA concentrations and will at some point result in the stabilization and contraction of the extent of TCA downgradient migration. Given the documented reduction of TCA concentrations downgradient from the northwest corner of the former AMSF Site, it is likely that stabilization has already taken place.

The distribution of COCs in groundwater is generally consistent with distribution of bedrock matrix COC concentrations, which demonstrates how integral matrix diffusion processes are to the distribution and migration of COCs in bedrock groundwater. The area of highest TCA mass in the bedrock matrix and the highest groundwater concentrations are co-located with solution enlarged fractures in the Eramosa Dolomite in the northwestern portion of the former AMSF Site and the northeastern portion of the Former RFM Site. The depth intervals of the detected TCA bedrock matrix concentrations in Upper Eramosa borings ITT-IBW-20 and AMSF-MW-17MP vary from approximately 540 ft amsl to 550 ft amsl with the highest concentrations generally occurring from about 542 ft amsl to 547 ft amsl. Most Upper Eramosa groundwater monitoring well screens located in the northwest corner of the former AMSF Site and in the northeast corner of the former RFM Site intercept the bedrock rock depth intervals with the highest bedrock matrix concentrations.

Bedrock Matrix Equivalent Porewater

In addition to the installation of groundwater monitoring wells for characterization of CVOC in groundwater, equivalent porewater concentrations of key COCs within the very low hydraulic conductivity bedrock matrix were calculated using bedrock matrix COC concentrations and measured physical parameters obtained from bedrock core samples as described in RFM RIR Section 5.2.1. These data provide the greatest density of depth discrete COC concentrations measured within the RI Study Area and help to characterize the nature, extent, and transport of COCs in the fractured bedrock system within the RI Study Area. Bedrock matrix equivalent porewater concentrations were also used with groundwater samples collected by other definitive and screening methods at similar elevations from nearby monitoring wells, as discussed below.

The bedrock fractures, especially the solution enlarged fractures, provide the primary pathways for groundwater flow in the bedrock. RI monitoring wells screen key permeable fractures in the bedrock strata. Groundwater impacts in the Eramosa and upper Penfield are dominated by CVOCs. TCA, PCE, and their degradation products were regularly detected above Class GA Standards in the RI Study Area groundwater. The primary CVOC detected in Eramosa and upper Penfield groundwater was TCA. During the RI and historically, the highest TCA concentrations in the Eramosa groundwater have been detected in monitoring wells located in the northwestern portion of the former AMSF Site and the northeastern portion of the former RFM Site (RFM RIR Figures 5-5a-f). The highest groundwater TCA concentration documented in a monitoring well was 110,000 µg/l (AMSF-MW-7, May 4, 1999). This concentration is close to 10% of the TCA solubility, suggesting that DNAPL may have persisted in the bedrock in this area during the period when the sample was obtained (Kueper & Davis, 2009). This groundwater concentration suggests that DNAPL could be or was present; however, no DNAPL has been observed in RI Study Area monitoring wells. Literature suggests that if DNAPL was present in the past, it may have completely dissolved and diffused into the bedrock matrix over time and caused locally high and persistent groundwater concentrations without DNAPL persistence (Parker et al., 1994 and 1997). AMSF-MW-17MP is located in the vicinity of AMSF-RW-2. As discussed in the RFM RIR Section 5.2.1**,** bedrock matrix equivalent porewater TCA concentrations in AMSF-MW-17MP were amongst the highest within the upper Eramosa (RFM RIR Figure 5-4). Equivalent porewater concentrations of TCA up to 20,299.7 µg/l were detected. The relative vertical distribution of TCA concentrations at AMSF-MW-17MP, in March 2008, generally corresponds to the vertical distribution of TCA from the PDB sampling in AMSF-MW-7 (82,700 µg/l, 542.5 to 540.5 ft amsl [20.7 to 22.7 ft bgs])and AMSF-MW-13S (71,600 µg/l, 542 to 540 ft amsl [22.5 to 24.5 ft bgs]), in December 2005. The most recent RFM RI groundwater sample TCA concentration from AMSF-MW-7 (8,300 µg/l) supports a back diffusion model with the highest AMSF-MW-17MP equivalent porewater concentration (20,299.7 µg/l) being greater than the groundwater TCA concentration (suggesting back diffusion at this location at the time of sampling).

Distribution of CVOCs in Groundwater

TCA concentrations in groundwater are distributed upgradient and downgradient from the northwestern portion of the former AMSF Site and the northeastern portion of the former RFM Site. Upgradient, to the west and south of the area of highest concentrations, the extent of TCA concentrations that exceeded Class GA Standards was defined for the Eramosa groundwater by wells on the former RFM and former AMSF Sites. Upgradient TCA concentrations reflect, at least in part, the radial groundwater flow caused by precipitation runoff discharging to recharge well AMSF-RW-2 and displacing the impacted groundwater in the fractures. The impacted groundwater is then “pushed” upgradient, as well as in other downgradient locations of the former AMSF Site and the Cinemark property.

Extent of CVOCs in Groundwater

Based on the RFM RIR groundwater monitoring and recharge well data, the extent of TCA concentrations in groundwater that exceed Class GA Standards were defined in the upper and lower Eramosa formations (RFM RIR Figures 5-5a,d and AMSF RIR Figure 13a).

Limits to CVOCs on Eastern, Northeastern and Southeastern Property Boundaries of Former AMSF Site

With additional groundwater monitoring well installation as part of the AMSF RIR, the eastern boundary is now further defined in the Eramosa formation with wells AMSF-MW-28, AMSF-MW-29, AMSF-MW-30, and AMSF-MW-34. Class GA Standards were exceeded in these three boundary wells for various compounds as reported in the AMSF RIR. TCA exceedances were detected at AMSF-MW-29 in June 2013, September 2013, and August 2015 (54 µg/l, 380 µg/l, 86 µg/l, respectively), at AMSF-MW-30 in June and September 2013 (13 J µg/l and 58 µg/l, respectively), and at AMSF-MW-34 in June 2015 and August 2015 (410 µg/l and 210 µg/l, respectively). PCE exceedances were detected at AMSF-MW-28 in June and September 2013 (5.7 µg/l and 5.7 µg/l, respectively), at AMSF-MW-29 in June 2013, September 2013, June 2015, and August 2015 (7.3 µg/l, 19 J µg/l, 6.3 µg/l, 19 µg/l, respectively), and at AMSF-MW-34 in June 2015 and August 2015 (14 µg/l and 25 µg/l, respectively). Based on this recent sampling reported in the AMSF RIR, it is evident that the horizontal extent of TCA concentrations exceeding Class GA Standards in bedrock groundwater have not been established on the eastern and northeast portions of the former AMSF Site. Additionally, Class GA Standards for PCE have not been met on the east and southeastern portions of the former AMSF Site, as indicated by the PCE concentrations in wells AMSF-MW-28 and AMSF-MW-29. The appropriate laboratory analysis for 1,4-dioxane was not used in the AMSF RI and so the results for 1,4-dioxane were rejected; therefore, the presence or absence of 1,4-dioxane cannot be verified.

Southern Boundary on Former RFM Site and Former AMSF Site

The southern boundary is documented in the upper and lower Eramosa formation by monitoring wells AMSF-MW-3S, AMSF-MW-10, and AMSF-MW-28 on the former AMSF Site and by wells ITT-SBW-4 and ITT-SBW-8 on the former RFM Site. Both monitoring wells on the southern boundary of the former RFM Site were non-detected for CVOCs in 2013 groundwater sampling and therefore the southern boundary limit of CVOCs is established on the former RFM property. Each of the groundwater monitoring wells that define the southern boundary of the former AMSF Site had exceedances of Class GA Standards for PCE in June and September 2013 in monitoring wells AMSF-MW-3S (70 µg/l and 45 µg/l, respectively), AMSF-MW-10 (50 µg/l and 25 µg/l, respectively) and AMSF-MW-28 (5.7 µg/l and 5.7 µg/l, respectively). Therefore, the southern boundary, with respect to the limits of Class GA Standards for PCE, has not been established on the former AMSF Site. The concentrations of TCA in the wells on the southern boundary of the former AMSF site were less than Class GA Standards and as a result the southern boundary limits for TCA on the former AMSF Site have been established.

Western Boundary on Former RFM Site

The western boundary of the limits of CVOC concentrations in the upper and lower Eramosa formation on the former RFM Site is defined by ITT-SBW-4 and ITT-SBW-23. Based on recent sampling conducted by O'Brien and Gere (2014a), the western boundary of CVOCs exceeding Class GA Standards has been established by monitoring wells ITT-SBW-4 and ITT-SBW-23 with concentrations less than Class GA Standards.

Northern Boundary on Former RFM Site

The northern boundary on the former RFM Site is on the southern portion of the Cinemark property and is defined in the upper and lower Eramosa formation by ITT-SBW-13, ITT-SBW-14, ITT-SBW-14 and ITT-SBW-16. North of the former RFM property on the Cinemark property CVOC concentrations were reported as less than Class GA Standards in ITT-SBW-13 and ITT-SBW-16 for the June 2013 sampling event. In June 2013, TCA concentrations in IT-SBW-14 and ITT-SBW-15 were reported at 23 µg/l and 8.6 µg/l, respectively, from sampling during the O'Brien and Gere June 2013 monitoring event (O'Brien & Gere 2014a). Historically, TCA concentrations in monitoring well ITT SBW-13 located on the Cinemark Property were reported to be greater than the Class GA Standard (12 µg/l on 2/12/2005 and 321 µg/l on 9/28/2005), but the last three rounds of sampling in 2010 and 2013 were less than the Class GA Standard. It is likely that TCA concentrations recorded in ITT-SBW-13 are influenced by TCA sources on the former AMSF Site and recharge events associated with AMSF-RW-2.

Limits of 1,4-Dioxane

The current limits of 1,4-dioxane concentrations were defined by O'Brien and Gere in the June 2013 monitoring event (O'Brien & Gere, 2014a) and 2015 AMSF RIR sampling. Because the appropriate analysis for 1,4-dioxane was not used during pre-2015 AMSF RI sampling, the results for these 1,4-dioxane analyses were rejected. Therefore, the presence or absence of 1,4-dioxane cannot be verified in any of the wells sampled pre-2015 on the former AMSF Site by Stantec as part of the AMSF RI (Stantec 2015).

In the northern boundary Cinemark property monitoring wells, the limits of 1,4-dioxane were defined by monitoring wells ITT-SBW-13 (0.71 µg/l) and ITT-SBW-16 (not detected [ND]) north of the former RFM Site and ITT-SBW-14 (2.4 µg/l) and ITT-SBW-15 (ND) north of the former AMSF Site.

The western boundary of the limits of 1,4-dioxane concentrations on the former RFM Site were defined by monitoring wells ITT-SBW-4 (ND) and ITT-SBW- 23 (0.31 µg/l).

The limits of 1,4-dioxane concentrations on the southern property boundary on the former RFM Site were defined by monitoring wells ITT-SBW-4 (ND) and ITT-SBW-8 (ND). The limits of 1,4-dioxane concentrations on the southern property boundary on the former AMSF Site were defined by monitoring wells AMSF-MW-3S (0.34 NJ µg/l, tentative estimated value) and AMSF-MW-10 (0.44 µg/l).

The limits of 1,4-dioxane concentrations on the eastern property boundary on the former AMSF Site were defined by monitoring wells AMSF-MW-34 (4.4 µg/l), AMSF-MW-29 (1.2 µg/l), and AMSF-MW-21 (4.9 µg/l). Of note, 1,4-dioxane concentrations in AMSF-MW-9S (an RFM RI Study Area well on the western side of the former AMSF Site) were the highest and had the most frequent detections throughout the RFM RI. The most recent sampling for 1,4-dioxane concentration in AMSF-MW-9S resulted in a 1,4-dioxane concentration of 230 µg/l (O'Brien & Gere, 2014a).

Impacts of Recharge Well AMSF-RW-2

Precipitation runoff is directed to recharge wells and consequently the runoff enters the groundwater system rapidly and at point discharge locations during a precipitation event. The distribution of COCs during and following precipitation events can be very different from the normal distribution of COCs. As previously discussed in **Section 3.4.4**, recharge well AMSF-RW-2 is located in the area of the highest COC bedrock groundwater concentrations. The effect of the point groundwater recharge at recharge well AMSF-RW-2 causes COC concentrations to decline, up to an order of magnitude, in the vicinity of the recharge well and to increase, upgradient, side gradient and downgradient, further from the recharge well. As discussed in RFM RIR Section 5.3.1 and **Section 3.4.4** above, the impact of precipitation runoff events causes higher than normal COC concentrations to be observed downgradient in monitoring wells on the Cinemark property and upgradient and side gradient from the northwestern portion of the former AMSF Site. While this response to recharge causes an increase in concentrations downgradient, the overall downgradient migration of COCs continues to be naturally attenuated by bedrock matrix diffusion. The deeper recharge wells (AMSF-RW-1, AMSF-RW-2, and ITT-W-1) provide open vertical pathways for facilitated groundwater flow and COC transport into the deeper bedrock units.

This vertical transport of groundwater in recharge wells can occur both during recharge events and, to a lesser extent, during periods of non-recharge when there is a downward vertical hydraulic gradient within the recharge well. Recharge well AMSF-RW-2 is an open borehole extending from near the top of bedrock down to a depth of 149 ft bgs (414 ft amsl) and facilitates downward advection across bedrock strata (such as the lower Penfield, Decew, and Rochester Shale) with fewer fractures and lower hydraulic conductivities. Shallow groundwater with high COC concentrations has the potential to migrate down the borehole to the Deep Bedrock. RI Study Area data, including historical vertical distribution sampling at AMSF-RW-2, packer test sampling, and bedrock matrix data, document that high concentrations of Site COCs occur at elevations near the base of AMSF-RW-2 and suggest that the COCs were most likely transported there via the recharge well. DNAPL, if historically present, likely traveled downward in the open AMSF-RW-2 borehole and contributed to the high COC concentrations at the bottom of that recharge well. Mixtures of DNAPL and LNAPL from degreasing waste solvents likely entered AMSF-RW-2 and have been discharged at the bottom of the solid casing in the open rock section and into solution enlarge fractures present in the Eramosa formation.

Recharge wells AMSF-RW-1 and ITT-W-1 are also constructed as open boreholes from near the top of bedrock to their total depth, 95 ft (463 ft amsl) and 136 ft (424 ft amsl), respectively. These open boreholes intersect multiple bedrock strata and consequently likely act as vertical pathways for facilitated groundwater flow and COC transport into deeper bedrock units. COC concentrations in these recharge wells have been inconsistently detected. The exception is the deep bedrock zone of recharge well ITT-W-1 where COCs were consistently detected below 445 ft amsl (116 ft bgs), suggesting that the COCs were most likely transported there via vertical migration in the recharge well. The other former AMSF Site recharge wells AMSF-RW-3, RW- AMSF- 4, and AMSF-RW-5 are shallow and do not intersect multiple bedrock strata. BTEX and acetone concentrations in groundwater were one to two orders of magnitude greater in the Deep Bedrock than in the Eramosa and upper Penfield strata. Higher BTEX concentrations were also detected throughout the Deep Bedrock matrix samples. These data further indicate that naturally occurring BTEX compounds occur in these deeper bedrock strata, along with the known presence of natural gas in the deeper bedrock.

Additional data presented in the AMSF RIR, enabled further interpretation of the role that recharge well AMSF-RW-2 plays with respect to the distribution of CVOCs reported from groundwater monitoring wells on the former ASMF and former RFM Sites. In the RFM RIR CSM, two cross sectional figures were presented on the northern portion of the former RFM and former AMSF Sites (RFM RIR Figure 8-1a and Figure 8-1b) under stormwater recharge and non-recharge conditions, respectively. Analyses presented in the RFM RIR clearly indicate that stormwater recharge into AMSF-RW-2 have had significant impacts on the distribution of CVOCs reported for a given monitoring event.

In addition to the CSM figures presented in the RFM RIR, a transect was developed using the most recent groundwater monitoring data from the sampling ITT conducted in 2013 and using the groundwater monitoring data presented in the AMSF RIR. The transect was developed extending from recharge well AMSF-RW-2 through

AMSF-MW-7 on the former AMSF Site and through ITT-SBW-2, ITT-SBW-3, ITT-SBW-9 and ITT-SBW-10 on the former RFM Site (see inset on **Figure 3-6** for the location of the transect). Each of these monitoring wells is screened in the Upper Eramosa formation at elevations that bisect the highest bedrock matrix TCA concentrations in ITT-IBW-20 and AMSF-MW-17MP. It should be noted that ITT-SBW-2 and ITT-SBW-9 are within the footprint of the 1999 excavation area on the former RFM Site. The maximum historical TCA concentrations from the wells since 1993 along the transect starting at AMSF-RW-2 and ending at ITT-SBW-10 are as follows: AMSF-MW-7 (110,000 µg/l), ITT-MW-2 (18,000 µg/l), ITT-SBW-2 (7,400 µg/l), ITT-SBW-3 (4,700 µg/l), ITT-SBW-9 (1,750 µg/l) and ITT-SBW-10 (260 µg/l). The distance from AMSF-RW-2 to ITT-SBW-10 is approximately 237 ft. A figure displaying these TCA concentrations is found in **Figure 3-6a**.

An analysis was also conducted to compare the historical maximum TCA concentrations in the above groundwater monitoring wells to the highest concentrations observed in these monitoring wells using data from the recent sampling events conducted by O'Brien and Gere in 2013 and by Stantec in 2013 and 2014 along the same transect. The highest TCA concentrations reported for the 2013, 2014 or 2015 sampling events along this same transect beginning at AMSF-RW-2 and ending at ITT-SBW-10 are as follows: AMSF-MW-7 (5,900 µg/l), ITT-MW-2 (abandoned), ITT-SBW-2 (760 µg/l), ITT-SBW-3 (abandoned), ITT-SBW-9 (250 µg/l) and ITT-SBW-10 (110 µg/l). A plot of these data are shown in **Figure 3-6b.** It is evident that the same trend of highest concentrations of TCA on the former AMSF Site and steadily decreasing TCA concentrations on the former RFM Site still exists in the most recent sampling conducted in the RI Study Area as historically existed. It should be noted that monitoring wells ITT-MW-2 and ITT-SBW-3 were abandoned during the 1999 excavation on the former RFM Site and therefore there were not TCA groundwater monitoring results from these wells presented in **Figure 3-6b**.

Classic injection well hydraulics with radial flow predict chemical compound concentration decaying relationships to be exponential type with respect to radial distance away from the injection well. The distribution of the highest historical TCA concentrations in the Upper Eramosa monitoring wells along this transect, with respect to distance away from recharge well AMSF-RW-2, is well described as an exponential decay curve. This type of exponential relationship indicates that the shallow bedrock area around AMSF-RW-2 is the primary source of TCA in groundwater in the northwest corner of the former ASMF Site and in the northeast corner of the former RFM Site. It is typical for dissolved groundwater concentrations to be distributed from highest to lowest concentrations along a hydraulically upgradient to a downgradient trend, it is evident, in this case, that recharge to well AMSF-RW-2 played a pivotal, upgradient, role in the distribution of TCA and as the primary source of TCA in groundwater responsible for the high TCA groundwater concentrations historically and currently observed in the northwest corner of the former AMSF Site and the northeast corner of the former RFM Site. Despite the long 24 year time period since many of the maximum TCA concentrations were recorded in groundwater monitoring wells along the transect presented in **Figure 3-6a** prior to groundwater sampling in 2013, a similar TCA concentration decline with respect to distance was observed along the same transect as presented in **Figure 3-3b**.

This trend can also be seen in the AMSF RIR in Table 18 where Stantec presented an analysis to compare recent and historic CVOC concentrations to ascertain trends over time. In this table, Stantec compared maximum individual CVOC concentrations from 2005 to 2010 and maximum individual CVOC concentrations from 2010 to their most recent groundwater sampling results. Additionally Stantec reported individual CVOC concentration sample results from 2013, 2014, and 2015. TCA results from three groundwater monitoring wells on the former AMSF Site were the highest ever reported during the most recent (September 2013 or May 2014) sampling events in comparison to historical concentrations (AMSF-MW-1S, AMSF-MW-15I, AMSF-MW-16I), located within approximately 125 ft and in three radial directions from AMSF-RW-2. All three of these groundwater monitoring wells are close to recharge well AMSF-RW-2. Additionally, TCA concentrations in six groundwater monitoring wells on the former ASMF Site, based on the most recent groundwater sampling results (either 2013, 2014, or 2015), were reported to be greater than 900 µg/l (AMSF-MW-1S (4,900 µg/l), AMSF-MW-9S (930 µg/l), AMSF-MW-13S (2,300 µg/l), AMSF-MW-15I (1,900 µg/l), AMSF-MW-16I (4,300 µg/l) and AMSF-MW-33 (3,600 µg/l). These groundwater monitoring wells are located in the northwest corner of the former AMSF Site proximate to recharge well AMSF-RW-2. Results of the 2013 periodic groundwater sampling conducted by O'Brien & Gere resulted in only one Lower Eramosa formation monitoring well on the former RFM Site (ITT-IBW-20 at 2,200 µg/l) with a TCA concentration greater than 900 µg/l. No sampled Upper Eramosa screened groundwater monitoring wells on the former RFM Site had TCA concentrations greater than 900 µg/l (ITT-SBW-2 at 760 µg/l had the highest TCA concentration) while four Upper Eramosa screened groundwater wells were reported with TCA concentrations greater than 900 µg/l on the former AMSF Site. While only one Lower Eramosa screened groundwater monitoring well located on the former RFM Site was reported with a TCA concentration greater than 900 µg/l (ITT-IBW-20 at 2,200 µg/l) based on 2013 monitoring, two Lower Eramosa screened monitoring wells were reported with TCA concentrations greater than 900 µg/l (AMSF-MW-15I at 1,900 µg/l and AMSF-MW-16I at 4,300 µg/l) on the former AMSF Site based on 2013 and 2014 sampling.

Groundwater Impacts in the RI Study Area

A conceptual cross section showing the northwestern portion of the former AMSF Site, with recharge well AMSF-RW-2, and declining COC concentrations extending outward in the fracture zones is presented in RFM RIR Figure 8-2. Based on the RI data, TCA and other VOCs in the bedrock groundwater are also distributed upgradient and side gradient from the northwestern portion of the former AMSF Site by recharge well AMSF-RW-2. TCA was detected in bedrock monitoring wells on the former RFM Site, upgradient during non-recharge events of the northwestern portion of the former AMSF Site. As noted above, in 1999 soils impacted by TCA were excavated immediately north of the former RFM building. Shallow bedrock monitoring wells ITT-SBW-2 and ITT-SBW-9, and intermediate monitoring well ITT-IBW-20, are located within the footprint of this former excavation area. Concentrations of TCA in the shallow wells, ITT-SBW-2 and ITT-SBW-9, were below groundwater standards during the 2010 Low Groundwater sampling event; however, intermediate well ITT-IBW-20 TCA concentrations were above groundwater standards. In addition to the highest TCA concentrations being observed in the northwestern portion of the former AMSF Site, high concentrations of TCA, DCA, and 1,4-dioxane were observed in Eramosa groundwater samples from AMSF-MW-9S (located adjacent to the western side of the former AMSF building). 1,4-Dioxane concentrations in AMSF-MW-9S were the highest and had the most frequent detections throughout the RI.

The rapid attenuation of TCA concentrations downgradient reflects a variety of attenuation processes including sorption, degradation, dispersion, and diffusion into the bedrock matrix. RI data have documented that bedrock matrix diffusion is a key attenuation process. TCA was detected in the bedrock matrix adjacent to prominent bedrock fractures. The horizontal and vertical distribution of TCA in the bedrock matrix are consistent with the distribution of TCA in the bedrock groundwater, with the most frequent and highest concentration detections of TCA in the bedrock matrix occurring in the vicinity of recharge well AMSF-RW-2 and the 1999 Soil Remediation Area. As TCA migrates downgradient in the groundwater, matrix diffusion acts to remove TCA from the groundwater and attenuate the TCA migration. The natural attenuation capacity of the bedrock matrix appears to cause the observed rapid downgradient attenuation of bedrock groundwater TCA concentrations, and has limited the horizontal extent of downgradient TCA migration, providing the equivalent of hydraulic control for the purposes of containment of TCA and other CVOCs in the bedrock groundwater. TCA that has diffused into the bedrock matrix can back diffuse from the matrix to the groundwater, thus contributing to concentrations of TCA in groundwater. The diffusion and back diffusion process was discussed in more detail in Section 3.4.3. The RI data are consistent with the TCA in the bedrock matrix contributing to the TCA in the bedrock groundwater through back diffusion.

During AMSF's RI, several groundwater monitoring wells were installed and subsequent groundwater sampling took place in 2013, 2014, and 2015 on the former AMSF Site (Stantec 2015). Details of the groundwater sampling locations and results are summarized in the AMSF RIR and should be referenced; they will not be repeated in this FS, other than those relevant to this updated CSM. As identified earlier, the limits of PCE in the Upper Eramosa groundwater exceeding Class GA Standards on the former AMSF Site have not been established on the eastern, southeastern and southern portions of the former AMSF Site. These PCE Class GA exceedances on the former AMSF Site appear to be related to higher PCE concentrations reported in groundwater in and around the location of a former degreaser and associated drains (AMSF-AOC-1), floor drains in AMSF-AOC-3, and various sanitary sewer lines and a former drainage swale that existed prior to a building expansion that took place on the former AMSF Site in 1979. TCA and PCE concentrations in the Eramosa groundwater in this general area have been defined in monitoring wells AMSF-MW-20, AMSF-MW-21, AMSF-MW-22, AMSF-MW-23, AMSF-MW-25 and extending outside of the building to the east in AMSF-MW-29 and AMSF-MW-34. PCE concentrations on the former AMSF Site have exceeded the Class GA Standard as reported by Stantec (2015) during sampling conducted in 2013, 2014, and 2015 in 15 monitoring wells. The highest current PCE concentrations in these wells reported in the AMSF RIR (June & September 2013 and June 2014) were as follows: AMSF-MW-20 (930 D µg/l), AMSF-MW-21 (190 D µg/l), AMSF-MW-22 (260 D µg/l), AMSF-MW-23 (70 µg/l), AMSF-MW-25 (120 µg/l), AMSF-MW-29 (19 J µg/l), and AMSF-MW-34 (25 µg/l). The highest PCE concentrations in groundwater to the northwest and west of these above-mentioned locations were much lower as reported in the AMSF RIR: AMSF-MW-26 (7.1 µg/l), AMSF-MW-27(6.3 µg/l), AMSF-MW-31 (20 µg/l) and AMSF-MW-32 (7.4 µg/l). PCE impacts in groundwater along the western side of the former ASMF Site exceed Class GA Standards in AMSF-MW-9S (77 J µg/l) and AMSF-MW-13S (5.8 µg/l).

The above PCE distributions in groundwater clearly identify separate sources of PCE to groundwater on the former AMSF Site.

During RFM RI sampling, TCE was detected in samples collected from AMSF-MW-1S (1 to 12.4 µg/l), AMSF-MW-7 (77 to 430 J µg/l), AMSF-MW-11S (2.6 to 26.5 µg/l), AMSF-MW-12S (7 to 19.9 µg/l), AMSF-MW-13S (21 to 130 J µg/l), AMSF-MW- 15I (3.5 to 7.3 µg/l), and AMSF-MW-16I (4.6 J to 4.8 µg/l) in the vicinity of recharge well AMSF-RW-2. During the RI High/Low Groundwater Events described in the RFM RIR, samples collected from AMSF-MW-1S, AMSF-MW-7, AMSF-MW-11S, AMSF-MW-12S, AMSF-MW-13S, and AMSF-MW-15I had TCE concentrations that exceeded the Class GA Standard. AMSF-MW-7 and AMSF-MW-13S TCE concentrations consistently exceeded the Class GA Standard. During pre-RI groundwater sampling events, TCE concentrations at AMSF-MW-1S and AMSF-MW-7 ranged from 8 J to 500 µg/l. In the most recent sampling conducted as part of the RFM RI, TCE concentrations in AMSF-MW-1S, AMSF-MW- 7, AMSF-MW-11S, AMSF-MW-12S, AMSF-MW-13S, AMSF-MW-15I, and AMSF-MW-16I were: 1 µg/l (September 2010), 77 µg/l (September 2010), 8.5 µg/l (September 2010), 8.8 µg/l (September 2010), 21 µg/l (September 2010), 7.3 µg/l (September 2010), and 4.6 J µg/l (September 2010), respectively.

In summary, TCE and PCE concentrations in Eramosa groundwater monitoring wells located in the northwest corner of the former ASMF Site historically were at least one order of magnitude higher in concentration than in Eramosa monitoring wells located on the northeast corner of the former RFM Site. Based on the most recent groundwater sampling event on the former RFM Site (O'Brien and Gere 2014a) and for the former AMSF Site (Stantec 2015), PCE concentrations in Eramosa groundwater monitoring wells located in the northwest corner of the former ASMF Site are currently at least an order of magnitude higher than on the former RFM Site. Based on recent sampling TCE concentrations in the northwest corner of the former AMSF Site are a factor of 4 times greater than on the former RFM Site. TCA concentrations in groundwater under the former AMSF manufacturing building were also reported in monitoring wells both new and historically installed on the former ASMF Site. The highest TCA concentrations in monitoring wells located in the AMSF-AOC-1 and AMSF-AOC-3 areas reported in the AMSF RIR were as follows: AMSF-MW-20 (120 µg/l), AMSF-MW-21 (420 µg/l), AMSF-MW-22 (27 µg/l), AMSF-MW-23 (58 µg/l), AMSF-MW-25 (15 µg/l), AMSF-MW-29 (380 µg/l), AMSF-MW-34 (410 µg/l). TCA concentrations in and around AMSF-MW-2 and AMSF-MW-21 are indicative of a separate source of TCA from that in the northwest corner of the former AMSF Site as concentrations TCA concentrations in groundwater decrease between these locations. TCA groundwater concentrations in the northwest corner and western portion of the former AMSF Site remain the highest reported in the 2013, 2014, and 2015 sampling events conducted by Stantec. As previously discussed, TCA concentrations in six Upper Eramosa groundwater monitoring wells on the former ASMF Site, based on either 2013, 2014, or 2015 sampling, were reported to be greater than 900 µg/l (AMSF-MW-1S (4,900 µg/l), AMSF-MW-9S (930 µg/l), AMSF-MW-13S (2,300 µg/l), AMSF-MW-15I (1,900 µg/l), AMSF-MW-16I (4,300 µg/l) and AMSF-MW-33 (3,600 µg/l). These high TCA concentrations clearly reflect an on-going source of TCA to the bedrock groundwater on the former ASMF Site. TCA concentrations in Upper Eramosa monitoring wells located in the north, northeastern and eastern portions of the former RFM Site reported by O'Brien and Gere (2014a) from sampling in 2013 were as follows ITT-SBW-2 (760 µg/l), ITT-SBW-9 (250 µg/l), ITT-SBW-5A (30 µg/l), ITT-SBW-10 (110 µg/l) and ITT-SBW-7 (ND). PCE concentrations in the same wells in 2013 were reported as follows: ITT-SBW-2 (ND), ITT-SBW-9 (10 µg/l), ITT-SBW-5A (1.2 µg/l), ITT-SBW-10 (5.1 µg/l) and ITT-SBW-7 (ND). As discussed previously, high rainfall occurred just prior to the 2013 sampling by O'Brien and Gere (2014a) recorded at the Greater Rochester International Airport for the 7 day and for the 20 day periods at 2.07 inches and 4.95 inches, respectively. It is most likely that the concentrations of PCE detected in the monitoring wells located on the former RFM Site were from the historically higher PCE concentrations at the former AMSF Site.

Soil Vapor / Vapor Intrusion

During the RFM RI, vapor intrusion was investigated in the RI Study Area beginning in 2004 through December 2009, followed by sampling associated with implementation of an IRM ISMP through the latest activity to date during the 2014-2015 Heating Season. As part of the RFM RI, sub-slab and indoor air samples were collected at the former RFM Site from five sampling locations in 2004. The soil vapor results indicated that concentrations of CVOCs were present in the sub-slab vapor samples and indoor air samples. Based on review of the sample results, NYSDEC requested the completion of an IRM in the former RFM building prior to any re-occupancy of the building. The former RFM building has remained vacant since 2003, and the building was demolished and removed in November/December 2015; therefore, no IRM has been completed to date.

In August 2004, as part of the RI Phase I activities, sub-slab and indoor air samples were also collected in the northwest portion of the former AMSF building. Based on review of the former AMSF building sampling results, NYSDEC required additional sub-slab and indoor air sampling. Additional sub-slab and indoor air sampling events were conducted in phases in February 2005, March 2008, and April 2009. Sampling began at the northwest portion of the former AMSF building and expanded south, east, and southeast until representative portions of the whole building had been subjected to sub-slab and indoor air sampling. PCE was detected at the highest concentration of any CVOC in sub-slab vapor at AMSF-19 (in the southeast portion of the former AMSF building) at a concentration of 1,400,000 µg/m^3. High concentrations of TCA were also found at this location and at AMSF-16 (in the southwest portion of the former AMSF building). PCE is not a COC for the former RFM Site and the source of PCE on the former AMSF Site is associated with former AMSF operations. Lower concentrations of TCA were detected between the northwest portion of the former AMSF building and the high TCA concentrations in the southeast and southwest portion of the former AMSF building, indicating sources of TCA on the former AMSF Site. However, NYSDEC requested that ITT identify mitigation options for the northwest portion of the former AMSF building.

In 2009, sub-slab depressurization pre-design communication testing was conducted in the BR and EZ-Movers tenant spaces in the northwest portion of the former AMSF building, and the results of the testing indicated sub-slab depressurization may not be feasible to implement due to various sub-slab materials and structures that blocked a sufficient extension of the pressure field. Because the indoor air sampling indicated that no vapor intrusion was occurring at or above NYSDOH guideline levels in these two tenant spaces (just the potential for vapor intrusion existed due to sub-slab concentrations), and because NYSDEC indicated they would like to eventually implement a remedial plan for the entire building, NYSDEC agreed that ITT conduct an IRM consisting of annual monitoring of sub-slab and indoor air conditions each heating season, from within the two tenant spaces in the northwest corner of the former AMSF building, to verify vapor intrusion is still not occurring at or above NYSDOH guideline levels.

As required by NYSDEC, sub-slab and indoor air sampling was conducted at the adjacent off-Site Cinemark and Batesville properties (to the north and west of the RFM site, respectively). Based upon the results of the sub-slab and indoor air sampling, no further action was required by the NYSDEC or NYSDOH for either property.

Vapor intrusion and ambient air sampling locations collected as part of the RFM RI are presented in the RFM RIR Figure 3-6. Vapor intrusion and ambient air sampling results for TCA and PCE collected as part the RFM RI are presented in RFM RIR Figure 5-10a and Figure 5-10b, respectively.

As a result of the vapor intrusion sampling results collected by ITT in the former AMSF building, NYSDEC required that MFP initiate a remedial investigation on that property. MFP submitted a BCP Application and RI Work Plan to NYSDEC on June 22, 2011. As part of the BCP RI conducted by MFP on the former ASMF Site, vapor intrusion sub-slab/indoor air and ambient air sampling was conducted in April 2013. MFP did not conduct vapor intrusion sampling in the northwest corner of the former AMSF building, but rather requested that ITT provide to MFP ITT's results of the upcoming annual vapor intrusion sampling to be conducted in the two tenant spaces during the heating season (December 2013). MFP also requested that ITT have the vapor intrusion samples analyzed for the full list of compounds via USEPA Method TO-15, instead of limiting the analysis to the six compounds (TCA, PCE, TCE, 1,1-DCE, cis-1,2-DCE, and DCA) as has been required of ITT by MFP as a condition of their granted access for previous sampling events. Results of the VI sampling conducted by ITT for the northwest corner of the former AMSF building are presented in a *2013-2014 Vapor Intrusion Monitoring Sampling Results - December 5-6, 2013* (O'Brien & Gere 2014) letter; results of the VI sampling conducted by MFP for the rest of the former AMSF building are presented in the AMSF RIR (Stantec 2014).

Revisiting the sub-slab results from the RFM RI, TCA was present in soil outside the north wall of the former RFM building. TCA was subsequently detected in sub-slab samples collected inside the former RFM building near the north wall in August 2004 at concentrations of 180,000 J $\mu g/m^3$ and 150,000 J $\mu g/m^3$. These are the highest sub-slab concentrations detected during the RFM RI for TCA at the former RFM building. Typical vapor diffusion from a higher concentration area results in decreasing concentrations at increased distances from the suspected soil vapor source location. However, as indicated in RFM RIR Figure 5-10a, there is no single TCA soil vapor diffusion gradient between the north wall of RFM to the northwest corner of the former AMSF building and to other portions of the former AMSF building. There appeared to be diffusion gradients away from at least three source locations under the former AMSF building, as there are at least three sub-slab sample results of lower concentrations between the highest sub-slab concentrations at the northeast corner of the former RFM building and each of the three elevated TCA source locations under the former AMSF building (AMSF-05, AMSF-16, and AMSF-19).

Looking at the recent combined vapor intrusion sampling results collected by MFP and ITT in the former AMSF building (April 2013 and December 2013, respectively), a fourth potential TCA soil vapor source location was revealed under the southwest corner of the former AMSF building at sample location AM-SVIA14 where sampling was not previously conducted. The potential TCA soil vapor source locations are defined by sub-slab vapor concentrations greater than 10,000 $\mu g/m^3$ surrounded by significantly lower concentrations. Therefore, source locations of TCA under the former AMSF Site are near AMSF-16, AM-SVIA14, AMSF-19 and AMSF-05.

The recent combined vapor intrusion results also suggest two PCE soil vapor source locations under the former AMSF building; one near AMSF-19 and another near AMSF-22. In addition, the gradient of PCE vapor away from the two source locations is what is typically found for vapor diffusion, which further supports the conclusion that there are multiple TCA sources located beneath the former AMSF building. If there was one source of TCA under the building coming from the RFM site, we would expect to see the same diffusion gradient. The AMSF RIR suggests that TCA does not follow typical diffusion gradients because the subsurface material is not homogeneous and has preferential vapor pathways. However, the PCE results show that the vapor does migrate via typical diffusion. If there were preferential pathways, then all four apparent TCA source locations would have elevated PCE vapors but two of the four do not (AMSF-16 and AM-SVIA14). Therefore, vapors do not appear to be migrating preferentially, but via typical diffusion away from the source locations, and thus supports the conclusion that TCA vapors are sourced at four separate locations under the former AMSF building.

3.7.4 Conceptual Site Model Summary

More than two decades of site investigations have taken place in the RI Study Area which includes the former RFM Site and adjacent properties including the former AMSF Site, the Batesville property and the Cinemark property. Several COCs are present in the subsurface in the RI Study Area including TCA and its related degradation products, PCE, TCE and 1,4-dioxane. Operations at both the former RFM Sites and former AMSF Sites used TCA in their historic operations. 1,4-Dioxane was used as a stabilizing agent for TCA at the former RFM Site. To date, there are no known records available regarding the manufacturer/supplier of TCA used at the former AMSF Site, therefore the presence of 1,4-dioxane in the TCA used in operations at the former AMSF Site is unknown. PCE was not used at the former RFM Site.

Environmental media affected by the COCs include overburden soil, bedrock groundwater and soil vapor/indoor air. There are no known current risks to human health and the environment from exposures to groundwater as there are no known human or ecological receptors to groundwater exceeding ARARs. While there are exceedances of sub-slab vapor criteria for COCs under both the former RFM building and the former AMSF building, there are no known indoor air human exposures to COCs exceeding ARARs in the former AMSF building and in the former RFM building. There have been no exceedances of sub-slab vapor/indoor air

ARARs/TBCs on either the Batesville or Cinemark properties. Existing IRMs in place have been and continue to be protective of public health with respect to sub-slab vapor and indoor air in the RI Study Area.

Based on historical analyses conducted at least 11 years ago, as part of the RFM RI and prior investigations, there were exceedances of soil ARARs on the former RFM Site. Some of these exceedances have been mitigated with an excavation that took place in the 1999 RFM Soil Remediation Area located immediately to the north of the former RFM building. With a few isolated exceptions, concentrations of organic compounds in soils at the former RFM and former AMSF Sites were generally within regulatory criteria applicable to the current and anticipated future use of the properties. Soil samples collected from the 1999 excavation area and also from under the former RFM building were screened for NAPLs using an in-field UV fluorescence method recommended by USEPA (1994). The results for NAPL screening on the samples were negative. Results of the analysis of TCA in overburden soils at the former RFM Site in and around the former excavation area, prior to excavation, indicate that no continuous distribution of TCA concentrations indicative of NAPL level concentrations existed in the overburden soil. Soil sampling results obtained from soils that were subsequently removed during the 1999 excavation on the former RFM Site, and presented in the RFM RIR Soil Addendum (O'Brien and Gere 2014b), provide an important component to the CSM, enabling a more detailed interpretation for the potential of these soils to serve as source material for impacts to shallow bedrock groundwater. Analyses, interpretations and conclusions drawn and presented in this CSM regarding soil sampling results from the 1999 RFM Soil Remediation Area indicate that these soils were not a source of groundwater impacts caused by TCA or other CVOCs found in the northwest corner of the former ASMF Site in and around recharge well AMSF-RW-2 located on the former AMSF Site.

The geology in the RI Study Area consists of a surficial layer of generally low permeability, minimally and intermittently saturated, overburden soils comprised of fill and glaciolacustrine deposits (ranging from 4 ft to 20 ft thick) underlain by carbonate bedrock. The occurrence of layers of sands, that are of higher permeability than the fine grained silts and clays in the overburden soils, is variable at the former RFM Site and former AMSF Site. The overburden overlies a weathered bedrock surface that slopes from the east (former AMSF Site) gently downward to the west (former RFM Site). The top of bedrock surface is an irregular surface due to the differential erosion and weathering of a dolomite with varying rock hardness. The uppermost bedrock unit is the Eramosa Dolomite, which extends from the soil/bedrock interface to a depth of approximately 55 to 65 ft bgs (approximately 510 ft amsl). Much of the Eramosa Dolomite is characterized as highly fractured with hydraulic conductivities ranging from greater than 10^{-1} to greater than 10^{-3} cm/sec range. Many of the fractures in the Eramosa show evidence of solution enlargement which has increased the fracture aperture and hydraulic conductivity. The fracture density and hydraulic conductivity in the Eramosa Dolomite appear to generally decrease with depth such that the Eramosa is less fractured and has a lower hydraulic conductivity near the base than in the upper portions. Within the Eramosa Dolomite, individual fractures or groups of fractures were often separated by sections of competent unfractured rock. A prominent solution enlarged bedding fracture in the upper Eramosa fracture zone was consistently observed between 12 to 31 ft bgs (approximately 548 and 543 ft amsl). Fracture apertures for this solution enlarged fracture ranged from 1.6 to 4.4 inches. The Penfield Formation underlies the Eramosa Dolomite, extends to a depth of approximately 100 to 110 ft bgs (approximately 465 to 455 ft amsl), and is less fractured with lower hydraulic conductivity (10^{-2} to the 10^{-6} cm/sec range) than the Eramosa. The Decew Dolomite underlies the Penfield Formation, extends to a depth of approximately 120 ft bgs (approximately 445 ft amsl), and is significantly less fractured with much lower hydraulic conductivity (10^{-4} to the 10^{-8} cm/sec range). The Rochester Shale underlies the Decew Dolomite and extends to depths greater than 159 ft bgs (404 ft amsl), which is the maximum depth at which borings were completed during ITT's RI. Fracture density in the Rochester Shale formation is low and the formation contains naturally occurring petroleum hydrocarbons and has pockets of natural gas.

Groundwater generally is first encountered in the shallow bedrock, the Eramosa Dolomite. Groundwater flow predominantly occurs in the secondary porosity of the bedrock, such as solution enlarged bedding plane fractures. Solution enlarged fractures are more common in the Eramosa Dolomite than the Penfield and Decew formations and therefore the Eramosa Dolomite is a preferential zone for groundwater flow in the bedrock. Of the bedrock units, the Eramosa Dolomite is the most fractured and has the highest hydraulic conductivity and it is expected that the groundwater flow in the bedrock predominantly occurs in the Eramosa Dolomite.

Open bedrock recharge wells on the former RFM Site and at the adjacent former AMSF Site are used for storm water runoff management. Storm water runoff from roof and surface drains is directed to these recharge wells where the storm runoff recharges the bedrock groundwater. There is a single recharge well on the southwest portion of the former RFM Site that receives runoff from a portion of the roof of the former RFM building. There are five recharge wells on the former AMSF Site, which receive storm water from both roof top drains and parking lot runoff. Recharge well AMSF RW-2 is an approximately 149-ft deep open borehole recharge well located in the northwestern portion of the former AMSF Site between the former RFM Site and the former AMSF building proximate to the highest concentrations of TCA detected in groundwater. During precipitation runoff events, large volumes (tens to hundreds of thousands of gallons) of runoff water can be rapidly introduced into the bedrock through these recharge wells. The highly fractured and permeable Eramosa Dolomite allows the bedrock to readily accept runoff in these recharge wells This rapid infiltration of water into the bedrock provides an episodic pressure gradient to push groundwater radially away from the recharge wells, particularly in the Eramosa. During groundwater recharge events, the hydraulic gradient increases around the recharge wells resulting in non-uniform radial groundwater flow that affects groundwater elevations and chemistry across portions of the RI Study Area in a transient manner. The functioning of the recharge wells in general, and of recharge well AMSF-RW-2 specifically, and the influence of recharge well AMSF-RW-2 on the hydrogeology and the nature and extent of horizontal distributions of CVOCs in the Eramosa formation have been presented in the ITT RIR. Precipitation runoff entering recharge well AMSF-RW-2 pushes the high CVOC concentrations present in groundwater (during non-recharge periods) in and around the recharge well away from the recharge well onto the former RFM Site, onto the Cinemark property and onto other areas of the former AMSF Site.

In the last 20 years knowledge has greatly increased based on experimental and theoretical research as well as many field investigations regarding the transport and fate of dissolved COCs in fractured sedimentary bedrock. It is now known that NAPLs and dissolved COCs are affected by the bedrock matrix because the total primary porosity of the bedrock matrix is typically significantly higher than the typical total secondary porosity of the fractures. Because of this, the bedrock matrix porosity can store significantly more COC mass than is present in the bedrock fractures and consequently this affects the transport and fate of dissolved COCs in a sedimentary bedrock aquifer through natural attenuation processes. Bedrock matrix CVOC data collected during the RFM RI were used in conjunction with other physical, geophysical, and analytical (screening and definitive) data, to evaluate the nature, extent, fate and transport of CVOCs in the various geologic units present across the RI Study Area. In the absence of bedrock matrix diffusion natural attenuation processes, COCs would be expected to migrate further downgradient through hydraulically conductive solution enlarged fractures than have been observed during RFM RI groundwater sampling.

In the vicinity of recharge well AMSF-RW-2 bedrock matrix sampling documented that concentrations of TCA, DCA, PCE, and TCE were most frequently detected in the Eramosa Dolomite. Most of these constituents were detected in samples collected adjacent to or near prominent solution enlarged fractures. In sections of bedrock between solution enlarged fractures, TCA, DCA, PCE, and TCE were generally not detected, indicating predominant COC transport took place in the horizontally oriented solution enlarged bedrock fractures in the Eramosa formation. BTEX constituents were highest and most frequently detected in bedrock matrix samples below an elevation of approximately 65 to 79 ft bgs (~495 ft amsl). These data, in conjunction with the occurrence of natural gas, support the hypothesis that naturally occurring petroleum-related compounds occur in these deeper bedrock strata.

Analyses were conducted on the TCA bedrock matrix concentration data from AMSF-MW-17MP and ITT-IBW-20 to calculate average TCA concentrations in bedrock matrix samples and were used to estimate a measure of TCA mass in each of the two bedrock cores. The mean, median and geometric mean TCA bedrock matrix concentrations were significantly greater in bedrock matrix located on the former AMSF Site in AMSF-MW-17MP than on the former RFM Site in ITT-IBW-20. Additionally, the total areas under the TCA bedrock matrix concentration versus depth curves were 1.5 times greater at AMSF-MW-17MP than at ITT-IBW-20, indicating a significantly greater TCA mass in the bedrock at the AMSF-MW-17MP location on the former AMSF Site. This is indicative that the source of the TCA present in the bedrock matrix in and around the northwest corner of the former AMSF Site and the northeast corner of the former RFM Site originated from the former AMSF Site.

To provide information regarding vertical or lateral sources of CVOCs in the bedrock matrix in and around AMSF-RW-2, comparisons were made between the depth discrete TCA bedrock matrix concentrations and the acoustic televiewer log from AMSF-MW-17MP. AMSF-MW-17MP is located approximately 27 ft in a northwesterly direction from AMSF-RW-2 and ITT-IBW-20 is located approximately 100 ft in a west-southwesterly direction from AMSF-RW-2. The elevations of the two highest TCA bedrock matrix concentrations in AMSF-MW-17MP are at 545.19 ft amsl and 543.09 ft amsl. The single highest TCA bedrock matrix concentration reported in ITT-IBW-20 was located at 543.52 ft amsl. The acoustic televiewer log clearly indicates the existence of larger (1.65 inch and 3.31 inch fracture apertures) and more transmissive fractures at depths shallower than the zone of the highest TCA bedrock matrix concentrations reported in both ITT-IBW-20 and AMSF-MW-17MP. The TCA bedrock matrix concentrations adjacent to these shallower more transmissive fractures were reported to be very low in ITT-IBW-20. This type of distribution of TCA bedrock matrix concentrations, with the highest bedrock matrix concentrations being deeper than the in the shallow bedrock matrix, points to lateral migration from a source of TCA in the bedrock. If a shallow source of TCA was from the overburden, then it would be expected that the shallower more transmissive fractures would be preferred flow fractures for either NAPLs or TCA in groundwater and the result would be that the highest TCA bedrock matrix concentrations would be in the bedrock matrix adjacent to the overburden and the shallower fractures. This is not the case. There is a zone of much lower TCA bedrock matrix concentrations between the top of bedrock at both ITT-IBW-20 (~11 ft) and AMSF-MW-17MP (~10 ft) and the depths at which the highest TCA bedrock matrix concentrations were reported. These data clearly do not indicate an overburden source of TCA in the soil in the areas of these borings on either the former RFM Site or the former AMSF Site.

To further investigate possible sources of the high TCA groundwater and bedrock matrix concentrations observed on the former RFM Site and the former AMSF Site, a comparison of the TCA bedrock matrix data from AMSF-MW-17MP was made with the construction detail of recharge well AMSF-RW-2. It is clear that the depth of the bottom of the casing of AMSF-RW-2 directly corresponds to the depths of the highest TCA bedrock matrix concentrations detected in AMSF-17MP. This points to recharge well AMSF-RW-2 as a source of the historically high concentrations of COCs in the northwest corner of the former AMSF Site and the northeast corner of the former RFM Site. It is likely that once present in recharge well AMSF-RW-2, COCs would migrate horizontally in the very conductive fractures located in the Eramosa formation.

The concentrations of TCA in the RI Study Area bedrock groundwater are highest on the former AMSF Site and in the northeast portion of the former RFM Site (RFM RIR, Figure 5-5a), with the highest TCA concentrations in groundwater occurring in the northwestern portion of the former AMSF Site. From the northwestern portion of the former AMSF Site, TCA groundwater concentrations decline rapidly downgradient to the north and east. Concentrations decline by orders of magnitude within a distance of 500 ft indicating that natural attenuation processes are limiting the migration of the VOCs, particularly in the conductive primary fractures of the Eramosa Dolomite. These natural attenuation processes have also limited the extent of downgradient TCA migration in the bedrock groundwater. The bedrock matrix COC concentrations, and the rapid downgradient decline in groundwater concentrations, indicate that natural attenuation processes, including bedrock matrix diffusion, have strongly limited the migration, and downgradient extent, of TCA and associated CVOCs in the bedrock groundwater.

TCA concentrations in groundwater are distributed upgradient and downgradient from the northwestern portion of the former AMSF Site and the northeastern portion of the former RFM Site. Upgradient, to the west and south of the area of highest concentrations, the extent of TCA concentrations that exceeded Class GA Standards was defined for the Eramosa groundwater by wells on the former RFM and former AMSF Sites. Upgradient TCA concentrations reflect, at least in part, the radial groundwater flow caused by precipitation runoff discharging to recharge wells and displacing the impacted groundwater in the fractures. During recharge events AMSF-RW-2 becomes an upgradient source of groundwater and the impacted groundwater is then "pushed" onto the former RFM Site, as well as to the former AMSF Site and the Cinemark property.

The delineation of the eastern and northeastern horizontal limits to TCA and PCE concentrations on the former AMSF Site have not been met with respect to Class GA Standards. While the horizontal limits to TCA concentrations exceeding Class GA Standards in groundwater have been established on the southern property boundary of the former AMSF Site, Class GA Standards for PCE were exceeded in June and September 2013 in the three monitoring wells along the southern former AMSF Site property boundary. The western boundary of the CVOCs exceeding Class GA Standards has been established by monitoring wells ITT-SBW-4 and ITT-SBW-23 on the former RFM Site with concentrations less than Class GA Standards. The northern boundary on the former RFM Site is on the southern portion of the Cinemark property and is defined in the Eramosa formation by ITT-SBW-13, ITT-SBW-14, ITT-SBW-14 and ITT-SBW-16. North of the former RFM Site on the Cinemark property CVOC concentrations were reported as less than Class GA Standards in ITT-SBW-13 and ITT-SBW-16 for the June 2013 sampling event. Monitoring of wells on the Cinemark property north of the former AMSF property periodically are observed to have TCA concentrations that exceed Class GA Standards and appear to be related to recharge events pushing groundwater from around recharge well AMSF-RW-2 to this location. When transient recharge conditions return to non-recharge conditions, TCA concentrations in monitoring wells on the Cinemark property decrease to below Class GA Standards.

PCE Class GA Standard exceedances on the former AMSF Site appear to be related to higher PCE concentrations reported in groundwater in and around the location of a former degreaser and associated drains (AMSF-AOC-1), floor drains in AMSF-AOC-3, and various sanitary sewer lines and a former drainage swale that existed prior to a building expansion that took place on the former AMSF Site in 1979. PCE distributions in groundwater on the former AMSF Site clearly identify separate sources of PCE in groundwater. Historically, TCE and PCE concentrations in Eramosa groundwater monitoring wells located in the northwest corner of the former ASMF Site were at least one order of magnitude higher in concentration than in Eramosa monitoring wells located on the northeast corner of the former RFM Site. Based on the most recent groundwater sampling event on the former RFM Site (O'Brien and Gere 2014a) and on the former AMSF Site (Stantec 2015), PCE concentrations in Eramosa groundwater monitoring wells located in the northwest corner of the former ASMF Site are currently at least an order of magnitude higher than on the former RFM Site. Based on this most recent sampling, TCE concentrations in the northwest corner of the former AMSF Site are a factor of four times greater than on the former RFM Site.

In addition to the CSM figures presented in the RFM RIR, a transect was developed to further interpret the source of TCA in the area of the northwest corner of the former AMSF Site and the northeast corner of the former RFM Site using historic and more recent maximum TCA groundwater monitoring data. The transect was developed extending from recharge well AMSF-RW-2 through AMSF-MW-7 on the former AMSF Site and through ITT-SBW-2, ITT-SBW-3, ITT-SBW-9 and ITT-SBW-10 on the former RFM Site. Each of these monitoring wells is screened in the Eramosa formation at elevations that bisect the highest bedrock matrix TCA concentrations in ITT-IBW-20 and AMSF-MW-17MP. The distance from AMSF-RW-2 to ITT-SBW-10 is approximately 237 ft. Examination of **Figure 3-6**a in the CSM clearly indicates the highest TCA concentration on the former AMSF Site, with concentrations exponentially decaying on the former RFM Site. Similarly, the same transect was used to plot the most recent, highest TCA concentrations observed in these monitoring wells (from 2013 and 2014 sampling events). From examination of **Figure 3-6b** in the CSM it is evident that the same trend of highest concentrations of TCA on the former AMSF Site and steadily decreasing TCA concentrations on the former RFM Site still exists in the most recent sampling conducted in the RI Study Area as historically existed. Classic injection well hydraulics with radial flow predict chemical compound concentration decaying relationships to be exponential with respect to radial distance away from the injection well. This type of exponential relationship indicates that the shallow bedrock area around AMSF-RW-2 is the primary source of TCA in groundwater in the northwest corner of the former ASMF Site and in the northeast corner of the former RFM Site. Despite the long 24 year time period since many of the maximum TCA concentrations were recorded in groundwater monitoring wells along this transect, a similar TCA concentration decline with respect to distance was observed when using the highest TCA concentrations from the 2013 and 2014 sampling events.

As discussed in **Sections 3.4.3** and **3.4.4** the rapid attenuation of TCA concentrations downgradient reflects a variety of attenuation processes including sorption, degradation, dispersion, and diffusion into the bedrock matrix. RI data have documented that bedrock matrix diffusion is a key natural attenuation process. As TCA migrates downgradient in the groundwater, matrix diffusion acts to remove TCA from the groundwater and naturally attenuate the TCA migration. The attenuation capacity of the bedrock matrix appears to cause the observed rapid downgradient attenuation of bedrock groundwater TCA concentrations, has limited the horizontal extent of downgradient TCA migration, and will continue to retard the downgradient migration of the

TCA concentrations, thus providing the equivalent of hydraulic control for the purposes of containment of TCA and other CVOCs in the bedrock groundwater. TCA that has diffused into the bedrock matrix can back diffuse from the matrix to the groundwater, thus contributing to concentrations of TCA in groundwater. The diffusion and back diffusion process was discussed in more detail in Section 3.4.3. The RI data are consistent with the TCA in the bedrock matrix contributing to the TCA in the bedrock groundwater through back diffusion.

During the RFM RI, vapor intrusion was investigated in the RI Study Area beginning in 2004 through December 2009 followed by sampling associated with implementation of an IRM ISMP through the latest activity to date during the 2014-2015 Heating Season. Sub-slab soil VOC vapor concentrations, based on sampling event that took place in 2004 or earlier, are present under the former RFM building. The source of these sub-slab concentrations may be the remaining impacted soils under the building and VOCs in the shallow bedrock groundwater. Again, based on sampling events conducted in 2004, sub-slab TCA vapor concentrations under the former RFM building are highest under the northern portion of the building, where soils containing VOCs are present. Vapor intrusion sampling of the former RFM building indicates that the building indoor air has been impacted by the sub-slab vapors. NYSDEC requested the completion of an IRM in the building prior to any re-occupancy of the building; however, the building has remained vacant since 2003 and was demolished and removed in November/December 2015, therefore, no IRM has been completed to date.

Vapor intrusion data from the Batesville building, located to the west of the former RFM Site, and the Cinemark property, located to the north of the former RFM Site, indicate that vapor intrusion is not an issue for these buildings.

Sub-slab VOC vapor concentrations were detected under the former AMSF building, located to the east of the former RFM Site. VOC concentrations are highest under the northern half of the former AMSF building with TCA and PCE representing the VOCs with the highest concentrations. PCE was detected at the highest concentration of any CVOC in sub-slab vapor at AMSF-19 (in the southeast portion of the former AMSF building) at a concentration of 1,400,000 μg/m^3. High concentrations of TCA were also found at this location and at AMSF-16 (in the southwest portion of the former AMSF building).

As a result of the vapor intrusion sampling results collected by ITT in the former AMSF building, NYSDEC required that MFP initiate a remedial investigation on that property, which they did under the NYSDEC BCP. As part of the AMSF RI, MFP conducted sub-slab, indoor air and ambient sampling at the former AMSF Site.

Results of the vapor intrusion sampling conducted during the RFM RI, as part of the IRM ISMP, and during the AMSF RI have consistently shown that vapors do not appear to be migrating preferentially, but via typical diffusion away from the source locations, supporting the conclusion that TCA vapors are sourced at four separate locations under the former AMSF building and not from the former RFM Site.

3.8. REMAINING VOLUMES OF IMPACTED MEDIA

Volumes and areas of unconsolidated overburden deposits and groundwater to be addressed in this FS were estimated based on Site conditions and the nature and extent of impacted soil. As described in **Section 3.5**, an excavation took place in 1999 immediately north of the former RFM building (1999 RFM Soil Remediation Area) that resulted in the removal of 968 tons of VOC impacted soil. The focus of this FS is the remaining soil and impacted groundwater on the RFM Site, as described in **Section 3.7**. The location and extent of the impacted media that remains is discussed below.

3.8.1 Unconsolidated Overburden Deposits

The former RFM Site consists of an area of approximately 3 acres. The thickness of unconsolidated overburden deposits across the Site ranges from approximately 6.5 to 14.5 ft in thickness. As described in **Section 3.4**, while soil samples from areas outside of the 1999 RFM Soil Remediation Area footprint exhibited concentrations below the Industrial Use and Commercial Use SCOs, some samples exhibited concentrations above the Protection of Groundwater SCOs and for Unrestricted Use SCOs. These exceedances correspond to the following areas:

- Soils exceeding the Protection of Groundwater SCOs were observed below the existing building footprint and at one location along the northern property boundary. The largest area of remaining impacted overburden soils coincides with AOC 2, 3 and 7 areas directly south of the 1999 excavation area and measures approximately 2,100 square feet. Six remaining discrete areas, three in the southern building area, one in the southern lawn area, one in the southern parking lot area, and one at the northern property boundary, measure a total of approximately 200 square feet. Based on the overburden thickness, approximately 2,265 cubic yards of overburden soils exceed the Protection of Groundwater SCOs.

- Soils exceeding Commercial SCOs were observed in the shallow overburden in the southern lawn area and in the southern parking lot area. This area measures approximately 400 square feet and totals approximately 14 cubic yards.
- For purposes of evaluating a Pre-Disposal condition for soil in accordance with DER-10, soils exceeding Unrestricted Use SCOs are observed in generally the same areas as described above but to greater lateral extents. Based on the overburden thickness, approximately 4,550 cubic yards of overburden soils exceed the Unrestricted Use SCOs.

For purposes of the estimation of areas of impacted soil, in general, the lateral extents reflect a distance of halfway between a sample exhibiting an exceedance and one that does not. In the absence of nearby samples, a distance of 10 ft around a sample location has been used in the above estimates.

3.8.2 Bedrock Groundwater

Groundwater occurring in the bedrock units on Site exceeds Class GA standards for Site COCs to the north and east and extends to approximately 110 feet below grade, as described in **Section 3.7**. Concentrations of COCs associated with the former RFM Site in the deepest (110 ft below grade) Site wells are only slightly elevated above Class GA standards. Concentrations of COCs associated with the former RFM Site in on-Site intermediate (44.5 feet below grade) and shallow wells (26 feet below grade and shallower) represent the majority of impacted groundwater.

On-site impacted groundwater exceeding Class GA standards up to a depth of 110 feet below grade is approximately 2.4 million gallons. On-site impacted groundwater exceeding Class GA standards up to 55 feet below grade, which represents the Eramosa Dolomite, is approximately 1.1 million gallons. For purposes of the estimation of volumes of groundwater, the areas of impacted groundwater have been estimated using the 2003 groundwater results and a bulk porosity of 2.2%.

4.0. REMEDIAL GOALS AND REMEDIAL ACTION OBJECTIVES

This section documents the development of remedial goals and RAOs for affected media at the Site. The RAOs were developed consistent with the *Guidance for Conducting Remedial Investigation and Feasibility Studies Under CERCLA* (Comprehensive Environmental Response, Compensation, and Liability Act; USEPA 1988) and DER-10 (NYSDEC 2010b), and the *RI/FS Work Plan* (O'Brien & Gere 2004). Site-specific conditions that present technical limitations to remediation are also presented in this section.

4.1. POTENTIALLY APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARS)

As part of the development of RAOs, potential ARARs were identified for the Site. There are three types of ARARs: chemical-, location-, and action-specific. Chemical-specific ARARs are health- or risk-based numerical values or methodologies which, when applied to site-specific conditions, result in the establishment of numerical values. These values establish the acceptable amount or concentration of a chemical that may be found in, or discharged to the ambient environment. Location-specific ARARs set restrictions on activities based on the characteristics of the facility or immediate environs. Action-specific ARARs set controls or restrictions on particular types of remedial actions once the remedial actions have been identified as part of a remedial alternative. The identification of potential ARARs is documented in **Table 4-1**.

4.2 REMEDIAL GOALS

In consideration of New York Codes, Rules, and Regulations (NYCRR) Part 375-2.8 (NYSDEC 2006), remedial goals for remedial action at a site should include the following:

- Restore the site to pre-disposal/pre-release conditions, to the extent feasible
- Eliminate or mitigate significant threats to public health and the environment through proper application of scientific and engineering principles
- Remove sources of contamination to the extent feasible

The term feasible is defined in NYCRR Part 375 -1.2 (NYSDEC 2006) as suitable to site conditions, capable of being successfully carried out with available technology, implementable and cost-effective.

4.3 REMEDIAL ACTION OBJECTIVES

RAOs are medium-specific goals for protecting human health and the environment. RAOs form the basis for the FS by providing site-specific goals for site remediation. The RAOs are considered during the identification of appropriate remedial technologies, development of alternatives for the Site, and later during the evaluation of remedial alternatives.

Consistent with the USEPA's *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA* (USEPA 1988) and NYSDEC's DER-10 (NYSDEC 2010a), the development of RAOs is based on engineering judgment, risk-based information, and the nature and extent of constituents exceeding potentially applicable ARARs. In addition, consistent with DER-10, the current, intended and anticipated future land use at the Site and its surroundings is considered in the identification of RAOs.

RAOs for the former RFM Site are described in the following sections.

4.3.1 Soil

Based on the current zoning for the former RFM Site and a DCR (Monroe, 2004) that stipulates industrial land use, it is reasonable to anticipate that the Site will continue to be used for industrial purposes. Constituents detected in soil during the RI were below Industrial Use SCOs and Commercial Use SCOs. In addition, no unacceptable risks were identified for current or future receptors potentially exposed via ingestion, dermal contact, and ambient air inhalation to COCs in soil at the RFM Site. Given the developed nature of the Site and the adjacent properties, no ecological receptors were identified and ecological pathways are considered incomplete. As such, RAOs for the protection of human health and ecological receptors have not been identified for soil at the Site.

Isolated detections of TCA, 1,1-DCE, acetone, and 1,4-dioxane exceeded the Protection of Groundwater SCOs. At the north end of the former RFM building, such exceedances have been detected in soils extending down to the top of bedrock. Bedrock groundwater in the vicinity and downgradient of these soils suggest that the subsurface soil may have a limited impact on bedrock groundwater quality.

Based on these findings, the following RAO for environmental protection has been identified for impacted Site soil:

- Prevent, to the extent necessary and practicable, migration of contaminants in soil that would result in exceedances of Class GA standards.

4.3.2 Bedrock Groundwater

Potentially unacceptable risks to human health were identified related to exposures to groundwater, and groundwater concentrations exhibit exceedances to Class GA standards. Therefore, the following groundwater RAOs for protection of human health were selected:

- Prevent, to the extent necessary and practicable, unacceptable risks to human health associated with ingestion and direct exposure with untreated bedrock groundwater.
- Prevent, to the extent necessary and practicable, unacceptable risks to human health associated with inhalation of VOCs in untreated bedrock groundwater.

The following groundwater RAO was selected for protection of the environment:

- Restore bedrock groundwater to pre-disposal/pre-release conditions, to the extent necessary and practicable.

There are no known receptors of CVOCs in groundwater.

4.3.3 Indoor Air/Sub-slab Soil Vapor

Based on the NYSDOH Guidance matrices and the TCA, DCA, PCE, 1,1-DCE and TCE concentrations detected in the sub-slab soil vapor and indoor air vapors, the following RAO for protection of public health was selected for indoor air/sub-slab soil vapor, in the event that a new building is constructed. It should be noted that the former RFM building was demolished and removed in November/December 2015.

- Mitigate, to the extent necessary and practicable, impacts to public health resulting from the potential for soil vapor intrusion in the event that a new building is constructed.

4.4. PHYSICAL AND TECHNICAL LIMITATIONS TO REMEDIATION

Site conditions limit the alternatives available for remediation of the Site. Specifically, the presence of fractured sedimentary bedrock, the associated bedrock matrix diffusion of CVOCs that has been documented at the Site, and the documented groundwater flow in Site fractured bedrock are conditions that limit the technical practicability of subsurface remediation technologies at this Site. In addition, physical and technical limitations on active remediation processes for the treatment of bedrock groundwater exist at the Site because the vast majority of the CVOC mass in the bedrock system has diffused into and is stored, either in a dissolved or sorbed state, in the primary porosity of the bedrock matrix. Once stored in the primary porosity of the bedrock matrix, removal of CVOCs by active engineered treatment processes has been demonstrated to be largely ineffective because of the inability of existing active remediation technologies to access CVOCs that have diffused into the bedrock matrix. Given these limitations, it is anticipated that it is technically impractical to restore bedrock groundwater to pre-disposal conditions using active remediation technologies in a timeframe that would be shorter than relying on the documented natural attenuation processes already operative in the Site groundwater. Below is a discussion of Site-specific conditions as they relate to physical and technical limitations to remediation.

Bedrock Groundwater

An extensive literature review was presented in the RFM RIR on the scientific principles and methods used to collect rock core samples, analysis, interpretation and usability of the results, as well as use of bedrock matrix diffusion by federal and state regulators, including NYSDEC, in remedy decisions at fractured sedimentary bedrock sites. As such, the RFM RIR should be referenced regarding the details of the presentation in bedrock matrix diffusion. A summary of materials presented on bedrock matrix diffusion, relevant to this FS, is presented in the following sections.

Physical and technical limitations on active remediation processes for the treatment of bedrock groundwater exist at the Site because the vast majority of the CVOC mass in the bedrock system has diffused into and is stored, either in a dissolved or sorbed state, in the primary porosity of the bedrock matrix. Once stored in the primary porosity of the bedrock matrix, removal of CVOCs by active engineered treatment processes has been demonstrated to be largely ineffective because of the inability of existing active remediation technologies to access CVOCs that have diffused into the bedrock matrix. RI data indicate that matrix diffusion has occurred in the RI Study Area and therefore, has played a role in strongly attenuating and retarding the downgradient migration of CVOCs in the bedrock groundwater. Once present in the bedrock matrix, CVOCs must desorb and diffuse from the bedrock matrix into fracture groundwater for active remediation technologies to be effective. This “back diffusion” process is known to take a very, very long time (many decades). Back diffusion occurs when COC concentrations in groundwater in the bedrock fractures begin to decline, resulting in a reverse COC concentration gradient, from the matrix to the fracture. This reverse concentration gradient will cause the stored COCs in the matrix to diffuse from the matrix to the groundwater in the fracture. This back diffusion process has the ability to cause COC concentrations in fracture groundwater to last for a much longer time than if there were no COCs in the matrix.

Active remediation processes, such as chemical oxidation or reductive processes (either physical, chemical or biological), while potentially effective in permeable bedrock fractures are not able to penetrate into the bedrock matrix, because transport of the active remedial components into the bedrock matrix is also diffusion limited. As such, the diffusion of active remediation components from groundwater in permeable bedrock fractures into the rock matrix that contains the bulk of the CVOC mass would also take many decades, assuming the active remediation components could be sustained in the permeable bedrock fractures for that long of a time period. Additionally, in most cases the pore sizes of the bedrock matrix are too small to allow active transport of oxidation materials or bacterial cells from permeable bedrock fractures into the rock matrix pores. It can take decades for CVOC transport from permeable bedrock fractures to reach stabilized conditions with aqueous CVOC concentrations in the rock matrix pores. This forward diffusion occurs when CVOC concentrations are greater in the permeable rock fractures than in the bedrock matrix. After the forward diffusion process reaches equilibrium between CVOC concentrations in the permeable bedrock fracture and the pore water in the rock matrix, much longer periods of time are generally necessary for back diffusion of CVOCs from the rock matrix to groundwater in permeable bedrock fractures.

Thermal processes have the theoretical potential to increase the CVOC diffusion from the rock matrix by vaporizing the CVOCs, along with vaporizing pore water. The gas phase diffusion coefficient for TCA is approximately three orders of magnitude greater than the aqueous phase diffusion coefficient; therefore, theoretically the back diffusion process has the potential to be approximately three orders of magnitude faster when a gas phase is present than when an aqueous phase is present. Unfortunately, as presented in **Section 7.2** of this FS, it is technically impractical to implement bedrock heating when fracture apertures larger than approximately 0.020 inches are present. Because solution enlarged fractures in the Eramosa formation have apertures up to 4.4 inches, the inflow of groundwater through these enlarged fractures would prevent the bedrock matrix from reaching the boiling point of water, making heating of the bedrock not feasible and not implementable.

In fact, during development of Site-specific conceptual cost estimates, a thermal vendor was consulted. The vendor indicated that given the large size of the fractures, the magnitude of groundwater flow and its velocity at the Site, implementation of thermal treatment would result in excessive heat loss and subsequently the inability to create and sustain target heating levels sufficient for thermal treatment. Therefore, the vendor provided estimate assumed groundwater control (TRS 2016) (**Appendix B**). Because the fractures in the Eramosa formation are so large, it may not be feasible to temporarily seal the fractures sufficiently to prevent the inflow of groundwater that is commonly observed during attempts of thermal treatment in high permeability aquifers (permanent hydraulic control would result in undesirable groundwater pooling). Extraction, treatment and reinjection of partially heated groundwater are expected to be technically impracticable and prohibitively expensive given the very high flowrates of produced water. Further, groundwater extraction and reinjection would hydraulically behave similarly to currently existing recharge wells. Given the ability of existing recharge wells to accept and radially dissipate within 24 hours hundreds of thousands of gallons of runoff exemplifies the infeasibility of reinjecting treated partially heated groundwater back into the subsurface in an attempt to control the high groundwater inflow expected if thermal treatment of the highly fractured bedrock system was attempted.

Because of the nature of impacted groundwater in fractured sedimentary bedrock, many state and federal regulatory agencies have determined it is technically impractical, given current remediation technologies, to apply active remediation technologies to reduce CVOCs in the bedrock matrix in a timeframe that is any shorter than is achievable though natural processes alone. This section will briefly summarize both technical and regulatory materials regarding the technical impracticability of active treatment to remediate bedrock groundwater at Sites in which bedrock matrix diffusion in sedimentary rock has been confirmed. The use of theoretical and experimental scientific work, field work and regulatory decisions regarding bedrock diffusion and its use at other sites impacted with CVOCs is directly applicable to the RFM Site and supports the conclusion made in this FS that it is technically impractical to apply active engineering remedial actions to return the bedrock groundwater to pre-release conditions in a timeframe any shorter than achievable through natural attenuation processes already active in the bedrock groundwater.

CVOC analysis of bedrock core samples conducted as part of the RFM RI confirmed that the bedrock matrix diffusion process was the controlling natural attenuation mechanism affecting the nature and extent of CVOCs in bedrock groundwater at the Site. Both physical and chemical processes associated with bedrock matrix diffusion control and retard groundwater COC migration and have resulted in stabilization of the extent of CVOCs in groundwater. In the absence of bedrock matrix diffusion processes, CVOCs would be expected to migrate further downgradient through hydraulically conductive solution-enlarged fractures. Bedrock matrix sampling and analysis was conducted during the RFM RI by a research team headed by Dr. Beth Parker of the University of Guelph to characterize the horizontal distribution and vertical extent of the impacts of CVOCs within the bedrock. Bedrock matrix analyses were also used to provide a better understanding of the distribution of the COC mass between groundwater in fractures and dissolved/sorbed CVOC mass in the bedrock matrix. The rock core concentration profiles helped to spatially identify solution enlarged fractures, in which active COC transport occurs in the bedrock. Results of the bedrock matrix rock core testing and analysis during the RFM RI enabled several conclusions to be made, including these listed below:

- Rock core results suggest any DNAPL phase that may have been present (none has been observed at the Site) appears to have been depleted due to combined effects of dissolution in groundwater flowing in fractures and diffusion into the rock matrix;
- The majority of CVOC mass now occurs in the rock matrix as dissolved and sorbed phase, and this transfer of CVOC mass from mobile to immobile zones is expected to have caused strong attenuation of CVOC transport (which has been observed at the Site);
- Preliminary modeling suggests the extent of TCA invasion into the matrix off fractures would be relatively limited, likely less than a foot over the decades since releases occurred, due to high matrix sorption given relatively high organic carbon content; however, mass storage in the matrix as dissolved/sorbed phase is still large with the majority of the mass expected to occur in the sorbed phase;
- Slow back diffusion of CVOC mass from the rock matrix back to groundwater flowing into fractures appears to be occurring at and near the site.

Regulatory Decisions using Bedrock Matrix Diffusion at Sites in New York State

Sampling and chemical constituent analysis of sedimentary rock cores to determine the concentration of CVOCs diffused into the bedrock matrix has been conducted under the regulatory oversight of many state and federal agencies, including in New York. During the past 15 years, regulatory use of bedrock core matrix sampling and analysis, as well as regulatory decisions, have been increasingly made by the USEPA and many state agencies incorporating these now standardized and well established methods for CVOC analysis of rock core, conceived and developed by Dr. Beth Parker (during her academic career since 1996) and colleagues, specifically for hard rock. CVOC rock core analyses, used in conjunction with other physical and chemical bedrock characteristics, have also been used to model the effects of CVOCs diffused into the rock matrix. These include the natural attenuation of CVOCs affecting their fate and transport in groundwater at contaminated sedimentary bedrock sites, impacts of back diffusion on groundwater impacts over long periods of time and the potential impacts of various proposed and actual remediation treatments on groundwater impacted by CVOCs.

The use of CVOC rock core analyses and associated impacts of CVOC diffusion into the bedrock matrix have been key elements enabling vastly improved CSMs to be developed at many sedimentary bedrock sites impacted by CVOCs throughout the U.S. This past work is directly applicable to the conditions that exist in the bedrock groundwater at the former RFM Site. Most importantly, these analyses have been used as a pivotal tool in regulatory decision-making in several states and under various federal regulatory programs, specifically in the past 15 years. These include regulatory decisions under the Resource Conservation and Recovery Act (RCRA) and CERCLA, for both state and federal lead sites, as well as within divisions at NYSDEC, including the New York State Inactive Hazardous Waste Disposal Site Remedial Program (known as the State Superfund Program) and the Division of Environmental Remediation. At sites where bedrock matrix diffusion of COCs has been demonstrated to be the predominant natural attenuation mechanism, typically the extent of groundwater transport of COCs has been greatly limited, in comparison to sites where matrix diffusion does not affect COC transport.

As presented below in this summary, regulatory decisions made by NYSDEC on sites with CVOCs present in fractured sedimentary rock have been based on natural attenuation of these compounds. Bedrock matrix diffusion and associated long-term back diffusion as the controlling natural processes that limit the ability of active treatment remedies to achieve unrestricted groundwater use in less than 30 years is a common theme in the selection of remedies at these sites. Additionally, it is also recognized that there will be exceedances of groundwater ARARs for some time after remedy implementation for active treatment alternatives because of difficulties presented by fractured bedrock conditions and the rate limiting effects posed by bedrock matrix diffusion.

The following is a summary of regulatory decisions and key factors used in decision making in selected sites in New York, as well as other USEPA Region II Sites.

1) **Scobell Chemical New York State Department of Transportation (NYSDOT) Operable Units (OUs) 1 and 2, Rochester, Monroe County, NY** – A proposed Record of Decision (ROD) Amendment was presented by NYSDEC in February 2013 (NYSDEC, 2013). A former chemical repackaging company operated at this location from the 1920s until 1986. It is stated in the Proposed ROD Amendment that the presence of DNAPL within the fracture zones (porous dolostone) of the Rockport Group) and TCE mass within the bedrock matrix will act as a continuing source of groundwater impacts. This is evidenced by steady state TCE concentrations in groundwater measured between 1998 and 2012. In this document it is stated: "An unrestricted use remedy for this site would be cost prohibited and is not achievable considering the contaminant mass that is diffused into the bedrock matrix……Such restrictions would likely have been required under the original remedies as well given the quantity of DNAPL in bedrock and the contaminant mass diffused in the bedrock matrix, which makes cleanup of the site to unrestricted conditions impractical." The original ROD for OU-2 of this site was issued by NYSDEC on March 31, 2002, in which the selected remedy included: in-situ thermal treatment for the off-site source area; in-situ treatment (flushing of contaminants or in-situ chemical oxidation) in the shallow bedrock under the railroad tracks; a limited downgradient groundwater extraction and treatment system (or bioremediation); and long-term monitoring. "The selected remedial actions for

the two operable units were not implemented. The primary selected remedy for OU2 (in-situ thermal) was also the selected remedy for a nearby site (Chemical Sales Facility) that required a ROD amendment due to excessive costs to implement." As a result of the proposed ROD amendment in February 2013 this high cost, as well as the time that has passed since the original ROD documents were signed and additional information collected in a 2012 supplemental investigation, it was determined that the selected remedies needed to be reassessed. Since the issuance of the FS and ROD documents for both OU1 and OU2, new information about the site had been obtained. In particular, additional information related to changes in the nature, areal extent, and contaminant concentrations in bedrock in OU1 and OU2 suggested potential issues with the implementation and overall cost for the selected remedy. NYSDEC determined in the 2013 ROD amendment that: "the additional cost for the thermal treatment of soil and bedrock to allow for unrestricted use as specified in the 2002 OU2 ROD (i.e., steam) is prohibitive."

2) **Watervliet Arsenal, Broadway, Watervliet, NY** – In August 2012, NYSDEC published a Statement of Basis for the Watervliet Arsenal (NYSDEC, 2012) in which the role of matrix diffusion in the fate and transport of CVOCs at this site was presented with respect to remedial action decision making, as follows: "Based on the results of the ICM [a permanganate Interim Corrective Measure injection with a capital cost of $2.13 million] and subsequent technology review, the Department has determined that achievement of the CAO [Class GA Standards] for the Building 40 bedrock groundwater is not technically feasible using currently available technologies. It is therefore recommended that No Further Action beyond natural attenuation, documented through long-term groundwater monitoring, be selected as the final corrective measure for the Building 40 bedrock groundwater…"

   Notable use of the rock core method was also reported in an *Environmental Security Technology Certification Program* (ESTCP) *Report* on the Watervliet Arsenal, a 140 acre government owned facility in Watervliet, NY (Kavanaugh 2011). The report was prepared by Malcolm Pirnie, Inc., in cooperation with John Cherry, Beth Parker, the United States Geological Survey (USGS) and the U.S. Army Corps of Engineers. As part of this ESTCP study, permanganate was used in both laboratory and at full-scale tests to evaluate In Situ Chemical Oxidation (ISCO) treatment of the PCE and TCE in the rock matrix at this site. Conclusions from the lab permanganate invasion testing showed that after 24 months, permanganate had only penetrated the shale matrix to a distance of approximately 120 to 150 micrometers (µm). The short distance of penetration is attributable to the rapid reduction of MnO4 by reaction with minerals and organic carbon in the shale, which results in precipitation of the manganese oxide reaction product. Full-scale test results comparing rock core analyses before and after three years of permanganate treatment indicate little effectiveness and that no substantial remediation was accomplished in treating PCE and TCE the bedrock matrix.

3) **Kodak Park Site, (current NYSDEC Registry Site) Eastman Kodak Company, 343 State Street, Rochester, NY –** In September 2005, NYSDEC executed RCRA Documentation for Environmental Indicator Determination for EI RCRIS code (CA750) Migration of Contaminated Groundwater Under Control at the Kodak Park Site, Rochester, NY (NYSDEC, 2005a). In this document a determination was made that the migration of "contaminated" groundwater has stabilized, and that monitoring will be conducted to confirm that impacted groundwater remains within the original "area of contaminated groundwater." In this document it is stated: "Contaminant migration within the bedrock at Kodak Park appears to be strongly attenuated…..Investigations at Kodak Park have shown that significant contaminant mass has diffused into the rock matrix (S.S. Papadopulos & Associates 1995), where it resides in immobile pore water, within the primary porosity of the rock (Parker, et al. 1994). ..In some areas of Kodak Park, groundwater monitoring has been conducted for approximately 20 years, with results showing no significant movement of a number of plumes. This is an indication that matrix diffusion and other attenuation mechanisms are strongly retarding contaminant migration at Kodak Park….While these mechanisms provide the benefit of reducing loadings/contaminant fluxes to potential receptors such as surface water bodies, they complicate and hinder efforts to remove contaminant mass from the environment."

4) **Kodak Park Site, (current NYSDEC Registry Site) Eastman Kodak Company Eastman Business Park – South Rochester, NY** – In March 2014, NYSDEC issued a Statement of Basis Final Corrective Measures Selection for the Eastman Kodak Company, Eastman Business Park – South Former Kodak Building 514 Investigation Area, DEC Site No. 828177, Town of Greece, Rochester, Monroe County, NY (NYSDEC 2014a). In the balancing criteria analysis, the NYSDEC states: "All three alternatives are expected to provide similar levels of long-term effectiveness after implementation. Residual groundwater concentrations are expected to continue to exceed the ARARs for some time after remedy implementation for all of the alternatives because of difficulties presented by fractured bedrock conditions and the rate limiting effects posed by bedrock matrix diffusion. Due to these site conditions, the time to achieve the ARARs for groundwater is expected to be comparable for all alternatives." The alternatives evaluated by NYSDEC in the Corrective Measures Selection were as follows: Alternative 1 – Groundwater Monitoring and Assessment with Institutional Controls, Alternative 2 –In-situ Nano-scale Zero Valent Iron Groundwater Treatment, and Alternative 3 – Groundwater Extraction and On-Site Treatment.

5) **Bell Aerospace Textron (Textron Realty Operations) NYSDEC Registry Site, Wheatfield, NY –** In 1999 NYSDEC published a *RCRA Corrective Action Environmental Indicator Migration of Contaminated Groundwater Under Control Report* for the Bell Aerospace Textron Site, Wheatfield, NY (NYSDEC, 1999a). As part of the Migration of Contaminated Groundwater Control report, it is concluded that migration of the chlorinated ethenes in the groundwater has stabilized and is expected to remain within the "existing area of contaminated groundwater." In this report it is stated, "These results indicate that diffusion of chlorinated ethenes from the rock matrix could provide a continuing source of contaminants at the site…. Simulation of sorption and diffusion had little effect on the computed concentration distributions, but simulation of TCE diffusion within the rock matrix above and below the fracture zone indicated little change in the computed concentrations after 5 years of pump-and-treat remediation; this suggests that diffusion of chlorinated ethenes from the rock matrix could provide a continuing source of these contaminants at the site."

6) **Former Doro Dry Cleaners State Superfund Project Cheektowaga, Erie County Site No. 915238** – In March 2014 NYSDEC issued a ROD for this site that included PCE in Onondaga Limestone bedrock groundwater (NYSDEC 2014b). The selected remedy relies on natural processes in the distant portions of the groundwater plume and will require a significant time period to meet ARARs and long term monitoring is required to ensure that toxicity, mobility, and volume do not increase over time. The selected remedy at this site was the Limited Excavation Alternative removing contaminated, unsaturated soils from the upper portions of the two, outdoor target remediation zones and replacing that material with clean soils mixed with chemical agents to treat the contamination remaining in the soils and groundwater below.

7) **DuPont/NECCO Park Superfund Site, Niagara Falls, NY** – In September 1998, a ROD was signed by USEPA Region II for the DuPont/NECCO Park Superfund Site. As part of the ROD, it is stated that (USEPA Region II, 1998):

   "Remediation of the DNAPL contaminated soils, bedrock and groundwater in the Source Area of the Necco Park Site is considered to be technically impracticable from an engineering perspective. The EPA has determined that, in the source area, groundwater restoration to drinking-water quality is a technical impracticability and suggested that it may well be impracticable for the plume as well. Recent research by Ms. Beth Parker at UW and field application of that research has indicated that matrix diffusion can be a significant process at fractured bedrock sites with DNAPL-type contaminants, in both the aqueous and non aqueous phases, and is an important consideration in remediation of such sites (Parker et al. 1994). Based on the contaminant concentrations in the far-field plume and the potential for diffusion of constituents from the aquifer matrix to act as a continuing source of contamination, DuPont believes that restoration of the far-field aquifer cannot be accomplished (as the EPA has noted) within a reasonable time frame, regardless of the remedial alternative, that is implemented."

8) **Shenandoah Road Groundwater Contamination Superfund Site, East Fishkill, NY -** In August and September 2012, respectively USEPA Region II published the Proposed Plan and ROD for this site (USEPA Region II, 2012c and 2012d). Dr. Parker's group (then at the University of Waterloo) conducted rock core VOC analyses on continuous core from this site in 2005 providing a report to Ground Water Sciences Corporation (the site consultants) in 2006. The ROD cites in the discussion of the effects of matrix diffusion that, "is determined by the anticipated future effects of secondary sourcing, *i.e.*, from mass diffused into the matrix of the rock or adsorbed onto aquifer solids, the time to attain groundwater standards in this aquifer cannot be accelerated by any technology that could be applied to this aquifer in this setting."

9) **Cayuga County Groundwater Contamination Superfund Site, Cayuga County, NY** – USEPA Region II published the Proposed Plan and the ROD for this site in July 2012 and March 2013, respectively (USEPA Region II, 2012e and 2013). Matrix diffusion modeling was conducted at this site using data collected by USEPA and General Electric Company to assess the VOC mass present within the pore space of the rock itself. The results of this modeling analysis presented in both the Proposed Plan and ROD support the use of a 30-year timeframe to remediate groundwater, although it was concluded that remediation timeframes could exceed this estimate. In the response to comments section of the ROD, it is stated, "Since a portion of the contamination is expected to be diffused into the bedrock matrix due to matrix diffusion, treatment effectiveness with ISCO would be very limited because contact between the ISCO agent and the diffused mass is necessary for treatment. If an insufficient amount of oxidant is added or if there is insufficient contact between the oxidant and the contaminant, this process option could result in the release of contaminants trapped in the adsorbed phase into the dissolved phase, increasing the size of the contaminant plume….Therefore, use of ISCO could impair the natural attenuation processes that are already active in areas of the site. For these reasons, ISCO would be ineffective or highly inefficient and was not retained for further evaluation after initial consideration during the screening of alternatives process of the FS."

In summary, the theoretical and experimental scientific basis for documenting the effects of bedrock matrix diffusion on the fate, transport, nature and extent of CVOCs at fractured sedimentary bedrock groundwater sites is well established and accepted by the scientific community. The collection and analysis of rock cores for CVOC analysis is well established and has been accepted by the scientific community and many state and federal regulatory agencies, including NYSDEC. The use of rock matrix CVOC data and the process of bedrock matrix diffusion and associated back diffusion of CVOCs from the primary porosity of the rock matrix into permeable sedimentary rock fractures has been accepted and used in regulatory decisions regarding the analysis and selection of remedies at many sites. The above scientific and regulatory use of the bedrock matrix diffusion processes in screening, analyzing and selecting remedial actions at sites is directly applicable to this FS and remedial alternatives and selection at the former RFM Site. Based on the above scientific basis and the above cited regulatory decisions made at sites in NYS and given that the bulk of the CVOC mass at the RFM Site in the bedrock system is bound in the bedrock matrix, it is evident that it is technically impractical to restore bedrock groundwater to pre-disposal conditions using active remediation technologies in a timeframe that would be shorter than relying on the documented natural attenuation processes already operative in the Site groundwater.

5.0. GENERAL RESPONSE ACTIONS

General response actions (GRAs) are medium-specific types of actions which may, either alone or in combination, form alternatives to address the RAOs. GRAs were identified to address soil, bedrock groundwater, and indoor air/sub-slab soil vapor as presented in the following sections.

5.1 SOIL

GRAs identified for soil, based on the RAOs, are summarized as follows:

- ***No further action.*** No further action must be considered in the FS, as specified in the National Oil and Hazardous Substances Contingency Plan (NCP) [40 Code of Federal Regulations (CFR) Part 300.430] and NYSDEC DER-10 Section 4.4(b)3 (NYSDEC 2010). This GRA also considers the 1999 RFM Soil Remediation Area and the existing environmental easement/deed restrictions that provide use restrictions.
- ***Institutional controls/limited actions.*** Actions that provide site access and use restrictions, provisions for continued operation of the remedy, monitoring of remedy effectiveness, and periodic site reviews.
- ***Natural recovery actions.*** Actions that rely on natural processes to attenuate CVOCs *in situ* by physical, chemical and/or biological processes.
- ***Containment actions.*** Actions that contain or minimize contact with soil.
- ***In situ treatment actions.*** Actions that treat impacted soil in place.
- ***In situ treatment enhancement.*** Actions that increase soil permeability and improve performance of some *in situ* treatment technologies.
- ***Removal actions.*** Actions that remove impacted soil by excavation.
- ***Ex situ treatment actions.*** Actions that treat impacted soil following excavation.
- ***Disposal actions.*** Actions that dispose of excavated soil in either an on-site containment system or an approved off-site disposal facility.

5.2 BEDROCK GROUNDWATER

GRAs identified for bedrock groundwater, based on the RAOs, are summarized as follows:

- ***No further action.*** No further action must be considered in the FS, as specified in the NCP [40 CFR Part 300.430] and NYSDEC DER-10 Section 4.4(b)3 (NYSDEC 2010). This GRA also considers previous implementation of existing environmental easement/deed restrictions that provide use restrictions.
- ***Institutional controls/limited actions.*** Actions that provide site access and use restrictions, provisions for an alternate water supply, a Site Management Plan, and periodic site reviews.
- ***Natural recovery actions.*** Actions that rely on natural processes to attenuate CVOCs *in situ* by physical, chemical and/or biological processes.
- ***Containment actions.*** Actions that contain impacted groundwater within the bedrock.
- ***In situ treatment actions.*** Actions that treat impacted groundwater in place.
- ***Collection/hydraulic control actions.*** Actions that collect and/or control groundwater in bedrock.
- ***Collection/hydraulic control enhancement actions.*** Actions that increase permeability and improve effectiveness in of groundwater collection/hydraulic control technologies.

5.3 INDOOR AIR/SUB-SLAB SOIL VAPOR

GRAs identified for indoor air/sub-slab soil vapor, based on the RAOs, are summarized as follows:

- ***No further action.*** No action must be considered in the FS, as specified in the NCP [40 CFR Part 300.430] and NYSDEC DER-10 Section 4.4(b)3 (NYSDEC 2010). This GRA also considers occupancy restrictions currently in place.

- ***Institutional controls/limited actions.*** Actions that provide for evaluation and mitigation of vapor intrusion for new structures on the former RFM Site, documentation of site restrictions, and periodic site reviews.
- ***Mitigation system.*** Actions that are taken to minimize exposures associated with soil vapor intrusion into an occupied building.

6.0 IDENTIFICATION AND SCREENING OF REMEDIAL TECHNOLOGIES

Potentially applicable remedial technology types and process options were identified for each GRA during this step. Technologies and process options were screened on the basis of technical implementability. Technical implementability for each identified process option was evaluated with respect to the type of impact, physical site characteristics, and areas and volumes of media identified in **Section 3.8**.

The identification of relevant remedial technologies and process options for soil, bedrock groundwater and indoor air/sub-slab soil vapor were based on engineering experience and a review of relevant literature and technology databases.

Descriptions of technologies and process options identified for the FS are presented in **Tables 6-1, 6-2, and 6-3**. Technologies and process options that were considered not applicable were not considered further in the FS. The remedial technologies and process options retained for further consideration are presented below. Since the former RFM building was demolished and removed in November/December 2015, active remedial technologies and process options to address indoor air/sub-slab soil vapor are not presented further in the FS.

- ***Soil***
  - No further action
  - Institutional controls/limited actions
    - Access restrictions (fencing)
    - Use restrictions/administrative controls (environmental easement/deed restrictions and Site Management Plan)
    - Alternate water supply (public water supply)
    - Periodic reviews
  - Natural recovery
    - Natural attenuation
  - Containment
    - Capping (*e.g.*, vegetative soil, asphalt and concrete surfaces)
    - Low permeability cover
  - *In situ* treatment
    - Physical/chemical treatment (passive soil venting, soil vapor extraction (SVE), chemical oxidation, flushing)
    - Biological treatment (enhanced bioremediation, enhanced biotic/abiotic degradation)
    - Thermal treatment (hot air/steam/hot water injection, soil heating, *in situ* vitrification)
  - *In situ* treatment enhancement
    - Permeability enhancement (pneumatic fracturing, hydraulic fracturing)
  - Removal
    - Excavation (mechanical excavation in addition to 1999 soil excavation)
  - *Ex situ* treatment
    - On-site physical/chemical treatment (solidification/stabilization, chemical oxidation, chemical dechlorination, extraction/washing)
    - On-site thermal treatment (incineration, low temperature thermal desorption, pyrolysis)
  - Disposal

    - Off-site treatment/disposal (commercial treatment/disposal facility)
    - Off-site disposal (commercial disposal facility)
    - On-site disposal (on-site consolidation)
- ***Bedrock groundwater***
  - No further action
  - Institutional controls/limited actions
    - Administrative controls (environmental easement/deed restrictions and Site Management Plan)
    - Alternate water supply (public water supply)
    - Monitoring (groundwater monitoring)
    - Periodic reviews
  - Natural recovery
    - Natural attenuation (natural attenuation)
  - Containment
    - Physical barrier wall (grout curtain)
  - *In situ* treatment
    - Physical/chemical treatment (circulation wells, flushing, air sparging, chemical oxidation)
    - Biological treatment (enhanced bioremediation, enhanced biotic/abiotic degradation)
    - Thermal treatment (hot air/steam/hot water injection, bedrock heating)
  - Collection/hydraulic control
    - Single phase extraction (vertical extraction/horizontal wells)
    - Dual-phase extraction (dual-phase extraction wells)
  - Collection/hydraulic control enhancement
    - Permeability enhancement (hydraulic fracturing)
- ***Indoor air/sub-slab soil vapor***
  - No further action
  - Institutional controls/limited actions
    - Administrative controls (environmental easement and Site Management Plan)

Remedial technologies and process options were evaluated further according to the criteria of effectiveness, implementability, and cost. The effectiveness criterion includes the evaluation of:

- Potential effectiveness of the process option in meeting the RAOs and handling the estimated lengths, areas and/or volumes of media summarized in **Section 3.6**;
- Potential effects on human health and the environment during implementation (including, as appropriate, construction and operation); and
- Reliability of the process options for site COCs and conditions.

Technical and institutional aspects of implementing the process options were assessed for the implementability criterion. The capital and operation and maintenance (O&M) costs of each process option were evaluated as to whether they were high, medium, or low relative to other process options of the same technology type.

Based on the evaluation, the more favorable process options of each technology type were chosen as representative process options. The selection of representative process options simplifies the development and evaluation of the alternatives, but does not eliminate other process options from consideration. The representative process option provides a basis for conceptual design during the FS, without limiting flexibility during the remedial design phase. An alternative process option may be selected during the remedial design phase as a result of design evaluations or testing (*e.g.,* the substitution of air stripping with chemical oxidation for water treatment). The evaluation of process options is presented in **Tables 6-4, 6-5, and 6-6**. A description of the selected representative process options for retained technologies is presented by GRA and technology for each medium in the following sections.

6.1 SOIL

Selected representative process options for retained technologies are presented, by GRA and technology for soil, as follows.

No Further Action

The no further action alternative must be considered in the FS, as required by the NCP (40 CFR Part 300.430) and NYSDEC DER-10 Section 4.4(b)3 (NYSDEC 2010). No remedial actions addressing CVOCs in soil would be conducted. No further action would be performed in addition to the 1999 soil removal and maintenance of existing deed restrictions that preclude the disturbance of soil at the Site without first obtaining approval from a Relevant Agency.

Institutional Controls/Limited Actions

Notice of fencing, environmental easement/deed restrictions, Site Management Plan, and periodic site reviews were identified as representative process options associated with the institutional controls/limited actions GRA for impacted soil.

- ***Fencing.*** Fencing and gates could be installed to limit unauthorized access to the property.
- ***Environmental easement/deed restrictions.*** Modifications to the environmental easement/deed restrictions would be necessary to comply with current NYSDEC policy.
- ***Site Management Plan.*** A Site Management Plan would document site institutional and engineering controls and any physical components of the selected remedy requiring monitoring and/or O&M to provide for continued effectiveness of the remedy. The Site Management Plan could also present provisions for periodic site reviews and requirements for annual NYSDEC required certification.
- ***Periodic site reviews.*** Periodic reviews are required by 6 NYCRR Part 375 (NYSDEC 2006) where institutional and engineering controls, monitoring and/or O&M activities are required at the Site. The purpose of the periodic review is to evaluate the Site remedy with regard to the continuing protection of human health and the environment and document remedy effectiveness. Periodic site reviews would include the performance of five year reviews in accordance with 40 CFR 300.430(f)(4)ii.

Natural Recovery

Natural attenuation was identified as a representative process option associated with the natural recovery GRA for soil. Natural attenuation utilizes naturally occurring *in situ* physical, chemical, and/or biological processes to degrade CVOCs in soil over time. Processes including biodegradation, sorption, dilution, volatilization, and/or transformation of COCs can reduce their toxicity, mobility, and/or volume.

Containment

An engineered cover consisting of vegetated soil, asphalt and/or the existing building slab was identified as a representative process option associated with the containment GRA. Vegetated soil, asphalt, and/or the existing building slab would provide overland drainage and minimize contact with soil.

In situ Treatment

SVE and soil heating were identified as representative process options associated with the *in situ* treatment GRA for impacted soil.

- ***Soil vapor extraction.*** SVE would use extraction wells to volatilize and remove CVOCs sorbed on the soil or dissolved in soil-pore water. Extracted vapors would then be treated *ex situ* as needed.
- ***Soil heating.*** Soil would be heated using various techniques to volatilize and remove organic CVOCs in soil. Extracted vapors would then be treated *ex situ* as needed.

Removal

Mechanical excavation was identified as a representative process option associated with the removal GRA. Mechanical excavation would be performed using construction equipment to remove impacted soil.

Disposal

Off-site disposal at a commercial disposal facility was identified as a representative process option associated with the disposal GRA. Excavated soil would be transported to a permitted commercial landfill, if it meets land disposal restriction requirements.

6.2 BEDROCK GROUNDWATER

Selected representative process options for retained technologies are presented, by GRA and technology for bedrock groundwater, as follows.

No Further Action

The no action alternative must be considered in the FS, as required by the NCP (40 CFR Part 300.430) and NYSDEC DER-10 Section 4.4(b)3 (NYSDEC 2010). No remedial actions addressing CVOCs in bedrock groundwater would be conducted. No further action would be performed in addition to maintenance of existing deed restrictions that restrict the use of groundwater at the Site without first obtaining approval from a Relevant Agency.

Institutional Controls/Limited Action

Environmental easement/deed restrictions, a Site Management Plan, use of a public water supply, groundwater monitoring, and periodic site reviews were identified as representative process options associated with the institutional controls/limited actions GRA for bedrock groundwater.

- ***Environmental easement/deed restrictions.*** Modifications to the environmental easement/deed restrictions would be necessary to comply with current NYSDEC policy.
- ***Site Management Plan.*** A Site Management Plan could document site institutional and engineering controls and any physical components of the selected remedy requiring monitoring and/or O&M to provide for continued effectiveness of the remedy. The Site Management Plan could also present provisions for periodic site reviews and requirements for annual NYSDEC required certification.
- ***Public water supply.*** Connection to a public water supply exists at the Site and the surrounding properties.
- ***Groundwater monitoring.*** Monitoring could involve periodic sampling and analysis of bedrock groundwater as a means of monitoring CVOC concentrations and remedy effectiveness.
- ***Periodic site reviews.*** Periodic reviews are required by 6 NYCRR Part 375 where institutional and engineering controls, monitoring and/or O&M activities are required at the Site. The purpose of the periodic review is to evaluate the Site with regard to the continuing protection of human health and the environment and document remedy effectiveness. Periodic site reviews would include the performance of five year reviews in accordance with 40 CFR 300.430(f)(4)ii.

Natural Recovery

Natural attenuation was identified as a representative process option associated with the natural recovery GRA for bedrock groundwater. Natural attenuation utilizes naturally occurring *in situ* physical, chemical, and/or biological processes to degrade organic constituents in the bedrock groundwater over time. Processes including biodegradation, sorption, dilution, dispersion, and/or transformation of COCs can reduce their toxicity, mobility, and/or volume (USEPA 1999).

In situ Treatment

Bedrock heating was identified as a representative process option associated with *in situ* treatment of bedrock groundwater. Thermal treatment by bedrock heating would use heating wells or electrical probes to increase the temperature of the bedrock and volatilize CVOCs in the bedrock matrix. Capture of volatilized constituents would be accomplished through use of an SVE system in the overburden to provide vapor phase control and/or treatment.

6.3 INDOOR AIR/SUB-SLAB SOIL VAPOR

Selected representative process options for retained technologies are presented, by GRA and technology for indoor air/sub-slab soil vapor as follows. As described above, the former RFM building was demolished and removed in November/December 2015, therefore, no mitigation system process options are further considered in this FS.

No Further Action

The no action alternative must be considered in the FS, as required by the NCP (40 CFR Part 300.430) and NYSDEC DER-10 Section 4.4(b)3 (NYSDEC 2010). No remedial actions addressing indoor air/sub-slab soil vapor would be conducted. No further action would be performed.

Institutional Controls/Limited Action

Environmental easements/deed restrictions and a Site Management Plan were identified as representative process options associated with the institutional controls/limited actions GRA for indoor air/sub-slab soil vapor.

- ***Environmental easement/deed restrictions.*** Modifications to the environmental easement/deed restrictions would be necessary to comply with current NYSDEC policy.
- ***Site Management Plan.*** A Site Management Plan would document site institutional and engineering controls and any physical components of the selected remedy requiring monitoring and/or O&M to provide for continued effectiveness of the remedy and it would provide for evaluation and mitigation of vapor intrusion if a new building(s) is constructed on the Site. The Site Management Plan could also present provisions for periodic site reviews and requirements for annual NYSDEC required certification.

7.0 DEVELOPMENT, SCREENING AND ANALYSIS OF REMEDIAL ALTERNATIVES

7.1 DEVELOPMENT OF REMEDIAL ALTERNATIVES

Remedial alternatives were developed by assembling general response actions and representative process options into combinations that address the RAOs. As discussed in the following subsections, five remedial alternatives were developed to address soil, bedrock groundwater and indoor air/sub-slab soil vapor. Remedial alternative components are summarized in **Table 7-1**. The five remedial alternatives are as follows:

- Alternative 1 is the no further action alternative. This alternative is required to be evaluated by the NCP (40 CFR Part 300.430) and serves as a benchmark for the evaluation of other alternatives.
- Alternative 2 includes natural attenuation of bedrock groundwater with monitoring, limited excavation of soils, maintenance of surface covers, a Site Management Plan, institutional controls and periodic reviews.
- Alternative 3 includes soil vapor extraction, limited excavation of soils, natural attenuation of bedrock groundwater with monitoring, a Site Management Plan, institutional controls and periodic reviews.
- Alternative 4 includes expanded excavation of soils, natural attenuation of bedrock groundwater with monitoring, a Site Management Plan, institutional controls and periodic reviews.
- Alternative 5 includes *in situ* thermal treatment to address impacted bedrock and select overburden soils on site, limited excavation of soils, a Site Management Plan, institutional controls and periodic reviews. This alternative is intended to evaluate restoration to pre-disposal conditions.

As described in **Section 3.2.2**, a recharge well, ITT-W-1, was previously in use at the former RFM property for the management of stormwater. The drain lines entering into the recharge well ITT-W-1 were sealed in November 2015. In addition, the former RFM building was demolished and removed from the Site in November/December 2015. A description of each alternative is included in the following subsections.

7.1.1 Alternative 1 – No Further Action

Alternative 1 is the no further action alternative, which is required by the NCP as a consideration and serves as a benchmark for comparison to other alternatives. This alternative provides for an assessment of the environmental conditions if no further remedial actions are implemented.

Under Alternative 1, the 1999 soil removal has been implemented, the existing environmental easement/deed restrictions would be left in place, and the existing public water source would continue to be used. Natural attenuation of CVOCs would also occur under this alternative, though no monitoring components are included to assess this attenuation.

Environmental Easement/Deed Restrictions

The existing environmental easement/deed restrictions would remain in effect under this alternative These restrictions preclude the disturbance of soil and the use of groundwater for potable or industrial use without approval from a Relevant Agency. Based on the assessment of land use described above in **Section 2.3**, the reasonably anticipated future land uses for the Site are industrial. The existing institutional controls reflect these Site uses.

Natural Attenuation

Natural attenuation mechanisms, including biodegradation, sorption, dilution, volatilization, transformation, and diffusion of CVOCs, would contribute to attenuation of CVOCs in soil and bedrock groundwater over time. Bedrock matrix diffusion has been documented to be the predominant natural attenuation mechanism resulting in stabilization of the extent of CVOC impacts. It is expected that CVOC concentrations in the soil and bedrock groundwater would continue to decline, thereby reducing the potential risk to human health, and eventually achieving SCOs and Class GA Standards. However, the lack of groundwater monitoring under this remedial alternative would not provide confirmation that the extent of CVOCs in groundwater continues to be stable and that natural attenuation processes continue to reduce CVOC concentrations at the Site.

7.1.2 Alternative 2 – Institutional Controls/Limited Soil Excavation/Containment/Natural Attenuation/Groundwater Monitoring

Alternative 2 consists of institutional controls, limited soil excavation, containment using surface covers as a cap and natural attenuation with groundwater monitoring, in addition to the previous 1999 soil removal. Alternative 2 would include maintenance of Site surface covers (*e.g.*, vegetative soil, asphalt and concrete surfaces), modifications to the environmental easement/deed restrictions to comply with current NYSDEC policy, natural attenuation with routine bedrock groundwater monitoring, Site Management Plan and periodic site reviews. The continued effectiveness of natural attenuation would be evaluated with the data obtained from groundwater monitoring. Additionally under Alternative 2, the Site surface water runoff recharge well ITT-W-1 would be abandoned (the drain lines leading to ITT-W-1 are currently sealed). The former RFM building has been removed and the building slab currently remains. The Site Management Plan would include provisions for evaluation of the need for and implementation of, if necessary, a means of soil vapor intrusion mitigation should a new building be constructed at the Site. The remedial components of Alternative 2 are described in this section. **Figure 7-1** depicts the components of this alternative.

Environmental Easement/Deed Restrictions

The existing environmental easement/deed restrictions would need to be modified to comply with current NYSDEC policy. In addition, use restrictions aimed at protection of the surface covers included in this alternative would be added. Based on the assessment of land use described above in **Section 2.3**, the reasonably anticipated future land uses for the Site are industrial. The existing institutional controls reflect these Site uses.

Natural Attenuation

Natural attenuation mechanisms including biodegradation, sorption, dilution, volatilization, transformation, and diffusion of CVOCs into the bedrock matrix would contribute to attenuation of CVOCs in soil and bedrock groundwater over time. Bedrock matrix diffusion has been documented to be the predominant natural attenuation mechanism resulting in stabilization of the extent of CVOC impacts. It is expected that CVOC concentrations in the soil and bedrock groundwater would continue to decline, thereby reducing the potential risk to human health, and eventually achieving SCOs and Class GA Standards.

Groundwater Monitoring

Groundwater monitoring would consist of monitoring of the bedrock groundwater unit both on-Site and off-Site. Groundwater monitoring provides a means for confirming that the extent of CVOCs in groundwater continues to be stable and that natural attenuation processes continue to reduce CVOC concentrations. It is conceptually envisioned that monitoring would occur at existing monitoring well locations, with new wells installed, if necessary. Groundwater samples collected under Alternative 2 would be analyzed for VOCs and CVOCs. The final monitoring program would be established during design.

Site Containment

Existing Site surfaces including vegetative soil, asphalt or concrete surfaces, would remain to provide a barrier from locations where impacted soils exceed Protection of Groundwater SCOs. Repairs to asphalt damage resulting from disconnection and sealing of the drain lines leading to recharge well ITT-W-1 on the former RFM Site during building demolition are included under this alternative. The existing low permeability areas (asphalt and building slab) cover those soils that exceed Protection of Groundwater SCOs; therefore, addressing interaction of infiltration with soils that exceed SCOs. Modification of existing Site surfaces would be managed under the Site Management Plan. Maintenance of the Site surfaces would be required by the environmental easement/deed restrictions for the Site.

Isolated Mechanical Excavation (vicinity of SS-8)

Excavation would consist of physical excavation of shallow overburden soils exceeding Commercial SCOs. The excavation would target soils in the southern lawn area (in the vicinity of SS-8) as shown on **Figure 7-1**. The excavation would extend approximately 1 ft in depth over 400 sq ft as shown on **Figure 7-1**. Restoration would consist of providing clean acceptable backfill, topsoil and reseeding to match surrounding lawn area.

Site Management Plan

A Site Management Plan would guide future activities at the Site by documenting institutional and engineering controls, defining the groundwater monitoring requirements and by developing requirements for periodic Site reviews, the implementation of required O&M activities for remedial elements, and future development on the Site. In addition, consistent with 6 NYCRR Part 375-1.8(h)(3) (NYSDEC 2006), annual certification of institutional and engineering controls would be required in the Site Management Plan. The Site Management Plan would also aid in developing the requirements and emplacement of a means for vapor intrusion mitigation, should a new building be constructed on the Site. Additionally, the Site Management Plan would include requirements to determine if soil vapor intrusion may be occurring at downgradient off-Site properties, if necessary, based on groundwater monitoring results.

Periodic Site Reviews

Periodic site reviews would be conducted in accordance with the Site Management Plan to evaluate the Site remedy with regard to continuing protection of human health and the environment as evidenced by information such as documentation of field inspections. 6 NYCRR Part 375-1.8(h)(3) (NYSDEC 2006) specifies that the frequency of periodic site reviews should be annual, unless a different frequency is approved by NYSDEC; therefore, it is assumed that annual reviews would be conducted at the Site. Because this alternative would result in COCs remaining above levels that allow for potential unrestricted exposure, CERCLA (USEPA 1988) requires that the Site be reviewed at least once every five years.

7.1.3 Alternative 3 – Institutional Controls/Limited Soil Excavation /*In-Situ* Soil Treatment/Natural Attenuation/Groundwater Monitoring

Alternative 3 consists of institutional controls, limited soil excavation, *in-situ* treatment and natural attenuation with groundwater monitoring, in addition to the previous 1999 soil removal. Alternative 3 would include maintenance of Site surface covers (*e.g.*, vegetative soil, asphalt and concrete surfaces) and modifications to the environmental easement/deed restrictions to comply with current NYSDEC policy. This alternative would also include installation of an SVE system to address soils exceeding Protection of Groundwater SCOs, soil excavation at two locations; in the north lawn area (near SB-10) and the south lawn area (near SS-8), natural attenuation with routine bedrock groundwater monitoring, Site Management Plan and periodic site reviews. The continued effectiveness of natural attenuation would be evaluated with the data obtained from groundwater monitoring. Additionally under Alternative 3, the Site surface water runoff recharge well ITT-W-1 would be abandoned (the drain lines leading to ITT-W-1 are currently sealed). The former RFM building has been removed and the building slab currently remains. The Site Management Plan would include provisions for evaluation of the need for and implementation of, if necessary, a means of soil vapor intrusion mitigation should a new building be constructed at the Site. The remedial components of Alternative 3 are described in this section. **Figure 7-2** depicts the components of this alternative.

Environmental Easement/Deed Restrictions

The existing environmental easement/deed restrictions would need to be modified to comply with current NYSDEC policy. Based on the assessment of land use described above in Section 2.3, the reasonably anticipated future land uses for the Site are industrial. The existing institutional controls reflect these Site uses.

Natural Attenuation

Natural attenuation mechanisms including biodegradation, sorption, dilution, volatilization, transformation, and diffusion of CVOCs into the bedrock matrix would contribute to attenuation of CVOCs in soil and bedrock groundwater over time. Bedrock matrix diffusion has been documented to be the predominant natural attenuation mechanism resulting in stabilization of the extent of CVOC impacts. It is expected that CVOC concentrations in the soil and bedrock groundwater would continue to decline, thereby reducing the potential risk to human health, and eventually achieving SCOs and Class GA Standards.

Groundwater Monitoring

Groundwater monitoring would consist of monitoring of the bedrock groundwater unit both on-Site and off-Site. Groundwater monitoring provides a means for confirming that the extent of CVOCs in groundwater continues to be stable and that natural attenuation processes continue to reduce CVOC concentrations. It is conceptually envisioned that monitoring would occur at existing monitoring well locations, with new wells installed, if necessary. Groundwater samples collected under Alternative 3 would be analyzed for VOCs and CVOCs. The final monitoring program would be established during design.

Soil Vapor Extraction

An SVE system would be installed within the overburden to remove CVOCs exceeding Protection of Groundwater SCOs. The system would consist of vapor extraction wells installed to the top of the bedrock formation, approximately 10 ft below grade. For purposes of evaluating the alternative, it is assumed that two separate systems would be installed within the building slab footprint; one would address the northern soils area and one would address the discreet areas to the south, as shown on **Figure 7-2**. A pre-design investigation and pilot test would be conducted to identify the extent of the area requiring remediation, generate vacuum influence data for design purposes, and evaluate the need for off-gas treatment prior to discharge.

For purposes of this alternative, it is assumed that reduction of CVOCs in the overburden soils by SVE would remove the source for vapor intrusion; however, as described under the Site Management Plan, the potential for vapor intrusion would need to be evaluated should another building be constructed at the Site.

Site Containment

Existing Site surfaces including vegetative soil, asphalt or concrete surfaces, would remain to provide a barrier from locations where impacted soils exceed Protection of Groundwater SCOs. Repairs to asphalt damage resulting from disconnection and sealing of the drain lines leading to recharge well ITT-W-1 on the former RFM Site during building demolition are included under this alternative. The existing low permeability areas (asphalt and building slab) cover those soils that exceed Protection of Groundwater SCOs; therefore, addressing interaction of infiltration with soils that exceed SCOs. Modification of existing Site surfaces would be managed under the Site Management Plan. Maintenance of the Site surfaces would be required by the environmental easement/deed restrictions for the Site.

Isolated Mechanical Excavation (vicinity of SS-8)

Excavation would consist of physical excavation of shallow overburden soils exceeding Commercial SCOs. The excavation would target soils in the southern lawn area (in the vicinity of SS-8) as shown on **Figure 7-2**. The excavation would extend approximately 1 ft in depth over 400 sq ft as shown on **Figure 7-2**. Restoration would consist of providing clean acceptable backfill, topsoil and reseeding to match surrounding lawn area.

Isolated Mechanical Excavation (vicinity of SB-10, optional)

Isolated excavation would consist of physical excavation of overburden soils exceeding Protection of Groundwater SCOs in the vicinity of sample location SB-10 along the northern boundary of the former RFM Site, as shown on **Figure 7-2**. Pre-design sampling would confirm the area and volume of soil required for excavation exceeding Protection of Groundwater SCOs. The exceedance of Protection of Groundwater SCOs for TCA at 0.680 mg/kg was based on a sample collected at SB-10 on 10/23/1991 with a TCA concentration of 1.000 mg/kg (2 to 3 ft bgs depth interval). Pre-design sampling would identify whether current conditions still exceed Protection of Groundwater SCOs and if removal by excavation is still necessary. Restoration would consist of providing clean acceptable backfill, topsoil and reseeding to match surrounding lawn area.

Site Management Plan

A Site Management Plan would guide future activities at the Site by documenting institutional and engineering controls, defining the groundwater monitoring requirements and by developing requirements for periodic Site reviews, the implementation of required O&M activities for remedial elements, and future development on the Site. In addition, consistent with 6 NYCRR Part 375-1.8(h)(3) (NYSDEC 2006), annual certification of institutional and engineering controls would be required in the Site Management Plan. The Site Management Plan would also aid in developing the requirements and emplacement of a means of vapor intrusion mitigation, should a new building be constructed on the Site. Additionally, the Site Management Plan would include requirements to evaluate if soil vapor intrusion may be occurring at downgradient off-Site properties, if necessary, based on groundwater monitoring results.

Periodic Site Reviews

Periodic site reviews would be conducted in accordance with the Site Management Plan to evaluate the Site remedy with regard to continuing protection of human health and the environment as evidenced by information such as documentation of field inspections. 6 NYCRR Part 375-1.8(h)(3) (NYSDEC 2006) specifies that the frequency of periodic site reviews should be annual, unless a different frequency is approved by NYSDEC; therefore, it is assumed that annual reviews would be conducted at the Site. Because this alternative would result in COCs remaining above levels that allow for potential unrestricted exposure, CERCLA (USEPA 1988) requires that the Site be reviewed at least once every five years.

7.1.4 Alternative 4 - Institutional Controls/Soil Excavation/Natural Attenuation/Groundwater Monitoring

Alternative 4 consists of institutional controls, soil excavation, and natural attenuation with groundwater monitoring, in addition to the previous 1999 soil removal. Alternative 4 would include maintenance of Site surface covers (*e.g*., vegetative soil, asphalt and concrete surfaces), modifications to the environmental easement/deed restrictions to comply with current NYSDEC policy, excavation of overburden soils exceeding Protection of Groundwater SCOs, natural attenuation with routine bedrock groundwater monitoring, Site Management Plan and periodic site reviews. The continued effectiveness of natural attenuation would be evaluated with the data obtained from groundwater monitoring. Additionally under Alternative 4, the Site surface water runoff recharge well ITT-W-1 would be abandoned (the drain lines leading to ITT-W-1 are currently sealed). The former RFM building has been removed and the building slab would also be removed to access soils to be excavated. The Site Management Plan would include provisions for evaluation of the need for and implementation of, if necessary, a means of soil vapor intrusion mitigation should a new building be constructed at the Site. The remedial components of Alternative 4 are described in this section. **Figure 7-3** depicts the components of this alternative.

Environmental Easement/Deed Restrictions

The existing environmental easement/deed restrictions would need to be modified to comply with current NYSDEC policy. Based on the assessment of land use described above in **Section 2.3**, the reasonably anticipated future land uses for the Site are industrial. The existing institutional controls reflect these Site uses.

Natural Attenuation

Natural attenuation mechanisms including biodegradation, sorption, dilution, volatilization, transformation, and diffusion of CVOCs into the bedrock matrix would contribute to attenuation of CVOCs in soil and bedrock groundwater over time. Bedrock matrix diffusion has been documented to be the predominant natural attenuation mechanism resulting in stabilization of the extent of CVOC impacts. As discussed in **Section 3.4.3** and **3.4.4**, these attenuation processes, including matrix diffusion, sorption, and/or abiotic and biotic degradation, can be expected to reduce the rate of downgradient migration of the TCA concentrations and will at some point result in the stabilization and eventual contraction of the extent of TCA downgradient migration. This is supported by the documented reduction of TCA concentrations downgradient from the northeast corner of the former AMSF Site. As such, it is expected that CVOC concentrations in the soil and bedrock groundwater would continue to decline, thereby reducing the potential risk to human health, and eventually achieving SCOs and Class GA Standards.

Mechanical Excavation

Excavation would consist of physical excavation of overburden soils exceeding Protection of Groundwater SCOs. Excavation would target soils in the northern (near the former 1999 RFM Soil Remediation Area), the southern portions of the building slab and in the vicinity of SS-8 as shown on **Figure 7-3**. Excavation would extend to the top of bedrock, a thickness of approximately 10 ft in the northern and southern excavations under the slab and the excavation would extend 1 ft in depth in the vicinity of SS-8. The building has been removed and the slab and foundation would be demolished in order to access these soils. The excavations would be backfilled with appropriate material and restored with topsoil and vegetation. Excavated soils and demolition debris would be disposed off-Site at an appropriate facility permitted to receive those materials. For purposes of this alternative, a pre-design investigation would be conducted to identify the horizontal and vertical limits of excavation of each area, with the exception of the SS-8 area excavation. Restoration would consist of providing clean acceptable backfill, topsoil and reseeding to match surrounding lawn area.

For purposes of this alternative, it is assumed that excavation of overburden soils would remove the source for vapor intrusion; however, as described under the Site Management Plan, the potential for vapor intrusion would need to be evaluated should another building be constructed at the Site.

Groundwater Monitoring

Groundwater monitoring would consist of monitoring of the bedrock groundwater unit both on-Site and off-Site. Groundwater monitoring provides a means for confirming that the extent of CVOCs in groundwater continues to be stable and that natural attenuation processes continue to reduce CVOC concentrations. It is conceptually envisioned that monitoring would occur at existing monitoring well locations, with new wells installed if necessary. Groundwater samples collected under Alternative 4 would be analyzed for VOCs and CVOCs. The final monitoring program would be established during design.

Site Containment

Existing Site surfaces including vegetative soil, asphalt or concrete surfaces, would remain to provide a barrier from locations where impacted soils exceed Protection of Groundwater SCOs. Repairs to asphalt damage resulting from disconnection and sealing of the drain lines leading to recharge well ITT-W-1 on the former RFM Site during building demolition are included under this alternative. The existing low permeability areas (asphalt and building slab) cover those soils that exceed Protection of Groundwater SCOs; therefore, addressing interaction of infiltration with soils that exceed SCOs. Modification of existing Site surfaces would be managed under the Site Management Plan. Maintenance of the Site surfaces would be required by the environmental easement/deed restrictions for the Site.

Site Management Plan

A Site Management Plan would guide future activities at the Site by documenting institutional and engineering controls, defining the groundwater monitoring requirements and by developing requirements for periodic Site reviews, the implementation of required O&M activities for remedial elements, and future development on the Site. In addition, consistent with 6 NYCRR Part 375-1.8(h)(3) (NYSDEC 2006), annual certification of institutional and engineering controls would be required in the Site Management Plan. The Site Management Plan would also aid in developing the requirements and emplacement of a means of vapor intrusion mitigation, should a new building be constructed on the Site. Additionally, the Site Management Plan would include requirements to evaluate if soil vapor intrusion may be occurring at downgradient off-Site properties, if necessary, based on groundwater monitoring results.

Periodic Site Reviews

Periodic site reviews would be conducted in accordance with the Site Management Plan to evaluate the Site remedy with regard to continuing protection of human health and the environment as evidenced by information such as documentation of field inspections. 6 NYCRR Part 375-1.8(h)(3) (NYSDEC 2006) specifies that the frequency of periodic site reviews should be annual, unless a different frequency is approved by NYSDEC; therefore, it is assumed that annual reviews would be conducted at the Site. Because this alternative would result in COCs remaining above levels that allow for potential unrestricted exposure, CERCLA (USEPA 1988) requires that the Site be reviewed at least once every five years.

7.1.5 Alternative 5 - Institutional Controls/Limited Soil Excavation/*In situ* Thermal Treatment/ Groundwater Monitoring

Alternative 5 consists of *in situ* thermal treatment and groundwater monitoring, in addition to the previous 1999 soil removal. Alternative 5 is included to represent the "Pre-Disposal Condition" alternative required by DER-10 for consideration. Alternative 5 would include thermal treatment of bedrock groundwater exceeding Class GA standards, associated impacted bedrock matrix, and overburden soils exceeding Unrestricted Use SCOs at the Site; routine bedrock groundwater monitoring; and periodic site reviews. Additionally under Alternative 5, the Site surface water runoff recharge well ITT-W-1 would be abandoned (the drain lines leading to ITT-W-1 are currently sealed). The former RFM building has been removed. The remedial components of Alternative 5 are described in this section. Figure 7-4 depicts the components of this alternative.

In Situ Thermal Treatment

Thermal treatment would be applied to impacted bedrock in the areas where bedrock groundwater exceeds Class GA standards and the coinciding overburden soils that exceed Unrestricted Use SCOs. Heating probes would be installed in the subject subsurface zones to raise the temperature of the surrounding media to increase the rate of volatilization of CVOCs. Vapor extraction wells would be installed in the treatment area to capture the vapors and provide treatment as necessary prior to discharge.

The areas for treatment are shown on **Figure 7-4**. Conceptually, bedrock heating probes would be installed to a depth of approximately 110 ft bgs to target the Eramosa and Upper Penfield formations at the Site exceeding Class GA Standards. A depth of 110 ft bgs was selected because naturally occurring pockets of natural gas were encountered at depths of approximately 150 ft bgs during the RI, and heating of these areas may result in uncontrolled migration of natural gas and the potential to create explosive conditions. Installing bedrock heating probes to a depth of approximately 55 ft as suggested by NYSDEC (Sowers, 2016) was also considered in this evaluation to target the Eramosa Dolomite, where the bulk of the mass is located, though this depth would not provide for full restoration to pre-disposal conditions. Additional overburden heating probes would also be installed, as appropriate, to facilitate volatilization of CVOCs from that media.

The number of probes required, probe spacing and vapor recovery and treatment system requirements would be evaluated during the design phase.

For purposes of this alternative, two scenarios were evaluated resulting in multiple assumptions. One scenario assumed that thermal treatment would remove the source for vapor intrusion and the source of the bedrock groundwater impact in the Eramosa formation with heating probes installed to depths of 55 ft bgs. The second scenario assumed that thermal treatment would remove the source for vapor intrusion and the source of the bedrock groundwater impact in the Eramosa and Penfield with heating probes installed to depths of 110 ft bgs. However, cost estimates were only evaluated for the probe depth of 55 ft bgs.

Isolated Mechanical Excavation (vicinity of SS-8 and SS-5)

Excavation would consist of physical excavation of shallow overburden soils exceeding Unrestricted Use SCOs. The excavation would target soils in the southern lawn area (in the vicinity of SS-8 and SS-5) as shown on **Figure 7-4**. The excavation would extend approximately 1 ft in depth over 800 sq ft as shown on **Figure 7-4**. Restoration would consist of providing clean acceptable backfill, topsoil and reseeding to match surrounding lawn area.

Groundwater Monitoring

Groundwater monitoring would consist of monitoring of the bedrock groundwater unit both on-Site and off-Site to evaluate the effectiveness of the thermal remediation. It is conceptually envisioned that monitoring would occur at existing monitoring well locations not destroyed or impacted by the thermal treatment, with new wells installed as needed. Groundwater samples collected under Alternative 5 would be analyzed for VOCs and CVOCs. The final monitoring program would be established during design.

Site Management Plan

A Site Management Plan would guide future activities at the Site by documenting institutional and engineering controls, defining the groundwater monitoring requirements and by developing requirements for periodic Site reviews, the implementation of required O&M activities for remedial elements, and future development on the Site. In addition, consistent with 6 NYCRR Part 375-1.8(h)(3) (NYSDEC 2006), annual certification of institutional and engineering controls would be required in the Site Management Plan. The Site Management Plan would also aid in developing the requirements and emplacement of a means of vapor intrusion mitigation, should a new building be constructed on the Site. Additionally, the Site Management Plan would include requirements to evaluate if soil vapor intrusion may be occurring at downgradient off-Site properties, if necessary, based on groundwater monitoring results.

Periodic Site Reviews

Periodic Site reviews would be conducted in accordance with the Site Management Plan to evaluate the Site remedy with regard to continuing protection of human health and the environment as evidenced by information such as documentation of field inspections. 6 NYCRR Part 375-1.8(h)(3) (NYSDEC 2006) specifies that the frequency of periodic site reviews should be annual, unless a different frequency is approved by NYSDEC; therefore, it is assumed that annual reviews would be conducted at the Site.

7.2 SCREENING OF ALTERNATIVES

Following the assembly of alternatives, a screening of remedial alternatives was conducted. The screening of remedial alternatives was conducted consistent with USEPA's *Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA* (USEPA 1988) and NYSDEC's DER-10 (NYSDEC 2010a). The following subsections provide a description of the results of screening of the five remedial alternatives with respect to three criteria: effectiveness, implementability and cost. More detailed discussion is found in **Table 7-2** and in **Section 7.3**.

7.2.1 Effectiveness Screening

In the effectiveness screening of the remedial alternatives, each alternative was evaluated with respect to protection of human health and the environment, effectiveness in providing reductions in toxicity, mobility or volume and both short-term and long-term effectiveness. Short-term effectiveness refers to the construction and implementation period, while long-term effectiveness refers to the period following construction.

The limited soil removal in Alternative 2 would not achieve Protection of Groundwater SCOs for soil; however existing on-Site soils do not appear to represent a significant ongoing source of impact to groundwater. Additionally, on-Site soils meet the Commercial Use SCOs except for two areas with SVOCs that appear to be associated with asphalt fragments observed in the samples, and these areas will be capped. Finally, it should be noted that under Alternative 2, the majority of the property is covered by a building slab or an asphalt parking lot thus infiltration through potential impacted soil is limited.

Site-specific conditions may limit the effectiveness of SVE treatment of Site soils (Alternative 3). Specifically, the presence of layers of silt/clay and sands at varying depths in areas requiring soil treatment using SVE are expected to limit the effectiveness of SVE treatment in the silt/clay zones, precluding SVE from meeting the Protection of Groundwater SCOs in the silt/clay zone.

Site-specific limitations related to the presence of fractured bedrock exhibiting large fractures (*e.g.*, up to 4.4 inches), and the presence of CVOCs in the bedrock matrix and bedrock pore water would limit the effectiveness of thermal treatment (Alternative 5) of bedrock groundwater. The large inflows of groundwater into the bedrock during thermal treatment would inhibit the technology from reaching target heating temperatures. The US Army Corp of Engineer's manual for *in situ* thermal design (ISTD) with thermal conductive heating (TCH) states "Treatment of VOCs with ISTD TCH can be readily performed below the water table except in highly permeable aquifers. Generally, the upper limit for hydraulic conductivity is approximately 10^{-3} cm/sec." (US Army Corp of Engineers 2014) Hydraulic conductivity estimates for the Eramosa ranged from $>5.4\text{x}10^{-3}$ to $>6.4\text{x}10^{-1}$ cm/sec, significantly exceeding the Corp's upper limit for hydraulic conductivity. Furthermore, the USEPA states "Perhaps the main subsurface feature that has hampered achievement of target temperatures is significant groundwater flow (greater than approximately 1 ft/day). Such flow regimes can act as a continuing heat sink. Because of high groundwater transmissivity, such zones may be relatively free of contamination, but adjacent lower permeability zones may have much higher levels of residual contamination. Such zones can be difficult to heat if groundwater flow is not controlled." (USEPA 2014). The minimum estimated groundwater flow for the Eramosa Formation at the Site is approximately1 ft/day and can be as high as approximately 390 ft/day (O'Brien & Gere, 2014c). Baston, *et. al.* (2007) conducted modeling to assess groundwater inflow on TCH of bedrock and report that fractures with greater than 500 micrometers (µm) (0.020 inches) did not reach target water boiling temperature of 100 degrees Centigrade (°C) in interwell rock after 1 year of heating. When fractures were greater than 1,000 µm (0.039 inches) interwell fracture temperatures did not exceed 20°C. Solution enlarged fractures have been identified in the Eramosa formation with apertures between 1.6 inches and 4.4 inches in the 12 ft bgs to 31 ft bgs zone corresponding to the highest CVOC concentrations in bedrock matrix in the area proposed for treatment with TCH. The presence of the large solution fractures in the Eramosa formation would provide the pathway for inflow of large volumes of water that would inhibit the ability of target bedrock temperatures to be reached to achieve effective removal/destruction of CVOCs in the bedrock matrix.

Extraction, treatment and reinjection of partially heated groundwater, in an attempt to reduce both groundwater inflow and improve the ability to reach required bedrock temperatures, are expected to be technically impracticable and prohibitively expensive given the very high flowrates of produced water. Further, groundwater extraction and reinjection would hydraulically behave similarly to currently existing recharge wells. The ability of existing recharge wells to accept and radially dissipate within 24 hours hundreds of thousands of gallons of runoff exemplifies the infeasibility of reinjecting treated partially heated groundwater back into the subsurface, and only into the treatment zone, in an attempt to control the expected high groundwater inflow if thermal treatment of the highly fractured bedrock system was attempted.

This concern was also noted by a vendor consulted during the development of Site-specific conceptual cost estimates. The vendor indicated that given the groundwater flow velocity at the Site, implementation of thermal treatment would result in excessive heat loss and would, therefore, require limiting groundwater flow in the treatment area to 1 ft/day or less (TRS 2016) (**Appendix B**).

It should be noted that bedrock matrix data as presented in RFM RIR, as well as equivalent TCA porewater concentrations, indicate that limiting the depth of thermal treatment to 55 ft bgs would not treat zones below this depth with CVOCs and VOCs that exceed Class GA Standards. Additionally, the RFM RIR indicates that the fracture frequency in the Upper Penfield formation can be high. Given the high fracture frequency and the high hydraulic conductivity values in the Upper Penfield, it is likely that groundwater from this zone would migrate vertically into the upper 55 ft bgs target zone during thermal treatment. Also because of the higher fracture frequency and the higher hydraulic conductivity value characteristic of the Upper Penfield formation, if thermal heating was limited to 55 ft bgs, grouting of the bedrock fractures would be required beneath the 55 ft bgs zone to prevent horizontal and vertical inflow of groundwater from the Upper Penfield. Therefore, limiting the thermal treatment interval to 55 ft bgs does not change the technical impracticability of thermal treatment of bedrock at this Site.

In addition, bedrock groundwater monitoring indicates that the greatest CVOC impacts have always been and remain to be on the northwest corner of the adjacent former AMSF Site. Because of this, even though target temperatures would not be reached, thermally induced gradients would result in groundwater inflow from the former ASMF Site to the former RFM Site. Limitations to effectiveness related to high hydraulic conductivities and solution enlarged fractures would also limit effectiveness if a shallower depth of treatment (*e.g.*, 55 ft) were considered. Impacts in untreated depths of bedrock would further limit the effectiveness of the remedy should potential sources of impact beneath the treatment zone remain in place.

The implementation of thermal treatment (either to a depth of 110 ft bgs or to 55 bgs) simultaneously implemented at the former AMSF Site, which currently has industrial and commercial uses, was also considered in this evaluation. Given the relative similarity of overburden and bedrock characteristics at both former RFM and former AMSF Sites the technical impracticability of a successful implementation of thermal treatment at the former AMSF Site is the same. There are some significant differences with respect to potential implementation of thermal treatment on the former AMSF Site based on the presence of the building, building foundations and footings, the subgrade indoor pit that was excavated to or proximate to the bedrock-overburden interface, and the occupancy of the building. The presence of occupants requires careful consideration of vapor capture which would be difficult given the configuration of the foundation footings and pit.

Short-term impacts to the community are anticipated to be minimal as a result of Alternatives 1 through 4. Alternative 5 presents potentially significant impacts to the surrounding properties. Specifically, the permeable bedrock fractures would make it difficult to control the migration of the thermally generated vapors, which could migrate off-Site and impact neighboring facilities. In addition, off-Site vapor intrusion at neighboring properties may occur as a result of increased bedrock temperatures at off-Site locations resulting in volatilization of CVOCs from groundwater and/or soil.

7.2.2 Implementability Screening

During the implementability screening of the remedial alternatives, each alternative was evaluated with respect to the technical and administrative feasibility of constructing, operating and maintaining a remedial action alternative. Technical feasibility refers to the ability to construct, reliably operate, and meet technology-specific requirements until the remedial action is complete. Technical feasibility also refers to operation, maintenance, replacement, and monitoring of technical components of the remedy. Administrative feasibility refers to the ability to obtain approval from agencies, as well as the availability of treatment, storage and disposal services; capacity; and specialists.

Alternatives 1 through 4 are technically feasible to construct and operate. Site-specific conditions present challenges that result in Alternative 5 being technically very difficult, if not impossible, to implement. Given the heterogeneous bedrock permeability distribution and the presence of enlarged fractures documented in the Eramosa formation, large inflows of groundwater in the bedrock heating zone are expected. These large inflows of groundwater to the bedrock heating zone would result in production of large volumes of water to treat and discharge, significant challenges to achieving target bedrock temperature, and greater than normal electrical heating requirements, thereby preventing successful implementation of this remedial alternative to restore groundwater to pre-disposal conditions. Continuous groundwater extraction at 100 to 1,000 gallons per minute in order to implement thermal treatment would be impracticable due to the excessive production rates and volumes of groundwater impacted with CVOCs that would require treatment and disposal. Such production rates would draw impacted groundwater from the former AMSF Site and further spread groundwater impacts.

If groundwater could be extracted and treated successfully for Alternative 5, disposal of the extracted groundwater for Alternative 5 would be to the sanitary sewer or it would be reinjected to the subsurface. Based on the large volume of water that would be extracted in order to implement Alternative 5, it may not be possible to discharge to the sanitary sewer. Reinjection of the extracted groundwater would present other significant challenges, as described above. In order to maintain the target bedrock temperatures throughout the treatment zone, the extracted groundwater would need to be reinjected at or near the same high temperature as the heated bedrock. In addition, the reinjection of groundwater would need to occur outside of the area of impacted groundwater to avoid the uncontrolled migration of COCs. As a result, the heated groundwater would need to be reinjected on adjacent off-Site properties which could result in possible thermal impacts to the off-Site properties. Heating of the bedrock matrix on neighboring properties could increase the volatilization of CVOCs from groundwater and result in increased vapor intrusion or the potential for vapor intrusion on those properties.

As an alternate to reinjection, the use of a physical barrier, such as a grout curtain, was considered. A grout curtain can be created in the subsurface by injecting grout under pressure in a series of vertically drilled holes in such way that they create a curtain. The large size fractures present in the high flow fracture bedrock zones may be technically challenging to seal, at minimum requiring very large quantities of grout to be injected. The large size of the fractures at the site could result in the migration of grout onto neighboring properties and the grout curtain could displace impacted groundwater onto adjacent properties. Once the thermal treatment was completed, the grout curtain would need to be removed to prevent high groundwater levels on the Site; however, current technologies to remove grout curtains are uncertain and presently technically infeasible.

7.2.3 Cost Screening

During the cost screening of the remedial alternatives, each alternative is evaluated with respect to cost. For the purposes of this step, relative costs were assigned to the alternatives. Alternative 1 is the least cost alternative, with no associated additional costs. Active Alternatives 2, 3, and 4 range in estimated cost from $0.8 million (Alternative 2) to $3.4 million (Alternative 3). Implementation of the thermal treatment remedial element included in Alternative 5 is estimated to range from $8.7 to $15.4 million[2]. The estimate was based on input from a thermal treatment specialty vendor. Implementation of Alternative 5 would also include additional significant costs related to extraction and treatment of groundwater. It is estimated that 100 to 1,000 gallons per minute of CVOC impacted groundwater would require extraction and subsequent treatment for implementation of Alternative 5.

7.2.4 Results of Screening of Remedial Alternatives

As a result of the screening of remedial alternatives, Alternative 5 was eliminated from further consideration in the FS. Alternative 5 is not anticipated to be effective or implementable given the Site conditions, potential risks to neighboring properties, and has substantially less cost effectiveness than the remaining alternatives by at least an order of magnitude. Furthermore, Alternative 5 would not achieve pre-disposal conditions in the bedrock groundwater in a shorter timeframe than natural attenuation as contemplated for Alternatives 1, 2, 3 or 4. Alternative 3, which includes SVE, was retained for further consideration even though there are potential limitations to its effectiveness. Alternatives 3 and 4, which include limited excavation and/or SVE treatment, were also retained even though the potential for future on-Site vapor intrusion would remain. As discussed in **Section 4.4**, due to the presence of CVOCs in the bedrock matrix at the Site, it is anticipated that restoration of the bedrock groundwater to Class GA standards or pre-disposal conditions is not technically feasible for this Site.

As a result of the screening of remedial alternatives, the following four remedial alternatives are retained in the FS for further detailed evaluation:

- Alternative 1: no further action
- Alternative 2: institutional controls, limited soil excavation, containment, natural attenuation, and groundwater monitoring
- Alternative 3: institutional controls, limited soil excavation, *in situ* soil treatment, natural attenuation, and groundwater monitoring
- Alternative 4: institutional controls, soil excavation and off-Site disposal, natural attenuation, and groundwater monitoring

7.3 DETAILED ANALYSIS OF ALTERNATIVES

This section documents the detailed analysis of four remedial alternatives that were developed during the FS and remain following the screening of remedial alternatives. The detailed analysis of the alternatives was conducted consistent with USEPA's *Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA* (USEPA 1988) and NYSDEC's DER-10 (NYSDEC 2010a). In addition, sustainability was considered in accordance with USEPA's *Superfund Green Remediation Strategy* (USEPA 2010) and NYSDEC DER's *Green Remediation Program Policy* (DER-31) (NYSDEC 2010b). This section describes the individual and comparative analysis of the remedial alternatives with respect to nine evaluation criteria that embody the specific statutory requirements that must be evaluated to satisfy the DER-10 (NYSDEC 2010a) and CERCLA (USEPA 1988) remedy selection requirements.

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[2] The thermal estimate range assumes the installation of approximately 158 electrodes approximately 17 ft apart to depths of 55 ft and 110 ft, with co-located vapor recover wells and 18 temperature monitoring wells. Captured vapors are assumed to be treated with activated carbon. The treatment footprint is assumed to be approximately 42,000 square feet, as illustrated on **Figure 7-4**. This estimate includes 5-years of groundwater monitoring but does not include the anticipated significant costs associated with groundwater collection and treatment that are necessary to implement thermal treatment.

The preambles to the NCP (Federal Register 1990) and NYSDEC DER-10 Section 4.2 (NYSDEC 2010a) indicate that, during remedy selection, selection criteria should be categorized into three groups: threshold criteria, primary balancing criteria, and modifying criteria. The two threshold criteria, overall protection of human health and the environment and compliance with ARARs, must be satisfied in order for an alternative to be eligible for selection. Long-term effectiveness and permanence; reduction of toxicity, mobility, or volume through treatment; short-term impact and effectiveness; implementability; and cost are primary balancing criteria that are used to balance the differences between alternatives. An additional primary balancing criterion under NYSDEC DER-10 (NYSDEC 2010a) includes an evaluation of land use. The modifying criterion of community acceptance is formally considered after public comment is received.

The objective of the detailed analysis of remedial alternatives is to analyze and present sufficient information to allow the alternatives to be compared and a remedy selected. This analysis consisted of an individual assessment of each alternative with respect to the eight above-referenced evaluation criteria (all but community acceptance) that encompass statutory requirements and overall feasibility and acceptability. Sustainability considerations were evaluated as part of the long-term and short-term effectiveness criteria. Following the individual assessment, a comparative analysis was completed.

7.4. INDIVIDUAL ANALYSIS OF ALTERNATIVES

In the individual analysis of remedial alternatives, each of the remedial alternatives was evaluated with respect to seven evaluation criteria and consideration of land use. The criteria are described below and summarized in **Table 7-2**.

7.4.1. Overall Protection of Human Health and the Environment

The analysis of each alternative with respect to this criterion provides an evaluation of whether the alternative would achieve and maintain adequate protection and a description of how Site risks would be eliminated, reduced, minimized or controlled through treatment, engineering, or institutional controls. The ability of each alternative to achieve RAOs is also described. The evaluation of each alternative with respect to overall protection of human health and the environment is presented in **Table 7-2**.

7.4.2. Compliance with Site-Specific ARARs

Each alternative was evaluated to assess whether it would attain ARARs or, if not, whether there is adequate basis for invoking one or more of the available waivers. Potential chemical-specific, location-specific, and action-specific ARARs were identified in **Table 4-1**. The evaluation of each alternative with respect to compliance with ARARs is presented in **Table 7-2**.

7.4.3. Long-Term Effectiveness and Permanence

Each alternative was evaluated to assess the long-term effectiveness and permanence it would afford. Factors considered, as appropriate, include:

- The magnitude of potential residual risk from materials remaining at the conclusion of the remedial activities. The characteristics of the remaining materials are considered with respect to their mobility, toxicity and volume, as well as their propensity to bioaccumulate.
- The adequacy and reliability of controls, such as containment and institutional controls, necessary to manage materials left on Site. This factor addresses the uncertainties of remedial components, the assessment of the potential need to replace components of the alternative, and the potential exposure pathways and risks posed should the remedial action need replacement.
- Long-term sustainability of the remedy, considering total environmental and sustainability impacts (*e.g.*, greenhouse gas sources, materials reused on-Site versus disposed off-Site, remedy maintenance requirements), and metrics related to direct and indirect impacts for each alternative (*e.g.*, energy usage, quantity of emissions, fuel consumption, volume of material reused on-site versus disposed off-Site).

The evaluation of each alternative with respect to long-term effectiveness and permanence is presented in **Table 7-2**.

7.4.4. Reduction of Toxicity, Mobility or Volume through Treatment

For each alternative, the degree to which the alternative results in the reduction of mobility, toxicity or volume was assessed. Factors that were considered consisted of the following:

- Treatment or recycling processes the alternative would employ and the materials it would treat
- Amount of hazardous substances, pollutants, or contaminants that would be treated or recycled
- Degree of expected reduction of mobility, toxicity or volume of the material due to treatment or recycling and the specification of which reduction(s) would occur
- Degree to which treatment would be irreversible
- Type and quantity of residuals that would remain following treatment, considering the persistence, toxicity, mobility and propensity to bioaccumulate
- Degree to which treatment would reduce the inherent hazards posed by the facility.

The evaluation of each alternative with respect to reduction in toxicity, mobility or volume through treatment is presented in **Table 7-2**.

7.4.5. Short-Term Effectiveness

The short-term impacts of each alternative were assessed, and considered the following:

- Potential short-term risks that might be posed to the community during implementation of the alternative
- Potential threats to workers during implementation of the remedy and the effectiveness and reliability of protective measures
- Potential environmental impacts of the remedial action and the effectiveness and reliability of mitigation measures during implementation
- Time until protection would be achieved
- Short-term sustainability of the remedy, considering DER-31 *Green Remediation* (NYSDEC 2010b), total environmental and sustainability impacts (*e.g.*, greenhouse gas sources and materials reused on-Site versus disposed during construction-phase activities) and metrics related to direct and indirect impacts, and construction-phase impacts (*e.g.*, energy, emissions, fuel, volume of material reused and disposed off-Site).

The evaluation of each alternative with respect to short-term effectiveness is presented in **Table 7-2**.

7.4.6. Implementability

Each alternative was assessed relative to the ease or difficulty of implementation by considering the following types of factors, as appropriate:

- Technical feasibility, including technical difficulties and unknowns associated with the construction and operation of a technology, the reliability of the technology, the ease of undertaking additional remedial actions, and the ability to monitor the effectiveness of the remedy
- Administrative feasibility, including activities needed to coordinate with other offices and agencies
- Ability and time required to obtain any necessary approvals and permits from agencies
- Availability of services and materials, including the availability of adequate off-Site treatment, storage and disposal capacity and services; the availability of necessary equipment and specialists, provisions to obtain necessary additional resources; and the availability of prospective technologies.

The evaluation of each alternative with respect to implementability is presented in **Table 7-2**.

7.4.7. Cost Effectiveness

To evaluate this criterion, cost estimates were prepared for each alternative based on vendor information and quotations, cost estimating guides, and experience. The cost estimates include capital costs, annual O&M costs for 30 years, and present worth costs. The present worth costs for the alternatives were calculated based on the expected/assumed duration of the remedy using a 7% discount rate, consistent with USEPA's *A Guide to Developing and Documenting Cost Estimates During the Feasibility Study* [Office of Solid Waste and Emergency Response (OSWER) 9355.0-75, USEPA, 2000]. The cost estimates for the remedial alternatives are included in **Tables 7-3 through 7-6**. A comparative evaluation of cost effectiveness is provided in **Section 7.5.7**.

7.4.8. Land Use

Pursuant to NYSDEC DER-10 Section 4.2(i), (NYSDEC 2010a) each alternative is assessed relative to the current, intended and reasonably anticipated future use of the Site and its surroundings by considering the following factors, as appropriate:

- Current land use and historical and/or recent development patterns
- Consistency of proposed land use with applicable zoning laws and maps
- Brownfield opportunity areas
- Consistency of proposed land use with applicable comprehensive master plans or any other applicable land-use plan formally adopted by a municipality
- Proximity to property currently used for residential use and to urban, commercial, industrial, agricultural and recreational areas
- Written and oral comments submitted by the public as part of citizen participation activities on the proposed land use
- Environmental justice concerns
- Proximity of the facility to cultural and natural resources
- Vulnerability of impacted groundwater that might migrate from the facility
- Final use determination of the facility.

Land use is discussed in **Section 2.3**. The evaluation of each alternative with respect to land use is presented in **Table 7-2**.

7.4.9. State Acceptance

State acceptance will be addressed by NYSDEC, in consultation with NYSDOH, during preparation of the Proposed Remedial Action Plan (PRAP) that will be released for public comment.

7.4.10. Community Acceptance

Community acceptance will be addressed during the public comment period on the PRAP presented by NYSDEC, in consultation with NYSDOH. The ROD subsequently issued by NYSDEC will include a Responsiveness Summary, in which NYSDEC will address the verbal and written comments received on the PRAP during the public comment period.

7.5 COMPARATIVE ANALYSIS OF ALTERNATIVES

The comparative evaluation of remedial alternatives was completed to consider the relative performance of the alternatives and identify major trade-offs among the alternatives. The comparative analysis of alternatives is presented in below.

7.5.1. Overall Protection of Human Health and the Environment

As described in **Section 4.3**, based on isolated detections of COCs in soil, COCs present at concentrations greater than the Protection of Groundwater SCOs have the potential to leach to groundwater. Though bedrock groundwater is not currently used as a potable water source and the area is serviced by a public water supply, potentially unacceptable risks to human health were identified related to exposures to groundwater. There are no known receptors of CVOCs in groundwater and the CVOC impacts are not expected to expand in magnitude or extent given the natural attenuation mechanisms effective in the bedrock groundwater. However, bedrock groundwater concentrations were detected at concentrations above the Class GA standards. Based on a comparison of the NYSDOH Guidance matrices (NYSDOH 2006) and the TCA, DCA, PCE, 1,1-DCE and TCE concentrations detected in the sub-slab soil during the RFM RI, a means of vapor intrusion mitigation may be required, should a new building be constructed on the Site.

As described in **Section 3.5**, institutional controls have been implemented at the Site that address groundwater use and exposure to soil. However, existing environmental easement/deed restrictions do not comply with current NYSDEC policy. Alternatives 2, 3, and 4 would provide for modified environmental easement/deed restrictions but Alternative 1 would not. While it is anticipated under Alternative 1 that existing environmental easement/deed restrictions would continue, they would not be as protective as the modified environmental easement/deed restrictions that comply with current NYSDEC policy. While each alternative would provide protectiveness to human health from exposures to soil and groundwater through institutional controls, Alternative 1 would not include periodic reviews, therefore confirmation of continued protectiveness into the future would not be provided in Alternative 1. Alternatives 2, 3 and 4 would provide added protectiveness from soil exposures through containment, treatment and removal, respectively.

Alternative 1 would not address potential risks related to indoor air/sub-slab soil vapor if a new building is constructed on Site at some time in the future following removal of the existing building. Alternatives 2, 3, and 4 would address exposures to indoor air/sub-slab soil vapor through implementation of a Site Management Plan that would provide a means of vapor intrusion mitigation should a new building be constructed on Site.

Each alternative utilizes natural attenuation to address bedrock groundwater concentrations. Alternatives 2, 3, and 4 each include periodic reviews and groundwater monitoring for VOCs and CVOCs to provide continued verification of protection of human health and the environment. Alternatives 2, 3, and 4 address each RAO, while Alternative 1 does not address the RAO related to indoor air/sub-slab soil vapor. Alternative 1 also does not address other RAOs for the long-term.

In summary, Alternatives 2, 3, and 4 provide a greater level of overall protection to human health and the environment as compared to Alternative 1. While Alternatives 2, 3, and 4 address each RAO, Alternative 1 does not address each RAO.

7.5.2. Compliance with ARARs

As described in **Section 3**, COC concentrations in soil, groundwater and indoor air/sub-slab soil vapor exhibit exceedances of potential chemical-specific ARARs and TBCs. Specifically, soil has been detected at concentrations exceeding the Protection of Groundwater SCOs, groundwater concentrations have been detected at concentrations above the Class GA groundwater standards, and indoor air/sub-slab soil vapor concentrations have been detected at concentrations warranting vapor intrusion mitigation based on NYSDOH guidance matrices. Alternative 1 relies on institutional controls and natural attenuation alone to address ARARs. Alternative 1 does not address the NYSDOH guidance values for indoor air/sub-slab soil vapor. Alternatives 2, 3, and 4 address ARARs through containment, treatment or removal of soil, in addition to institutional controls and natural attenuation.

None of the alternatives meet the ARARs for groundwater in the short-term, though on-Site risks associated with this condition are addressed through institutional controls and groundwater is not currently used as a potable water source as the area is serviced by a public water supply.

A waiver of the chemical-specific ARAR for groundwater may be indicated due to the technical impracticability of restoring the heterogeneous fractured bedrock system at the Site to pre-disposal conditions.

It should be noted that groundwater exceedances of Class GA standards in off-Site wells at the Cinemark property correlate with recharge events as discussed in **Section 3.4.3**, suggesting that groundwater impacts are a result of CVOC mobilization towards the Cinemark property due to recharge of groundwater by surface water at AMSF recharge wells, specifically AMSF-RW-2. Eramosa groundwater flow velocities and the presence of impacted groundwater for at least two decades suggest that TCA transport would be expected to have migrated much further than has been observed unless natural attenuation processes were acting to reduce TCA concentrations and retard TCA migration. As discussed in **Section 3.4.3**, these attenuation processes, including matrix diffusion, sorption, and/or abiotic and biotic degradation, can be expected to significantly reduce the rate of downgradient migration to the Cinemark property of the TCA concentrations and will at some point result in the stabilization and eventual contraction of the extent of TCA downgradient migration. The abandonment of AMSF recharge wells as part of planned remediation at the former AMSF Site is expected to mitigate the groundwater exceedances to Class GA standards at the Cinemark property. As such, it is anticipated that potential vapor intrusion related to impacted groundwater at the Cinemark property may also be mitigated once surface water recharge is controlled.

No location-specific ARARs were identified for the former RFM Site.

Action specific ARARs were identified for Alternatives 2, 3 and 4. No action-specific ARARs were identified for Alternative 1, as no further actions are proposed. Remedy construction and monitoring activities in Alternatives 2, 3 and 4 would be conducted in accordance with Occupational Safety and Health Administration (OSHA) requirements regarding the health and safety of workers. In addition, the off-Site disposal of soil in Alternative 4 would be conducted in conformance with applicable transportation and disposal requirements.

7.5.3. Long-term Effectiveness and Permanence

Long-term risks are reliably addressed by each alternative, though Alternative 1 does not provide a means of confirming continued effectiveness and permanence as it does not include periodic reviews or groundwater monitoring. Alternatives 3 and 4 result in no long-term risks associated with soil. Alternatives 2, 3, and 4 provide a greater degree of effectiveness and permanence for addressing soil. Treatment or removal of soil included in Alternatives 3 and 4 provides better effectiveness and permanence for addressing soil than containment used in Alternative 2. The effectiveness of SVE in Alternative 3 may be limited by the heterogeneity of the Site soils. The potential remains for CVOC impacts to soil vapor for Alternatives 2, 3 and 4 (and subsequent potential for vapor intrusion in future buildings at the Site). Each alternative results in minimal to no long-term sustainability impacts. Each of these alternative may achieve groundwater ARARs in the long term by retardation of VOCs through natural attenuation processes to nontoxic byproducts (*i.e.,* carbon dioxide and ethane), ultimately reducing both the concentration and mass of the CVOCs in the groundwater. As discussed in **Section 3.4.3**, these attenuation processes, including matrix diffusion, sorption, and/or abiotic and biotic degradation, can be expected to significantly reduce the rate of downgradient migration to the Cinemark property of the TCA concentrations and will at some point result in the stabilization and eventual contraction of the extent of TCA downgradient migration. The abandonment of AMSF recharge wells as part of planned remediation at the former AMSF Site is expected to mitigate the groundwater exceedances to Class GA standards at the Cinemark property. As such, it is anticipated that potential long-term vapor intrusion concerns related to impacted groundwater at the Cinemark property may also be mitigated once surface water recharge is controlled.

Natural attenuation would be further documented by bedrock groundwater monitoring. For Alternatives 2, 3, and 4, the Site Management Plan would include requirements to determine if soil vapor intrusion may be occurring at downgradient off-Site properties, if necessary, based on groundwater monitoring results.

7.5.4. Reduction of Toxicity, Mobility, or Volume through Treatment

Alternatives 3 and 4 result in the greatest reduction in toxicity, mobility or volume through either treatment or removal of soil exhibiting concentrations greater than Protection of Groundwater SCOs. While Alternative 2 includes only limited soil removal, it includes a cover that would reduce the mobility of CVOCs in soil to groundwater. As a result of treatment or removal of soil, Alternatives 3 and 4 result in the greatest reduction in contaminant mass in soil that could result in on-site soil vapor, as compared to Alternative 2.

Given that existing soils at the Site are not considered a significant on-going source of groundwater contamination, the removal and treatment of soil in Alternatives 3 and 4 are not expected to result in noticeable improvements in groundwater quality relative to Alternative 2.

As described in **Section 3.4.4**, surface water recharge plays a significant role in the transport of VOCs in groundwater at the site. Abandonment of ITT-W-1 included in each alternative coupled with abandonment of AMSF recharge wells as part of planned remediation at the former AMSF Site is anticipated to result in plume stability. As discussed in **Section 3.4.3**, natural attenuation processes, including matrix diffusion, sorption, and/or abiotic and biotic degradation, can also be expected to significantly reduce the rate of downgradient migration to the Cinemark property of the TCA concentrations and will at some point result in the stabilization and eventual contraction of the extent of TCA downgradient migration.

Each alternative utilizes natural attenuation processes to reduce the toxicity, mobility or volume of CVOCs in bedrock groundwater. Under current conditions, the relative mass transport of Site VOCs and 1,4-dioxane from bedrock to groundwater is greater than from soil to groundwater. Natural attenuation would be further documented by bedrock groundwater monitoring.

7.5.5. Short-term Effectiveness

Each alternative would be implemented using proper health and safety measures to minimize impacts to the community and workers. Existing institutional controls currently afford protectiveness of human health for each alternative. Alternatives 3 and 4 are anticipated to require between two and three years to address soil RAOs for the protection of the environment, while the cover system in Alternative 2 currently addresses this RAO. Each alternative utilizes natural attenuation to address the RAO for restoration of the aquifer to pre-disposal conditions in the long-term. Given the bedrock conditions at the Site, it is not technically feasible to restore CVOCs in bedrock groundwater to Class GA groundwater standards or pre-disposal conditions at the Site in the short-term or within a 30 year period.

Negligible to moderate fuel/energy use, greenhouse gas emissions and water use are anticipated during implementation of each remedy of the active alternatives, Alternative 4 is anticipated to have the greatest consumption of energy while Alternative 2 is anticipated to have the least. Green remediation techniques, as detailed in NYSDEC's *Green Remediation Program Policy - DER-31* (NYSDEC 2010b), would be considered for each alternative to reduce short-term environmental impacts. Green remediation best practices such as the following may be considered:

- Use of renewable energy and/or purchase of renewable energy credits to power energy needs during construction and/or operation and maintenance of the remedy
- Reduction in vehicle idling, including both on and off road vehicles and construction equipment during construction and/or operation and maintenance of the remedy
- Design of cover systems, to the extent possible, to be usable for alternate uses, require minimal maintenance (*e.g.,* less mowing), allow for infiltration of storm water and/or be integrated with the planned use of the property.
- Beneficial reuse of material that would otherwise be considered a waste
- Use of Ultra Low Sulfur Diesel (ULSD).

7.5.6. Implementability

With the exception of Alternative 3, each alternative is readily implementable and reliable. Site-specific heterogeneous subsurface soil conditions (layers of silt/clay and sand) limit implementability and reliability of *in situ* SVE for CVOC removal in subsurface soil as compared to removal by excavation included in Alternative 4.

The necessary equipment and specialists would be available for each alternative. Cover system construction materials are anticipated to be available; however, material sources and availability of cover system materials would be further evaluated during the design.

7.5.7 Cost Effectiveness

Detailed cost estimates for Alternatives 1, 2, 3, and 4 are included as **Tables 7-3 through 7-6**, respectively. The costs associated with Alternatives 1, 2, 3, and 4 are summarized as follows:

Alternative	Total estimated capital cost	Total estimated present worth of O&M (30 yrs)	Total estimated net present worth cost
1 – No Further Action	$0	$0	$0
2 – Intuitional Controls/Limited Soil Excavation/Containment/Natural Attenuation/Groundwater Monitoring	$104,100	$702,000	$806,000
3 – Institutional Controls/Limited Soil Excavation/*In situ* Soil Treatment/Natural Attenuation/Groundwater Monitoring	$ 1,195,000	$2,200,500	$3,396,000
4 – Institutional Controls/Soil Excavation/Natural Attenuation/Groundwater Monitoring	$ 943,000	$600,500	$1,544,000

Alternative 1 is the least cost alternative; however, it is not protective of human health. Alternatives 2, 4 and 3, in ascending cost order, each achieve protection of human health, and, thus, Alternative 2 is the most cost effective. Alternative 2 relies on institutional controls for protectiveness for human health from soil, potential soil vapor and groundwater exposures. Alternatives 3 and 4 treat and/or remove soil and address a greater quantity of soil than Alternative 2; however, both these alternatives also rely on institutional controls for protectiveness from groundwater and potential soil vapor exposures. While Alternatives 3 and 4 may provide incremental protection relative to soil exposures, the cover included in Alternative 2, coupled with institutional controls, is adequately protective. In addition, while additional soil removal and/or soil treatment in Alternatives 3 and 4 results in a benefit from the standpoint for potential future vapor intrusion from soil impacts, the continued presence of impacted groundwater does not preclude the potential for future vapor intrusion under these alternatives. For these reasons, the cost for the incremental protection afforded under Alternatives 3 and 4 (almost twice to over five times the total estimated capital cost for Alternative 2) is not as cost effective at achieving similar protectiveness.

7.5.8 Land Use

With the exception of Alternative 1, each alternative is consistent with the current and reasonably anticipated future use (industrial use). Alternative 1 also does not address continued protectiveness of human health by lacking periodic reviews or groundwater monitoring.

7.5.9 State Acceptance

State acceptance will be addressed by NYSDEC, in consultation with NYSDOH, during preparation of the PRAP that will be released for public comment.

7.5.10 Community Acceptance

Community acceptance will be addressed by NYSDEC, in consultation with NYSDOH, during preparation of the PRAP that will be released for public comment.

8. SUMMARY AND RECOMMENDED REMEDY

The FS was conducted consistent with the requirements of NYSDEC DER-10 and CERCLA (USEPA 1988). As such, RAOs were identified to address the elimination or mitigation of significant threats to human health and the environment presented by historical operations at the Site, as required by 6 NYCRR Part 375-2.8(a) (NYSDEC 2006) and the cost-effective protectiveness of human health and the environment and attainment of ARARs as required by CERCLA (USEPA 1988). The threats to human health and the environment were identified through evaluation of exposure pathways and comparison of concentrations in affected media to ARARs.

As documented in the RIR, the affected media at the Site are soil, bedrock groundwater and future indoor air/sub-slab soil vapor. The COCs associated with the former RFM Site are TCA, its associated degradation products, and the TCA constituent compound, 1,4-dioxane. Other compounds including PCE and its associated degradation products have been historically detected but are not related to activities at the former RFM Site.

Following the 1999 soil excavation, none of the RFM RI or pre-RI soil sample concentrations from any location on the former RFM Site exceeded the Commercial Use SCOs for TCA. There are only two exceedances of the Protection of Groundwater SCO for TCA (0.680 mg/kg) in soil samples collected from under the building concrete slab floor and these samples were from AOC-2 with results of BH-99-44 (8 to 10 ft bgs) at 0.920 mg/kg and OBG-SB-13 (9.5 to 10.5 ft bgs) at 0.710 mg/kg.

As part of the RFM RI, sub-slab and indoor air samples were collected at the former RFM Site. The soil vapor results indicated that concentrations of VOCs were present in the sub-slab soil vapor samples and indoor air samples. Based on review of the sample results, NYSDEC (Sowers 2004) requested the completion of an IRM in the RFM building prior to any re-occupancy of the building (further discussed in Section 3.5). The RFM building was vacant since 2003, and was demolished and removed in November/December 2015 and therefore, no IRM has been completed. Additionally, recharge well ITT-W-1 is planned to be abandoned as part of active remedial alternatives presented in this FS.

During the RFM RI, groundwater impacts by COCs were observed in samples collected on the RFM Site from monitoring wells screened in the Eramosa, upper Penfield, and Deep Bedrock. TCA was the primary CVOC reported in groundwater during the RFM RIR and degradation products of TCA, PCE, TCE, as well as BTEX were also regularly detected in RFM RI groundwater samples. The most current groundwater results on the former RFM Site were from samples collected in 2013 (O'Brien and Gere 2014a). During the 2013 groundwater sampling, exceedences of Class GA Standards were observed in several monitoring wells located in the northeast corner of the former RFM Site and to the north of the former RFM Building. No Class GA exceedences were observed in in groundwater samples from the southern portion of the former RFM Site.

CVOC analysis of bedrock core samples conducted as part of the RFM RI confirmed that the bedrock matrix diffusion process was the controlling natural attenuation mechanism affecting the nature and extent of CVOCs in bedrock groundwater at the Site. Both physical and chemical processes associated with bedrock matrix diffusion control and retard groundwater COC migration and have resulted in stabilization of the extent of CVOCs in groundwater. The majority of CVOC mass now occurs in the rock matrix and this transfer of CVOC mass from mobile (i.e., groundwater in permeable fractures) to immobile zones (i.e., pore water and sorbed phase in extremely low permeability rock matrix) is expected to have caused the strong attenuation of CVOC transport observed in the bedrock groundwater at the Site.

Physical and technical limitations on active remediation processes for the treatment of bedrock groundwater exist at the Site because the vast majority of the CVOC mass in the bedrock system has diffused into and is stored in the primary porosity of the bedrock matrix. Once stored in the primary porosity of the bedrock matrix, removal of CVOCs by active engineered treatment processes has been demonstrated to be largely ineffective because of the inability of all existing active remediation technologies to access CVOCs that have diffused into the bedrock matrix. Once present in the bedrock matrix, CVOCs must desorb and diffuse from the bedrock matrix into fracture groundwater for active remediation technologies to be effective. This "back diffusion" process is known to take a very, very long time (many decades). This back diffusion process also has the ability to cause COC concentrations in fracture groundwater to last for a much longer time than if there were no COCs in the matrix.

Materials are presented in the RFM RIR and this FS regarding both the scientific basis and regulatory decisions made at other sites in NYS with CVOCs present in fractured sedimentary bedrock sites. The collection and analysis of rock cores for CVOC analysis is well established and has been accepted by the scientific community and many state and federal regulatory agencies, including NYSDEC. The use of rock matrix CVOC data and the process of bedrock matrix diffusion and associated back diffusion of CVOCs from the primary porosity of the rock matrix into permeable sedimentary rock fractures has been accepted and used in regulatory decisions regarding the analysis and selection of remedies at many sites. The scientific and regulatory use of the bedrock matrix diffusion processes in screening, analyzing and selecting remedial actions at sites is directly applicable to this FS and remedial alternatives and selection at the former RFM Site. Given that the bulk of the CVOC mass at the RFM Site in the bedrock system is bound in the bedrock matrix, it is concluded in this FS that it is technically impractical to restore bedrock groundwater to pre-disposal conditions using any active remediation technology in a timeframe that would be shorter than relying on the documented natural attenuation processes already operative in the Site groundwater.

As described in this FS, the following RAOs were identified:

RAOs for the protection of human health

- Mitigate, to the extent necessary and practicable, impacts to public health resulting from existing, or the potential for, soil vapor intrusion into a new building constructed at the Site. Prevent, to the extent necessary and practicable, unacceptable risks to human health associated with ingestion and direct exposure with untreated bedrock groundwater.
- Prevent, to the extent necessary and practicable, unacceptable risks to human health associated with inhalation of VOCs in untreated bedrock groundwater.

RAOs for protection of the environment:

- Restore bedrock groundwater to predisposal/pre-release conditions, to the extent necessary and practicable.
- Prevent, to the extent necessary and practicable, migration of contaminants in soil that would result in groundwater contamination.

Technology and process options to address the RAOs in the various media were identified, screened and evaluated. Following the evaluation of technologies, five remedial alternatives were developed. These were:

- Alternative 1: no further action
- Alternative 2: institutional controls, limited soil excavation, containment, natural attenuation, and groundwater monitoring
- Alternative 3: institutional controls, limited soil excavation, *in situ* soil treatment, natural attenuation, and groundwater monitoring
- Alternative 4: institutional controls, soil excavation and disposal, natural attenuation, and groundwater monitoring
- Alternative 5: thermal treatment and limited soil excavation alternative aimed at restoring the Site to pre-disposal conditions.

Following the development of remedial alternatives, the five remedial alternatives were subjected to a screening, during which they were screened against effectiveness, implementability and cost. Alternative 5 was screened from further consideration due to anticipated limited effectiveness and implementability. The basis of screening Alternative 5 from further consideration was based on Site-specific limitations related to the presence of fractured bedrock exhibiting large fractures (e.g., up to 4.4 inches) and the presence of CVOCs in the bedrock matrix limiting the effectiveness of thermal treatment of bedrock groundwater. It is anticipated that the effects of the large inflows of groundwater into the bedrock during thermal treatment would inhibit the technology from reaching target heating temperatures, to such an extent that the duration to achieve pre-disposal conditions using thermal treatment would likely not be different from the duration for these to be achieved using natural attenuation processes alone included in Alternatives 2, 3 and 4.

Based on the detailed evaluation of the four remaining alternatives, in accordance with evaluation criteria consistent with DER-10 (NYSDEC 2010a) and CERCLA (USEPA 1988), Alternative 2 is recommended as the final remedy for the Site. Alternative 2 is recommended because it satisfies the two threshold criteria, overall protection of human health and the environment, and compliance with ARARs, to the extent practicable, and provides the best balance with respect to the primary balancing criteria (long-term and short-term effectiveness and permanence, reduction in toxicity, mobility and volume, implementability and cost).

Alternative 2 would include maintenance of Site surface covers (e.g., vegetative soil, asphalt and concrete surfaces), limited soil excavation in the vicinity of SS-8, modifications to the existing environmental easement/deed restrictions to comply with current NYSDEC policy, natural attenuation and routine bedrock groundwater monitoring, and a Site Management Plan and periodic Site reviews. The continued protectiveness of the remedy would be evaluated via groundwater monitoring and periodic Site reviews. Additionally under Alternative 2, the Site surface water runoff recharge well ITT-W-1 would be abandoned and the building slab would remain. Remedial components of Alternative 2 are described in **Section 7.1.2**. Public water supply would continue to be available for use at the Site. **Figure 7-1** depicts the components of this alternative and a detailed analysis of Alternative 2 is presented in **Table 7-2**. The basis for the recommendation of Alternative 2 is provided below.

8.1 BASIS FOR RECOMMENDING ALTERNATIVE 2

The recommended remedy for the former RFM Site is based on the results of the RI and the evaluation of the alternatives presented in this FS. The criteria to which potential remedial alternatives are compared are defined in 6 NYCRR Part 375 and presented in DER-10 (NYSDEC 2010a) and CERCLA (USEPA 1988).

Threshold Criteria

The first two evaluation criteria are termed “threshold criteria” and must be satisfied in order for an alternative to be considered for selection.

1. **Protection of Human Health and the Environment.** This criterion is an overall evaluation of the ability of each alternative to protect public health and the environment.

Alternative 2 is protective of human health and the environment. COCs detected in soil during the RI were below Industrial Use SCOs and Commercial Use SCOs. Based on the current zoning for the former RFM Site and a DCR (Monroe, 2004) that stipulates industrial land use, it is reasonable to anticipate that the Site will continue to be used for industrial purposes. The maintenance of the surface covers (e.g., vegetative soil, asphalt and concrete surfaces) would be protective of human health by minimizing contact with soil. Isolated detections of TCA, 1,1- 1,1-DCE, acetone, and 1,4-dioxane exceeded Protection of Groundwater SCOs under the former RFM building. Maintenance of surface covers (e.g., vegetative soil, asphalt and concrete surfaces) would be protective of the environment by minimizing infiltration of rainwater and potential leaching of COCs from soils to the groundwater. Alternative 3 (SVE) and Alternative 4 (limited excavation) provide for more treatment of COC impacted soils under the former RFM building in comparison to Alternative 2, which utilizes natural attenuation of COC-impacted soils over time. Under Alternatives 2, 3 and 4 the implementation of a Site Management Plan allows for emplacement of a means for vapor intrusion mitigation if another building is constructed on the Site. Implementation of a Site Management Plan and modifications to the environmental easement/deed restrictions (necessary to comply with current NYSDEC policy) would minimize potentially unacceptable risks to public health and would provide for mitigation of exposures to soils and future indoor air/sub-slab soil vapor under Alternatives 2, 3 and 4. Therefore with respect to exposure to soils and sub-slab vapor/future indoor air, Alternative 2 is as protective of the public health and the environment as are Alternatives 3 and 4.

Natural attenuation would restore bedrock groundwater quality over time under Alternatives 2, 3 and 4. As discussed in Section 3.4.3, natural attenuation processes, including matrix diffusion, sorption, and/or abiotic and biotic degradation, can be expected to significantly reduce the rate of downgradient migration to the Cinemark property of the TCA concentrations and will at some point result in the stabilization and eventual contraction of the extent of TCA downgradient migration. It is expected that Eramosa bedrock formation groundwater TCA concentrations will continue to decline. Groundwater monitoring included in this alternative provides a means for confirming that CVOC migration in groundwater does not result in either an expanded magnitude and/or extent beyond current conditions. Periodic reviews under Alternatives 2, 3 and 4 would provide for evaluation of continued protectiveness of human health and the environment. Use of the existing public drinking water source is protective of human health. There are no known receptors of CVOCs for groundwater at the Site.

2. **Compliance with Potentially Applicable or Relevant and Appropriate Requirements (ARARs).** Compliance with ARARs addresses whether a remedy will meet environmental laws, regulations, and other standards and criteria.

Soil removal conducted to date has partially addressed soil ARARs. Because COCs detected in soil samples collected during the RI were below Industrial Use SCOs and Commercial Use SCOs, Alternative 2 currently meets these criteria. Alternatives 2, 3 and 4 each address Protection of Groundwater SCOs; the main differentiator is the amount of time to reach SCOs. Alternative 4 would require the least amount of time to achieve ARARs through excavation; Alternative 3 would require more time to achieve ARARs using SVE to treat soils; and the alternative that would need the most time to achieve ARARs is Alternative 2, which utilizes natural attenuation to achieve ARARs. During the time period needed for Alternative 2 to attain ARARs, the maintenance of vegetative soil, asphalt and/or concrete surface covers minimizes leaching of soils exceeding Protection of Groundwater Criteria.

Alternatives 2, 3 and 4 all utilize natural attenuation to achieve groundwater ARARs and there is no difference in the time period required to meet groundwater ARARs among these alternatives. Alternative 2 may achieve groundwater ARARs in the long term by continuing reductions of CVOCs through natural attenuation processes to nontoxic byproducts (i.e., carbon dioxide and ethane), ultimately reducing both the concentration and mass of the CVOCs in the groundwater. A waiver of the chemical-specific ARARs for groundwater may be indicated due to the technical impracticability of restoring CVOCs in heterogeneous fractured bedrock systems to Class GA groundwater standards. The technical impracticability of achieving Class GA groundwater standards for CVOCs at the former RFM Site is based on technical challenges due to fractured sedimentary bedrock and the rate limiting effects posed by bedrock matrix diffusion of CVOCs. This technical impracticability is strongly supported both from a scientific basis as well as by a number of precedent setting regulatory decisions made at sites in NYS, as described in the FS. Given that the bulk of the CVOC mass at the RFM Site is in the bedrock and is strongly bound in the bedrock matrix, it is technically impractical to restore bedrock groundwater to pre-disposal conditions using any remediation technology in a timeframe that would be shorter than relying on the documented natural attenuation processes already operative in the Site groundwater.

Balancing Criteria

3. **Long-Term Effectiveness and Permanence.** This criterion evaluates the long-term effectiveness of the remedial alternatives after implementation. If wastes or treated residuals remain on-Site after the selected remedy has been implemented, the following items are evaluated: 1) the magnitude of the remaining risks, 2) the adequacy of the engineering and/or institutional controls intended to limit the risk, and 3) the reliability of these controls.

Alternative 2 provides for minimal long-term residual risks. Alternative 2 combines natural attenuation and engineering controls (surface covers and a means for vapor intrusion mitigation) to mitigate risk associated with CVOC concentrations in soil, bedrock groundwater, and in indoor air/sub-slab soil vapor should another building be constructed on Site. Residual risks to human health are minimized through modified environmental easement/deed restrictions and the existing public water source. Maintained covers, a means for vapor intrusion mitigation (in the event another building is constructed on Site) and natural attenuation coupled with institutional controls, groundwater monitoring, and periodic reviews are effective means of managing long-term risks at the Site.

Under Alternative 2 the maintenance of surface covers and a means for vapor intrusion mitigation in future buildings are both adequate and reliable means of controlling Site risks related to soil and to indoor air/sub-slab soil vapor should another building be constructed on Site. Also under Alternative 2 the modified environmental easement/deed restrictions are a reliable means of minimizing potential for future exposure to soil and bedrock groundwater. Alternative 2 provides for monitoring and periodic reviews that are a reliable means of assessing protectiveness of the remedy. While there are no known receptors of CVOCs for groundwater and the CVOC impacts are not expected to expand in magnitude or extent, natural attenuation with groundwater monitoring for CVOCs under Alternative 2 is a reliable method to confirm that CVOC migration in groundwater does not result in an expanded magnitude and/or extent beyond current conditions. A Site Management Plan, as part of Alternative 2, is a reliable and effective means of controlling exposure to CVOCs in soil, bedrock groundwater and in indoor air/sub-slab soil vapor should another building be constructed on Site.

4. **Reduction of Toxicity, Mobility or Volume.** Preference is given to alternatives that permanently and significantly reduce the toxicity, mobility or volume of the wastes at the site.

Based on the 1999 excavation, there has already been a reduction in volume and mobility of COCs within the 968 tons of CVOC-impacted soil at the Site. Alternatives 3 and 4 result in the greatest reduction in toxicity, mobility or volume through either treatment or removal of soil exhibiting concentrations greater than NYS SOCs for the protection of groundwater. Under Alternative 2, it is anticipated that there will be continued reduction of mobility of CVOC-impacted soil exceeding Protection of Groundwater SCOs as a result of the reduction of precipitation infiltration due to the asphalt and/or building slab covers.

Each alternative utilizes natural attenuation processes to reduce the toxicity, mobility or volume of CVOCs in bedrock groundwater. Alternative 2, 3 and 4 result in the reduction of toxicity, mobility and volume of CVOCs in bedrock groundwater by reducing the CVOC mass in the bedrock matrix and subsequently in the bedrock groundwater as a result of natural attenuation processes. Groundwater monitoring included in this alternative provides a means of evaluating potential reduction in the toxicity, mobility and volume of CVOC-impacted bedrock groundwater.

5. **Short-term Impacts and Effectiveness.** The potential short-term adverse impacts of the remedial action upon the community, the workers, and the environment during the construction and/or implementation are evaluated. The length of time needed to achieve the remedial objectives is also estimated and compared against the other alternatives.

Proper community health and safety measures would be employed during implementation of Alternative 2. Dust, surface runoff, erosion, and volatile emissions, if any, would be controlled during construction activities associated with the surface covers (e.g., vegetative soil, asphalt and concrete surfaces), and abandonment of recharge well ITT-W-1. Proper health and safety measures would be established and employed during implementation of Alternative 2, and would be effective in protecting workers from exposure to adverse conditions. Dust, surface water runoff controls, and erosion control measures would also be instituted to minimize impacts to the environment during implementation Alternative 2. Negligible short-term fuel/energy use, greenhouse gas emissions and water use would result during implementation Alternative 2. Alternatives 3 and 4 have considerably greater short-term fuel/energy use and greenhouse gas emissions in comparison to Alternative 2. Implementation of Alternative 2 also results in minimal resource use and impacts to water and ecology. Green remediation techniques, as detailed in NYSDEC DER-31, would be considered to reduce short-term impacts of Alternative 2. Under Alternatives 2, 3 and 4, RAOs for the protection of human health exposure to groundwater are currently achieved and would continue to be achieved upon completion of each of these remedies. The RAO for human health exposure to indoor air would be achieved upon implementation of Alternative 2. The RAO for protection of the environment related to migration of CVOCs in soil to groundwater is currently addressed by site covers and would continue to be addressed upon completion of Alternative 2. Under Alternative 2, it is not expected to achieve the RAO related to groundwater restoration in the short-term. It should be noted that it is not technically feasible to meet the RAO related to the restoration of groundwater to pre-disposal conditions at this Site in the short-term. The RAO related to groundwater restoration is expected to be met in the long-term through natural attenuation processes under Alternatives 2, 3 and 4.

A key element that differentiates Alternatives 2, 3 and 4 for short-term effectiveness is the amount of time that remedial operations will be required on-site. These time periods are:

Alternative 2 - Approximately 6 months
Alternative 3 - Approximately 5 years and 6 months
Alternative 4 - Approximately 2 years and 6 months

6. **Implementability.** The technical and administrative feasibility of implementing each alternative are evaluated. Technical feasibility applies to the construction of the remedy and the ability to monitor its effectiveness. For administrative feasibility, the availability of the necessary personnel and materials is evaluated along with specific operating approvals, access for construction, and institutional controls.

Site work associated with implementation of Alternative 2 is the abandonment of recharge well ITT-W-1, which are common elements of Alternatives 2, 3 and 4. Compared to Alternative 3, which requires the installation of an SVE system and an estimated five and a half years of operations and Alternative 4, which requires removal of all building foundations, slabs, footings, subsurface utilities and may also require some shoring, Alternative 2 is the easiest remedy to implement. Alternative 3 may also be challenging to implement because of the general ineffectiveness of SVE in silt/clay soils, which are present in layers in the subsurface at the Site. Maintenance of surface covers is readily implementable and a reliable containment method. Implementation of Alternative 2 would not preclude consideration of a new and/or innovative alternative, if necessary, should new technological advances be made at a future date.

Alternatives 2, 3 and 4 each include groundwater monitoring, periodic reviews that would monitor the protectiveness of these remedies. Implementation of a Site Management Plan and modifications to the existing environmental easement/deed restrictions (necessary to comply with current NYSDEC policy) is technically and administratively readily implementable and would minimize potentially unacceptable risks to public health and the environment and provides for mitigation of exposures to soils and future indoor air/sub-slab soil vapor under Alternatives 2, 3 and 4.

Coordination with NYSDEC and possibly other local agencies is necessary to implement Alternative 2 on-Site. Implementation of Alternative 2 requires no off-Site treatment, storage or disposal services. Equipment, specialists and materials are readily available to implement Alternative 2.

7. **Cost-Effectiveness.** Capital costs and annual monitoring and O&M costs are estimated for each alternative and compared on a present worth basis. Although cost-effectiveness is the last balancing criterion evaluated, where two or more alternatives have met the requirements of the other criteria, it can be used as the basis for the final decision.

The total present worth cost of the active alternatives ranges from approximately $0.8 million to $3.4 million. Alternative 2 has the lowest total present worth cost (approximately $0.8 million), but some soils exceeding Protection of Groundwater SCOs will be left in place and will remain on the property, whereas under Alternative 3 (approximately $3.4 million) soils are treated with SVE and in Alternative 4 (approximately $1.5 million) soils are removed through excavation. However, under each alternative, the potential for future vapor intrusion remains, and is addressed through institutional controls and a Site Management Plan. Because the same need exists for potential vapor intrusion mitigation under each alternative as well as the same need for institutional controls for maintaining covers and inhibiting groundwater use, the increased costs and increased short-term fuel/energy use and greenhouse gas emissions associated with implementation of Alternatives 3 or 4 provide little benefit to public health and the environment, beyond that provided in Alternative 2.

8. **Land Use.** When cleanup to pre-disposal conditions is determined to be infeasible, the NYSDEC may consider the current, intended, and reasonable anticipated future land use of the Site and its surroundings in the selection of the soil remedy.

Based on the current zoning for the former RFM Site and a DCR (Monroe 2004) that stipulates industrial land use, it is reasonable to anticipate that land use at the Site will continue to be used for industrial purposes. Alternatives 2, 3, and 4 would each be implemented in a manner consistent with current and reasonably anticipated future use of the property. Alternative 2 provides for the maintenance of building slab, asphalt and/or vegetative soil surface cover that minimizes leaching of soils exceeding Protection of Groundwater Criteria remaining under the building after Alterative 2 is implemented. The environmental easement/deed restrictions and Site Management Plan will address risks associated with these soils. These potential residual risks would be managed in the same way as under Alternative 2.

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Tables

ITT Corporation
Former RFM Facility
Town of Gates, New York
Feasibility Study

Table 3-1: Analysis of TCA Bedrock Matrix Concentrations from AMSF-MW-17-MP

Elevation of Sample (ft AMSL)	Depth of Sample (ft bgs)	TCA Bedrock Matrix Concentration µg (VOC)/g (rock)	Average TCA Bedrock Matrix Concentration in Adjacent Samples µg (VOC)/g (rock)
551.69	11.75	1.0119	0.5267
551.39	12.05	0.0416	0.0796
550.49	12.95	0.1177	0.0734
549.89	13.55	0.0291	0.2660
548.09	15.35	0.5030	0.2522
547.69	15.75	0.0015 U	0.0012
547.09	16.35	0.0008 U	0.0009
545.49	17.95	0.0010 U	4.3176
545.19	18.25	8.6342	4.3175
543.69	19.75	0.0008 U	4.5296
543.09	20.35	9.0583	5.0966
542.19	21.25	1.1349	0.5679
541.29	22.15	0.0009 UB	0.0388
540.59	22.85	0.0767	0.0386
540.09	23.35	0.0006 U	0.0011
538.99	24.45	0.0016 U	0.0015
538.49	24.95	0.0014 U	
	Mean	1.2127	
	Median	0.0291	
	Geomean	0.0249	
		Total area under curve	20.1092

Notes:

µg - micrograms

ft AMSL - feet above mean sea level

ft bgs - feet below ground surface

g - grams

U - Not Detected at the Detection Limit shown

UB - Analyte was not detected above the raised detection limit due contamination in the associated blank.

VOC - volatile organic compound

Table 3-2. Analysis of TCA Bedrock Matrix Concentrations from ITT-IBW-20

Elevation of Sample (ft AMSL)	Depth of Sample (ft bgs)	TCA Bedrock Matrix Concentration ug (VOC)/g (rock)	Average TCA Bedrock Matrix Concentration in Adjacent Samples ug (VOC)/g (rock)
551.62	13.45	0.0653	0.0332
550.02	15.05	0.0010 UB	0.0010
549.42	15.65	0.0011 UB	0.0010
549.02	16.05	0.0010 U	0.9951
547.72	17.35	1.9892	0.9953
547.12	17.95	0.0013 U	0.0017
546.42	18.65	0.0021 U	0.8974
544.72	20.35	1.7926	0.8968
544.12	20.95	0.0009 U	4.8752
543.52	21.55	9.7496	4.8750
542.92	22.15	0.0005 UB	0.0006
542.12	22.95	0.0006 UB	0.0470
541.72	23.35	0.0933	0.0474
540.42	24.65	0.0016 UB	
	Mean	0.9786	
	Median	0.0014	
	Geomean	0.0107	
		Total area under curve	13.6667

Notes:

µg - micrograms

ft AMSL - feet above mean sea level

ft bgs - feet below ground surface

g - grams

U - Not Detected at the Detection Limit shown

UB - Analyte was not detected above the raised detection limit due contamination in the associated blank.

VOC - volatile organic compound

Table 4-1: Potentially Applicable or Relevant and Appropriate Requirements (ARARs)

Medium/Location/ Action	Citation	Requirements	Comments	Potential ARAR	Potential TBC
Potential Chemical-Specific ARARs and TBCs					
Soil/fill material	6 NYCRR Part 375-6 Remedial Program Soil Cleanup Objectives	Promulgated state regulation that provides guidance for soil cleanup objectives for various restricted property uses (industrial, commercial, restricted residential, and residential), for the protection of groundwater and ecological resources, and for unrestricted property use. Industrial use is the land use category which is considered for the primary purpose of manufacturing, production, fabrication or assembly processes and ancillary services. Industrial use does not include a recreational component. The commercial use category anticipates use by businesses with the primary purpose of buying, selling or trading of merchandise or services and includes passive recreational (DER-10 (NYSDEC 2010)).	Soil cleanup objectives for restricted use (industrial and commercial) are potentially relevant and appropriate to site soil for areas where reasonably anticipated future property use includes industrial or commercial use. While characterization data indicates that subsurface soil has limited impact on bedrock, if any, soil cleanup objectives for the protection of groundwater are being considered for this FS.	Yes	No
	New York State Department of Environmental Conservation Commissioner's Policy - Soil Cleanup Guidance (CP-51) (October 21, 2010)	CP-51 provides recommended soil cleanup levels appropriate for various NYSDEC Department of Environmental Remediation (DER) remedial programs.	To be considered for site soil.	No	Yes
Bedrock groundwater	6 New York Codes, Rules and Regulations (NYCRR) 703 - Class GA groundwater quality standards	6 NYCRR 703 requires that fresh groundwaters of the state must attain Class GA standards.	Potentially applicable to groundwater.	Yes	No
	NYSDEC Technical and Operational Guidance Series (TOGS) 1.1.1 - Ambient Water Quality Standards and Guidance Values and Groundwater Effluent Limitations (June 1998 as amended)	The TOGS 1.1.1 presents NYSDEC Division of Water Ambient Water Quality Standards and Guidance Values and Groundwater Effluent Limitations. The authority for these values is derived from Article 17 of the Environmental Conservation Law and 6 NYCRR 700-706, Water Quality.	Standards potentially applicable to groundwater. Guidance values are to be considered for site groundwater.	Yes	Yes
	National Primary Drinking Water Regulations (NPDWRs) - Maximum Contaminant Levels (MCLs)	NPDWRs require the public water systems attain primary drinking water standards, regulating contaminant concentrations in drinking water.	Potentially applicable to groundwater.	Yes	No
	10 NYCRR 5 - New York State Department of Health Drinking Water Standards	10 NYCRR 5-1 establish MCLs for public drinking water.	Potentially applicable to groundwater.	Yes	No
Indoor air/sub-slab vapor	NYSDOH's October 2006 Guidance for Evaluating Soil Vapor Intrusion in the State of New York	Guidance document that provides thresholds for indoor air and subslab soil vapor above which vapor mitigation is required.	Not currently applicable, because no buildings on the Site are occupied. Potentially applicable if buildings are re-occupied in the future at the Site.	No	Yes
Potential Location-Specific ARARs and TBCs					
Wetlands	6 NYCRR 663 - Freshwater wetland permit requirements	Actions occurring in a designated freshwater wetland (within 100 ft) must be approved by NYSDEC or its designee. Activities occurring adjacent to freshwater wetlands must: be compatible with preservation, protection, and conservation of wetlands and benefits; result in no more than insubstantial degradation to or loss of any part of the wetland; and be compatible with public health and welfare.	No wetlands present at site.	No	No
	Executive Order (EO) 11990 - Protection of Wetlands	Activities occurring in wetlands must avoid, to the extent possible, the long- and short-term adverse impacts associated with the destruction or modification of wetlands. The procedures also require the United States Environmental Protection Agency (USEPA) to avoid direct or indirect support of new construction in wetlands wherever there are practicable alternatives or to minimize potential harm to wetlands when there are no practicable alternatives.	No wetlands present at site.	No	No
	Clean Water Act Section 404 33 CFR Parts 320 - 330	Regulatory policies and permit requirements for work affecting waters of the United States, including wetlands.	No wetlands present at site.	No	No
	Clean Water Act Section 404 40 CFR Parts 230-231	Provides for restoration and maintenance of integrity of waters of the United States, including wetlands, through the control of dredged or fill material discharge.	No wetlands present at site.	No	No
	USEPA Office of Solid Waste and Emergency Response (OSWER) Directive 9280.0-02 (August 1985) - Policy on Floodplains and Wetlands Assessments for CERCLA Actions	Superfund actions must meet the requirements of EO 11990 (Protection of Wetlands) and EP 11988 (Floodplain Management).	No wetlands present at site.	No	No
Floodplains	6 NYCRR 373-2.2 - Location standards for hazardous waste treatment, storage, and disposal facilities -100-yr floodplain	Hazardous waste treatment, storage, or disposal facilities located in a 100-yr floodplain must be designed, constructed, operated and maintained to prevent washout of hazardous waste during a 100-yr flood.	The site is not located within a 100-yr floodplain.	No	No
	40 CFR Part 264.18(b) - Location Standards - Floodplains	Hazardous waste treatment, storage, or disposal facilities located in a 100-yr floodplain must be designed, constructed, operated and maintained to prevent washout of hazardous waste during a 100-yr flood.	The site is not located within a 100-yr floodplain.	No	No
	Executive Order 11988 - Floodplain Management	USEPA is required to conduct activities to avoid, to the extent possible, the long- and short- term adverse impacts associated with the occupation or modification of floodplains. The procedures also require USEPA to avoid direct or indirect support of floodplain development wherever there are practicable alternatives and to minimize potential harm to floodplains when there are no practicable alternatives.	The site is not located within a 100-yr floodplain.	No	No
	6 NYCRR 500 - Floodplain Management Regulations Development Permits	Promulgated state regulations providing permit requirements for development in areas of special flood hazard (floodplain within a community subject to a one percent or greater chance of flooding in any given year).	The site is not located within a 100-yr floodplain.	No	No
	USEPA OSWER Directive 9280.0-02 (August 1985) - Policy on Floodplains and Wetlands Assessments for CERCLA Actions	Superfund actions must meet the requirements of EO 11990 (Protection of Wetlands) and EO 11988 (Floodplain Management).	The site is not located within a 100-yr floodplain.	No	No
Within 61 meters (200 ft) of a fault displaced in Holocene time	40 Code of Federal Regulations (CFR) Part 264.18	New treatment, storage, or disposal of hazardous waste is not allowed.	Not applicable. Not located within 200 ft of a fault displaced in Holocene time, as listed in 40 CFR 264 Appendix VI.	No	No
Wilderness area	Wilderness Act 50 CFR Part 35 - Wilderness Preservation and Management	Provides for protection of federally-owned designated wilderness areas.	Not applicable or relevant and appropriate. Site not located in wilderness area.	No	No
Wild, scenic, or recreational barrier	Wild and Scenic Rivers Act	Provides for protection of areas specified as wild, scenic, or recreational.	Not applicable or relevant and appropriate. Site not located near wild, scenic or recreational river.	No	No

Table 4-1: Potentially Applicable or Relevant and Appropriate Requirements (ARARs)

Medium/Location/ Action	Citation	Requirements	Comments	Potential ARAR	Potential TBC
Protection of Waters	33 U.S.C. 1341 - Clean Water Act Section 401, State Water Quality Certification Program	States have the authority to veto or place conditions on federally permitted activities that may result in water pollution.	Not applicable to site.	No	No
River or stream	16 USC 661 - Fish and Wildlife Coordination Act	Requires protection of fish and wildlife in a stream when performing activities that modify a stream or river.	No rivers or streams at the Site.	No	No
Habitat of an endangered or threatened species	6 NYCRR 182	Provides requirements to minimize damage to habitat of an endangered species.	Not applicable, as no endangered or threatened species or their habitat were found at the site.	No	No
	Endangered Species Act	Provides a means for conserving various species of fish, wildlife, and plants that are threatened with extinction.	Not applicable, as no endangered or threatened species or their habitat were found at the site.	No	No
Historical property or district	National Historic Preservation Act	Remedial actions are required to account for the effects of remedial activities on any historic properties included on or eligible for inclusion on the National Register of Historic Places.	Not applicable, as no historic properties were identified at the site.	No	No
Potential Action-Specific ARARs and TBCs					
Construction in a floodplain	6 NYCRR 500 - Floodplain management regulations development permits	Hazardous waste treatment, storage, or disposal facilities located in a 100-yr floodplain must be designed, constructed, operated and maintained to prevent washout of hazardous waste during a 100-yr flood.	The site is not located within a 100-yr floodplain.	No	No
Treatment actions	6 NYCRR 373 - Hazardous waste management facilities	Provides requirements for managing hazardous wastes.	Not applicable or relevant and appropriate as generation of hazardous waste is not anticipated.	No	No
General excavation	6 NYCRR 257-3 - Air Quality Standards	Provide limitations for generation of constituents including particulate matter.	Potentially applicable to excavated soils.	Yes	No
	40 CFR 50.1 through 50.12 - National Ambient Air Quality Standards.	Provides air quality standards for pollutants considered harmful to public health and the environment. The six principle pollutants include carbon monoxide, lead, nitrogen dioxide, particulates, ozone, and sulfur oxides.	Potentially applicable during dust generating activities such as earth moving, grading, and excavation of soil.	Yes	No
Generation and disposal of hazardous material and treatment residuals	6 NYCRR 360 - Solid Waste Management Facilities	Provides requirements for management of solid wastes, including disposal and closure of disposal facilities.	Potentially applicable.	Yes	No
Land disposal	6 NYCRR 376 - Land disposal restrictions	Provides treatment standards to be met prior to land disposal of hazardous wastes.	Potentially applicable.	Yes	No
Discharge to surface water	6 NYCRR 750 through 758 - State Pollutant Discharge Elimination System (SPDES) Regulations	Provides concentration limits and monitoring requirements for discharges to waters of the State.	Potentially applicable or relevant and appropriate for discharge of groundwater.	Yes	No
Construction	29 CFR Part 1910 - Occupational Safety and Health Standards - Hazardous Waste Operations and Emergency Response	Remedial activities must be in accordance with applicable OSHA requirements.	Applicable for construction phase of remediation.	Yes	No
	29 CFR Part 1926 - Safety and Health Regulations for Construction	Remedial construction activities must be in accordance with applicable OSHA requirements.	Applicable for construction phase of remediation.	Yes	No
Transportation	6 NYCRR 364 - Waste Transporter Permits	Hazardous waste transport must be conducted by a hauler permitted under 6 NYCRR 364.	Potentially applicable for transportation of excavated, non-hazardous soil.	Yes	No
	6 NYCRR Part 372 - Hazardous Waste Manifest System and Related Standards for Generators, Transporters, and Facilities	Substantive hazardous waste generator and transportation requirements must be met when hazardous waste is generated for disposal. Generator requirements include obtaining a USEPA Identification Number and manifesting hazardous waste for disposal.	Potentially applicable for transportation of excavated, non-hazardous soil.	Yes	No
	49 CFR 172-174 and 177-179 - Department of Transportation (DOT) Regulations	Hazardous waste transport to off-site disposal facilities must be conducted in accordance with applicable DOT requirements	Potentially applicable for transportation of excavated, non-hazardous soil.	Yes	No
Disposal	TSCA requirements and/or hazardous waste requirements.	TSCA or hazardous waste disposal must be conducted in accordance with applicable requirements	Not applicable or relevant and appropriate as generation of TSCA and hazardous waste are not anticipated.	No	No
Generation of air emissions	NYS Air Guide 1	Provides annual guideline concentrations (AGLs) and short-term guideline concentrations (SGCs) for specific chemicals. These are property boundary limitations that would result in no adverse health effects.	Potentially applicable.	Yes	No
	NYS TAGM 4031 - Dust Suppressing and Particle Monitoring at Inactive Hazardous Waste Disposal Sites	Provides limitations on dust emissions.	Potentially applicable.	Yes	No
Construction storm water management	NYSDEC General permit for storm water discharges associated with construction activities. Pursuant to Article 17 Titles 7 and 8 and Article 70 of the Environmental Conservation Law.	The regulation prohibits discharge of materials other than storm water and all discharges that contain a hazardous substance in excess of reportable quantities established by 40 CFR 117.3 or 40 CFR 302.4, unless a separate NPDES permit has been issued to regulate those discharges. A permit must be acquired if activities involve disturbance of 5 acres or more. If the project is covered under the general permit, the following are required: development and implementation of a storm water pollution prevention plan; development and implementation of a monitoring program; all records must be retained for a period of at least 3 years after construction is complete.	Not applicable due to site size less than 5 acres.	No	No

Notes:

ARARs - Applicable or Relevant and Appropriate Requirements
FS - Feasibility Study
MCLs - Maximum Contaminant Levels
NYCRR - New York Code of Rules and Regulations
NYSDEC - New York State Department of Environmental Conservation
NYSDOH - New York State Department of Environmental Conservation
NPDWRs - National Primary Drinking Water Regulations
OSWER - Office of Solid Waste and Emergency Response
SCOs - Soil Cleanup Objectives
TBC - To be Considered
TOGS - Technical and Operational Guidance Series
USEPA or EPA - United States Environmental Protection Agency

Table 6-1: Identification and Screening of Remedial Technologies and Process Options for Soil

General Response Action	Remedial Technology	Process Option	Description	Screening Comments
No further action	No further action	No further action	No further action considers the 1999 soil removal and the implementation of deed restrictions that provide for access and use restrictions.	Applicable. Required for consideration by the NCP (40 CFR Part 300.430) and NYSDEC DER-10 Technical Guidance for Site Investigation and Remediation.
Institutional Controls/Limited Actions	Access restrictions	Fencing	The installation of fencing and gates at the site to limit unauthorized access to the property.	Potentially applicable
	Use restrictions/administrative controls	Environmental easement/deed restrictions	Implementation and documentation of access and land use restrictions in accordance with the site management plan.	Potentially applicable, easement currently in place as part of IRM completed for RMF property.
		Site management plan	A site management plan would document site engineering and institutional controls and physical components of the selected remedy requiring operation, maintenance and monitoring to–provide continued effectiveness. The site management plan would also present provisions for periodic site reviews.	Potentially applicable
	Periodic reviews	Periodic site reviews	Periodic reviews are required by 6 NYCRR Part 375 where institutional and engineering controls, monitoring plans, and/or operations and maintenance activities are implemented at a site. The purpose of periodic reviews is to evaluate the site with regard to the continuing protection of human health and the environment and to provide documentation of remedy effectiveness. Periodic site reviews would be performed in accordance with 40 CFR 300.430(f)(4)ii.	Potentially applicable
Natural recovery	Natural attenuation	Natural attenuation	The natural degradation of CVOCs by *in situ* physical, chemical and/or biological processes. Over time, contaminants' toxicity, mobility, and/or volume of CVOCs can be reduced by processes that include biodegradation, sorption, dilution, volatilization, and/or transformation.	Potentially applicable

Table 6-1: Identification and Screening of Remedial Technologies and Process Options for Soil

General Response Action	Remedial Technology	Process Option	Description	Screening Comments
Containment	Capping	Vegetated soil, asphalt and concrete surfaces	Engineered cover consisting of vegetated soil, asphalt and concrete surfaces to promote overland drainage and minimize contact with soil. Top restoration cover selected based upon site use and restoration requirements within the covered area. Grading and cover installation would be performed such that drainage is promoted, erosion is minimized, and cover integrity is protected. If a cover did not include the concrete slab (*e.g* ., implementation of an asphalt or vegetative cover) removal of the concrete slab and footings may also be required.	Potentially applicable
		Low permeability cover	Use of low permeability cover to minimize surface water infiltration, encourage runoff and control erosion, and isolate and contain impacted soil. Low permeability cover components may consist of low permeability clay or a geomembrane system. Vegetation, asphalt, or gravel may be utilized as the top layer based upon site use and restoration requirements within the covered area. If impacted soils under the existing building are excavated, building demolition and removal of the concrete slab and footings may be required.	Potentially applicable
In situ treatment	Physical/chemical treatment	Passive soil venting	Soil gas containing CVOCs from the subsurface is removed and vented to the atmosphere via shallow wells. Natural pressure gradients between the subsurface and the atmosphere could drive the passive venting of soil gas.	Potentially applicable in conjunction with a low permeability cover and/or former building slab.
		Soil vapor extraction (SVE)	Vacuum is applied through extraction wells within the vadose zone to create a pressure/concentration gradient to extract organics sorbed on the soil, dissolved in soil-pore water and/or present as vapor. Extracted vapors are removed from the soil through extraction wells and treated *ex situ* as needed.	Potentially applicable
		Dual phase extraction	A high-pressure vacuum is applied through extraction wells to simultaneously extract groundwater and vapors from the subsurface. Extracted groundwater and vapors are separated and treated *ex situ* .	Not applicable because of limited soil thickness and lack of water table in soil.
		Solidification/stabilization	Contaminants are physically bound or enclosed within a stabilized mass (solidification), or chemical reactions are induced between stabilizing agent and contaminants to reduce their mobility (stabilization).	Not applicable because of potential for uncontrolled release of VOCs.

Table 6-1: Identification and Screening of Remedial Technologies and Process Options for Soil

General Response Action	Remedial Technology	Process Option	Description	Screening Comments
In situ treatment (cont'd)	Physical/chemical treatment (cont'd)	Chemical reduction	Mixing of reactive media and stabilizing agents with impacted soil using conventional soil mixing equipment.	Not applicable because of potential for uncontrolled release of VOCs.
		Chemical oxidation (ISCO)	Injection of oxidation agents such as hydrogen peroxide, ozone, sodium persulfide, Fenton's reagent and/or permanganate into the subsurface. Oxidation reactions chemically convert contaminants to non-hazardous or less toxic compounds that are more stable, less mobile, and/or inert. Oxidation agents can be applied to the subsurface via injection points, deep soil mixing, or soil fracturing.	Potentially applicable
		Flushing	Water, aqueous solution, surfactants, or cosolvents are injected into the subsurface. The extraction fluid is utilized to enhance CVOC solubility. CVOCs are leached into the groundwater and subsequently removed through a collection system and treated *ex situ* .	Potentially applicable in conjunction with a groundwater collection system.
	Biological treatment	Enhanced bioremediation	Injection of microbial populations, nutrient sources, or electron donors into the subsurface to enhance biological degradation of CVOCs to minimize their migration and accelerate their mass removal. Bioremediation amendments can be applied to the subsurface via hydrofracturing, injection points, a modified landfarming process, or mixing of the soil.	Potentially applicable
		Enhanced biotic/abiotic degradation	Use of zero valent iron (ZVI) (*i.e.* , nanoscale iron or bimetallic ZVI) and a slowly degrading carbon substrate to enhance physical, chemical and biological processes to create reducing conditions, resulting in complete CVOC degradation. Biological processes result in enhanced reactivity of ZVI. ZVI and carbon amendments can be applied to the subsurface via injection points or a permeable reactive barrier.	Potentially applicable

Table 6-1: Identification and Screening of Remedial Technologies and Process Options for Soil

General Response Action	Remedial Technology	Process Option	Description	Screening Comments
In situ treatment (cont'd)	Biological treatment (cont'd)	Bioventing	Use of air circulation to stimulate and support aerobic degradation of soil contaminants.	Not applicable. Not applicable for metals or chlorinated organics; reducing conditions preferred for chlorinated organic biological degradation.
		Phytoremediation	Use of plants to remove, transfer, stabilize, or destroy contaminants in soil.	Not applicable, not effective for deeper soils.
	Thermal treatment	Hot air/steam/hot water injection	Use of hot air, steam or hot water injection into soil to dissolve and vaporize CVOCs. The volatilized CVOCs are removed by vapor extraction and treated *ex situ* as needed. Hot water injection would be implemented in conjunction with a groundwater collection system.	Potentially applicable
		Soil heating	Heating of soil using various techniques, including heating wells, thermal blankets, injection points, electrodes, or electromagnetic energy to heat and volatilize CVOCs. Volatilized CVOCs are removed by vapor extraction and treated *ex situ* as needed.	Potentially applicable
		Vitrification	An electric current or plasma arc torch is utilized to melt soil at extremely high temperatures (1,600 to 2,000 °C [2,900 to 3,650 °F]) and thereby destroy organics by pyrolysis.	Potentially applicable
In situ treatment enhancement	Permeability enhancement	Pneumatic fracturing	Use of high pressure air to fracture soil. Gases of evaporated chemicals are captured and treated above ground. Pneumatic fracturing increases soil permeability, improving the performance of some *in situ* treatment technologies.	Potentially applicable for enhancement of soil permeability.
		Hydraulic fracturing	Use of liquid, usually water with or without propping agent, to create permeable channels in subsurface material. Hydraulic fracturing increases soil permeability, improving the performance of some *in situ* treatment technologies.	Potentially applicable for enhancement of soil permeability.
Removal	Excavation	Mechanical excavation (in addition to the 1999 soil excavation)	Use of construction equipment to remove impacted soil. Excavated soil can be transported off-site for disposal and/or consolidated on-site for treatment or containment. If impacted soils under the existing building are excavated, building demolition and removal of the concrete slab and footings may be required. Dewatering of excavated soil may be necessary to facilitate transportation or disposal.	Potentially applicable. Partial soil excavation was implemented as an IRM at the Site.

Table 6-1: Identification and Screening of Remedial Technologies and Process Options for Soil

General Response Action	Remedial Technology	Process Option	Description	Screening Comments
Ex situ treatment	On-site physical/chemical treatment	Particle size separation	Sieves and screens of different sizes are used to concentrate contaminants into smaller volumes. Most organic and inorganic contaminants tend to bind, either chemically or physically, to other soil particles. Separating the fine particles from the coarser particles can effectively concentrate the contaminants into a smaller volume of soil that could be further treated or disposed.	Not applicable because of potential for uncontrolled release of CVOCs.
		Solidification/stabilization	CVOCs are physically bound or enclosed within a stabilized mass (solidification), or chemical reactions are induced between stabilizing agent and CVOCs to reduce their mobility (stabilization) for excavated soils. Solidification and stabilization involve mixing treatment agents with the excavated impacted soil yielding a crystalline, glassy or polymeric framework around the impacted soil. If impacted soils under the existing building are excavated, building demolition and removal of the concrete slab and footings may be required. Treated soil would require transportation off-site for disposal and/or consolidated on-site for reuse or containment.	Potentially applicable
		Chemical oxidation	*Ex situ* treatment of impacted soil using oxidants such as ozone, hydrogen peroxide, hypochlorites, permanganate, Fenton's reagent and/or sodium persulfide. Oxidation reactions chemically convert CVOCs to non-hazardous or less toxic compounds that are more stable, less mobile, and/or inert. If impacted soils under the existing building are excavated, building demolition and removal of the concrete slab and footings may be required. Treated soil would require transportation off-site for disposal and/or consolidated on-site for reuse or containment.	Potentially applicable
		Chemical dechlorination	Reagent prepared from polyethylene glycol and potassium hydroxide dechlorinates CVOCs through a nucleophilic substitution process. The products of the reaction are non-toxic, non-mutagenic, and non-bioaccumulative. In this process, reagents are mixed with soil and heated in a reactor. If impacted soils under the existing building are excavated, building demolition and removal of the concrete slab and footings may be required. Treated soil would require transportation off-site for disposal and/or consolidated on-site for reuse or containment.	Potentially applicable

Table 6-1: Identification and Screening of Remedial Technologies and Process Options for Soil

General Response Action	Remedial Technology	Process Option	Description	Screening Comments
Ex situ treatment (cont'd)	On-site physical/chemical treatment (cont'd)	Extraction/washing	Impacted soil and extractant are mixed in an extractor, thereby dissolving the CVOCs. The extracted solution is then placed in a separator, where the CVOCs and extractant are separated for treatment and further use. If impacted soils under the existing building are excavated, building demolition and removal of the concrete slab and footings may be required. Treated soil would require transportation off-site for disposal and/or consolidated on-site for reuse or containment.	Potentially applicable
	On-site biological treatment	Biopiles	Excavated soil is mixed with soil amendments and placed in aboveground enclosures. Compost is formed into piles and aerated with blowers or vacuum pumps using an aerated static pile composting process. Naturally occurring microorganisms are stimulated through the addition of nutrients, oxygen, and cometabolites to enhance the degradation of organic contaminants into less toxic contaminants.	Not applicable for CVOCs.
		Biological reactor	Excavated soil is mixed with water and degrading microbes in a bioreactor. Aerobic conditions are maintained by agitation and air sparging. Biodegradation can be enhanced by adding nutrients and maintaining optimal dissolved oxygen, pH and temperature for microbial growth.	Not applicable for CVOCs.
		Landfarming	Impacted soil is excavated, applied into lined beds, and periodically turned over or tilled to aerate the waste. Naturally occurring microorganisms are stimulated through the addition of nutrients, oxygen, and cometabolites to enhance the degradation of organic contaminants into less toxic contaminants.	Not applicable for CVOCs and limited property size.
	On-site thermal treatment	Incineration	Combustion of CVOCs present in soil in incinerator at temperatures generally between 1600 and 2200 degrees F. Organic substances are oxidized into products that generally include CO_2, H2O vapor, SO_2, NOx, HCl gases and ash. If impacted soils under the existing building are excavated, building demolition and removal of the concrete slab and footings may be required. Treated soil would require transportation off-site for disposal and/or consolidated on-site for reuse or containment.	Potentially applicable for CVOCs.

Table 6-1: Identification and Screening of Remedial Technologies and Process Options for Soil

General Response Action	Remedial Technology	Process Option	Description	Screening Comments
Ex situ treatment (cont'd)	On-site thermal treatment (cont'd)	Low temperature thermal desorption	Use of direct or indirect heat to volatilize CVOCs at temperatures generally between 90 and 300 °C, creating a physical separation (volume reduction) process. The volatilized CVOCs from the thermal desorption process are typically directed to a secondary system for destruction via incineration, catalytic oxidation, adsorption on activated carbon, or recovery by condensation. If volatilized CVOCs are incinerated, further treatment of acid gases and particulates would be required. If impacted soils under the existing building are excavated, building demolition and removal of the concrete slab and footings may be required. Treated soil would require transportation off-site for disposal and/or consolidated on-site for reuse or containment.	Potentially applicable for CVOCs.
		Pyrolysis	Chemical decomposition of organic materials is induced by heat in the absence of oxygen at temperatures around 800 °F. Organic materials are transformed into gaseous components and solid residue (coke) containing fixed carbon and ash. If impacted soils under the existing building are excavated, building demolition and removal of the concrete slab and footings may be required. Treated soil would require transportation off-site for disposal and/or consolidated on-site for reuse or containment.	Potentially applicable for CVOCs.
Disposal	Off-site treatment/disposal	Commercial treatment/disposal facility	Excavated soil would be transported to an approved commercial hazardous waste treatment facility for treatment to meet land disposal restrictions.	Potentially applicable
	On-site disposal	On-site consolidation	Disposal of excavated or treated soil in on-site containment system and/or reused as fill. Soil for on-site consolidation must meet the applicable SCOs. Once consolidated, the area would be restored with vegetation, asphalt, or a cap.	Potentially applicable
	Off-site disposal	Commercial disposal facility	Excavated treated soil would be transported to a permitted hazardous commercial landfill, if it meets land disposal restriction requirements.	Potentially applicable

Table 6-1: Identification and Screening of Remedial Technologies and Process Options for Soil

General Response Action	Remedial Technology	Process Option	Description	Screening Comments

Notes:

CFR - Code of Federal Regulations
CO_2 - Carbon Dioxide
CVOC - Chlorinated Volatile Organic Compounds
DER - Division of Environmental Remediation
HCl - Hydrogen Chloride
H_20 - Water
ISCO - *In Situ* Chemical Oxidation
NCP - National Contingency Plan
Nox - Oxides of Nitrogen
NYCRR - New York Code of Rules and Regulations
NYSDEC - New York State Department of Environmental Conservation
SCO - Soil Cleanup Objective
SVE - Soil Vapor Extraction
SO_2 - Sulfer Dioxide
ZVI - Zero valent iron

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Table 6-2: Identification and Screening of Remedial Technologies and Process Options for Bedrock Groundwater

General Response Action	Remedial Technology	Process Option	Description	Screening Comments
No further action	No further action	No further action	No further action considers implementation of the existing easements/deed restrictions that provide for access and use restrictions.	Potentially applicable. Required for consideration by the NCP (40 CFR Part 300.430) and NYSDEC DER-10 Technical Guidance for Site Investigation and Remediation. Easement/deed restrictions currently exist for the former RFM Site.
Institutional controls/limited actions	Administrative controls	Environmental easement/deed restrictions	Restrictions of groundwater use where applicable. Existing public water supply.	Potentially applicable, easement currently exists as part of IRM completed for former RFM Site. Modifications to the environmental easement/deed restrictions would be necessary to comply with current NYSDEC policy.
		Site management plan	Documentation of site restrictions and provisions for continued operation and maintenance of the remedy. Presents requirements for groundwater monitoring and includes a provision for periodic site reviews.	Potentially applicable
	Alternate water supply	Public water supply	Public water currently exists at the former RFM site and in the vicinity of the former RFM site.	Applicable. Currently exists.
	Monitoring	Groundwater monitoring	Periodic sampling and analyses of bedrock groundwater as a means of monitoring CVOC concentrations. Groundwater monitoring also provides a means of monitoring remedy effectiveness.	Potentially applicable

Table 6-2: Identification and Screening of Remedial Technologies and Process Options for Bedrock Groundwater

General Response Action	Remedial Technology	Process Option	Description	Screening Comments
Institutional controls/limited actions (cont'd)	Periodic reviews	Periodic site reviews	Periodic reviews are required by 6 NYCRR Part 375 where institutional and engineering controls, monitoring plans, and/or operations and maintenance activities are implemented at a site. The purpose of periodic reviews is to evaluate the site with regard to the continuing protection of human health and the environment and to provide documentation of remedy effectiveness. Periodic site reviews would be performed in accordance with 40 CFR 300.430(f)(4)ii.	Potentially applicable
Natural recovery	Natural attenuation	Natural attenuation	Long-term monitoring of the natural degradation of CVOCs by *in situ* physical, chemical and/or biological processes. Over time, CVOCs toxicity, mobility, and/or volume can be reduced by processes that include biodegradation, sorption, dilution, volatilization, and/or transformation, diffusion of groundwater CVOCs into the bedrock matrix, desorption and back diffusion of bedrock matrix CVOCs into advective flowing groundwater. Monitoring of CVOCs only.	Potentially applicable for both dissolved CVOCs in groundwater and source material in bedrock matrix.
Containment	Physical barrier wall	Grout curtain	Injection of grout along the perimeter of the area of groundwater CVOC ARAR exceedences on the former RFM Site. This would potentially act to contain impacted groundwater within the Eramosa Formation. The grout curtain containment wall would need to extend into a confining unit.	Potentially applicable for dissolved CVOCs in groundwater. Not applicable to source material in bedrock matrix.
In situ treatment	Physical/chemical treatment	Circulation wells	Air is injected into the water column to volatilize dissolved CVOCs. Groundwater is circulated *in situ* , with groundwater entering the well at one screen and discharging through a second screen. Air is collected and treated if necessary.	Potentially applicable for dissolved CVOCs in groundwater. Not applicable to source material in bedrock matrix.
		Flushing	Water, aqueous solution, surfactants, or cosolvents are injected into the subsurface. The extraction fluid is utilized to enhance CVOC solubility. CVOCs are leached into the groundwater and subsequently removed through a collection system and treated *ex situ* .	Potentially applicable in conjunction with a groundwater collection system. Not applicable to source material in bedrock matrix.

Table 6-2: Identification and Screening of Remedial Technologies and Process Options for Bedrock Groundwater

General Response Action	Remedial Technology	Process Option	Description	Screening Comments
In situ treatment (continued)	Physical/chemical treatment (continued)	Air sparging	Injection of air into the saturated zone to volatilize dissolved CVOCs within the groundwater and transfers the CVOCs into a gas phase. Used in conjunction with soil vapor extraction and gas phase treatment.	Potentially applicable for dissolved CVOCs in groundwater. Not applicable to source material in bedrock matrix.
		Chemical oxidation	Addition of oxidation agents such as hydrogen peroxide, ozone, sodium persulfate and/or permanganate into groundwater. Oxidation reactions chemically convert CVOCs to non-hazardous or less toxic compounds that are more stable, less mobile, and/or inert.	Potentially applicable for both dissolved CVOCs in groundwater and source material in bedrock matrix.
	Biological treatment	Enhanced bioremediation	Injection of microbial populations, nutrient sources, or electron donors into groundwater to enhance anaerobic reductive dechlorination reactions of CVOCs in groundwater. Increases naturally active anaerobic biodegradation processes occurring in site groundwater via biostimulation and/or bioaugmentation.	Potentially applicable for both dissolved CVOCs in groundwater and source material in bedrock matrix.
		Enhanced biotic/abiotic degradation	Injection of soluble iron (i.e., ferric citrate), electron donors (i.e., a carbon source such as lactate or EVO), and/or sulfate to support biotic and abiotic process resulting in the degradation of organic contaminants. The addition of these amendments stimulates sulfate reducing microorganisms to convert iron to iron sulfides (precipitate). Iron sulfides promote the attenuation of organic contaminants.	Potentially applicable for both dissolved CVOCs in groundwater and source material in bedrock matrix.
	Treatment wall	Permeable reactive barrier	Construction of a reactive material wall, air sparging zone, or biobarrier to treat dissolved CVOCs in groundwater as it flows through the treatment zone. Permeable reactive barrier walls can be installed as a "funnel and gate"; funneling the groundwater toward the reactive media gate.	Not applicable. Extremely difficult to implement for bedrock.

Table 6-2: Identification and Screening of Remedial Technologies and Process Options for Bedrock Groundwater

General Response Action	Remedial Technology	Process Option	Description	Screening Comments
In situ treatment (continued)	Thermal treatment	Hot air/steam/hot water injection	Use of hot air, steam or hot water injection into wells to dissolve and vaporize CVOCs. The volatilized CVOCs are removed by vapor extraction and treated *ex situ* as needed. Hot water injection would be implemented in conjunction with a groundwater collection system.	Potentially applicable for both dissolved CVOCs in groundwater and source material in bedrock matrix.
		Bedrock heating	Heating of bedrock using various techniques, including heating wells, thermal blankets, injection points, electrodes, or electromagnetic energy to heat and volatilize CVOCs. Volatilized CVOCs are removed by vapor extraction and treated *ex situ* as needed.	Potentially applicable for both dissolved CVOCs in groundwater and source material in bedrock matrix.
Collection/hydraulic control	Single phase extraction	Vertical extraction/ horizontal wells	Use of vertical extraction wells to pump and collect impacted groundwater. Extracted groundwater and vapors are separated and treated *ex situ* .	Potentially applicable for dissolved CVOCs in groundwater. Not applicable to source material in bedrock matrix.
	Dual-phase extraction	Dual-phase extraction wells	A high-pressure vacuum is applied through extraction wells to simultaneously extract groundwater, NAPL, and vapors from the subsurface. Extracted groundwater and vapors are separated and treated *ex situ* .	Potentially applicable for dissolved CVOCs in groundwater. Not applicable to source material in bedrock matrix.
Collection/hydraulic control enhancement	Permeability enhancement	Pneumatic fracturing	Injection of high pressure air to create channels or fractures in subsurface material.	Not applicable. Extremely difficult to implement for bedrock.
		Hydraulic fracturing	Injection of water, with or without propping agent, into subsurface to create permeable channels in subsurface material.	Potentially applicable for dissolved CVOCs in groundwater and for source material in bedrock matrix.
		Controlled blasting	Use of explosives to construct subsurface bedrock trench for groundwater collection.	Not applicable due to proximity of neighboring facilities.

Table 6-2: Identification and Screening of Remedial Technologies and Process Options for Bedrock Groundwater

General Response Action	Remedial Technology	Process Option	Description	Screening Comments

Notes:

ARAR - Applicable or Relevant and Appropriate Requirement
CVOC - Chlorinated Volatile Organic Compound
DER - Department of Environmental Remediation
EVO - emulsified vegetable oil
NAPL - Non-aqueous Phase Liquid
NCP - National Contingency Plan
NYCRR - New York Codes, Rules and Regulations
NYSDEC - New York State Department of Environmental Conservation
RFM - Rochester Form Machine

Table 6-3: Identification and Screening of Remedial Technologies and Process Options for Indoor Air/Sub-Slab Soil Vapor

General Response Action	Remedial Technology	Process Option	Description	Screening Comments
No further action	No further action	No further action	Maintenance of the Access Restriction would be discontinued.	Applicable. Required for consideration by the NCP (40 CFR Part 300.430) and NYSDEC DER-10 Technical Guidance for Site Investigation and Remediation.
Institutional controls/limited actions	Administrative controls	Environmental easement	Provides for evaluation and mitigation of vapor intrusion if a new building(s) is constructed on the former RFM Site.	Potentially applicable
		Site management plan	Documentation of site restrictions and provisions for continued operation and maintenance of the remedy. Includes a provision for periodic site reviews.	Potentially applicable
Mitigation System	Passive Mitigation	Passive SSDS	Installation of porous material and perforated piping as part of slab construction to allow for passive venting of sub-slab vapors impacted by CVOCs to be vented to atmosphere, preventing vapors beneath a slab from entering a building,	Potentially applicable for new buildings constructed at site.
	Active Mitigation	Building Pressurization	Adjustment of the building's heating, ventilation and air-conditioning system to maintain a positive pressure to prevent infiltration of subsurface vapors impacted by CVOCs from entering a building.	Potentially applicable.
		Increased Building Ventilation	Adjustment of building's heating, ventilation and air conditioning system to maintain a level of air exchange to maintain acceptable indoor air concentrations.	Potentially applicable.

Table 6-3: Identification and Screening of Remedial Technologies and Process Options for Indoor Air/Sub-Slab Soil Vapor

General Response Action	Remedial Technology	Process Option	Description	Screening Comments
Mitigation System (cont'd)	Active Mitigation (cont'd)	SSDS	An SSDS involves the inducement of a vacuum under a structure's concrete slab where soil vapors impacted with CVOCs have been identified during vapor intrusion sampling. An SSDS is much like a radon mitigation system, and essentially prevents vapors beneath a slab from entering a building. Vacuum is induced by a fan, mounted on the exterior of the building, which pulls sub-slab soil vapor through polyvinyl chloride (PVC) pipe that penetrates the slab (referred to as system suction points).	Potentially applicable

Notes:
CFR - Code of Federal Regulations
CVOC - Chlorinated Volatile Organic Compound
DER - Department of Environmental Remediation
NCP - National Contingency Plan
NYSDEC - New York State Department of Environmental Conservation
PVC - Polyvinyl Chloride
RFM - Rochester Form Machine
SSDS - Sub-slab Depressurization System

Table 6-4: Evaluation of Remedial Technologies and Process Options for Soil

GENERAL RESPONSE ACTION	REMEDIAL TECHNOLOGY	PROCESS OPTION	DESCRIPTION	EFFECTIVENESS	IMPLEMENTABILITY	RELATIVE COST	RETAINED OR NOT RETAINED FOR FURTHER CONSIDERATION
No further action	No further action	No further action*	No further action. Considers the 1999 soil removal and the implementation of deed restrictions that provide for access and use restrictions.	Completed soil removal was an effective means of protection of human health and the environment. Easement in place provides added protection to human health.	Implemented.	Low capital Low O&M	Retained, effective and readily implementable. Required for consideration by the NCP (40 CFR Part 300.430) and NYSDEC DER-10 Technical Guidance for Site Investigation and Remediation.
Institutional Controls/ Limited Actions	Access restrictions	Fencing*	The installation of fencing and gates at the Site to limit unauthorized access to the property.	Fencing is an effective means of limiting unauthorized access to the RFM Site and controlling site use for protection of human health.	Readily implementable.	Low capital Low O&M	Retained, effective and readily implementable.
	Use restrictions/ administrative controls	Environmental easement/deed restrictions*	Documentation of access and land use restrictions in accordance with the site management plan.	Effective means of controlling site use for protection of human health. Effective means of evaluating and mitigating vapor intrusion if the building is redeveloped or reoccupied, or if a new building is constructed for use at the facility.	Readily implementable, easement/deed restrictions currently in place for RFM Site and can be amended to match NYSDEC's current template.	Low capital No O&M	Retained, effective and readily implementable.
		Site management plan*	A site management plan would document site engineering and institutional controls, additional IRMs and physical components of the selected remedy requiring operation, maintenance and monitoring to provide continued effectiveness. The site management plan would also present provisions for periodic site reviews.	Effective means of controlling site use for protection of human health.	Readily implementable.	Low capital Low O&M	Retained, effective and readily implementable.
Institutional Controls/ Limited Actions (continued)	Periodic reviews	Periodic site reviews*	Periodic reviews are required by 6 NYCRR Part 375 where institutional and engineering controls, monitoring plans, and/or operations and maintenance activities are implemented at a site. The purpose of periodic reviews is to evaluate the Site with regard to the continuing protection of human health and the environment and to provide documentation of remedy effectiveness. Periodic site reviews would be performed in accordance with 40 CFR 300.430(f)(4)ii.	Effective means of evaluating continued protection to human health and the environment.	Readily implementable.	No capital Low O&M	Retained, effective and readily implementable.
Natural recovery	Natural attenuation	Natural attenuation*	The natural degradation of CVOCs by *in situ* physical, chemical and/or biological processes. Over time, toxicity, mobility, and/or volume of CVOCs can be reduced by processes that include biodegradation, sorption, dilution, volatilization, and/or transformation.	Potentially effective over the long-term for attenuation of CVOCs.	Readily implementable.	No capital No O&M	Retained, effective and readily implementable.
Containment	Capping	Vegetated soil/ asphalt/ building slab cover*	Engineered cover consisting of vegetated soil, asphalt and/or the existing building slab to promote overland drainage and minimize contact with soil. Top restoration cover selected based upon site use and restoration requirements within the covered area. Grading and cover installation would be performed such that drainage is promoted, erosion is minimized, and cover integrity is protected. If a cover did not include the concrete slab (e.g., implementation of an asphalt or vegetative cover) removal of the concrete slab and footings may also be required.	Effective means of mitigating human contact with impacted soil. Also effective means of minimizing infiltration of precipitation and increasing overland flow. Reduced infiltration would reduce potential leaching of CVOCs from soil to groundwater. Potential for residual concentrations of CVOCs to leach to groundwater and serve as a continuing source of groundwater impact. Effectiveness relies on maintaining integrity of cover system.	Implementable. Routine cover maintenance and inspections for integrity would be necessary.	Med capital Low O&M	Retained, effective and implementable.

Table 6-4: Evaluation of Remedial Technologies and Process Options for Soil

GENERAL RESPONSE ACTION	REMEDIAL TECHNOLOGY	PROCESS OPTION	DESCRIPTION	EFFECTIVENESS	IMPLEMENTABILITY	RELATIVE COST	RETAINED OR NOT RETAINED FOR FURTHER CONSIDERATION
		Low permeability cover	Use of low permeability cover to minimize surface water infiltration, encourage runoff and control erosion, and isolate and contain impacted soil. Low permeability cover components may consist of low permeability clay or a geomembrane system. Vegetation, asphalt, or gravel may be utilized as the top layer based upon site use and restoration requirements within the covered area. The building slab can function as a low permeable cover if maintained. If impacted soils under the existing building are excavated, building demolition and removal of the concrete slab and footings may be required.	Effective means of mitigating human contact with impacted soil. Also effective means of minimizing infiltration of precipitation and overland flow. Reduced infiltration would reduce potential leaching of CVOCs from soil to groundwater. Effectiveness relies on maintaining integrity of cover system.	Implementable. Routine cover maintenance and inspections for integrity would be necessary.	High capital Med O&M	Not retained, because limited leaching of CVOCs from soil to groundwater.
In situ treatment	Physical/ chemical treatment	Passive soil venting	Soil gas containing CVOCs from the subsurface are removed and vented to the atmosphere via shallow wells. Natural pressure gradients between the subsurface and the atmosphere could drive the passive venting of soil gas.	Limited effectiveness for CVOC removal. Low permeable soils limit venting ability and provide retention of CVOC mass in the low permeable soils.	Potentially implementable in conjunction with a low permeability cover to restrict vapor exchange between the atmosphere and the subsurface.	Low capital No O&M	Retained, potentially effective and potentially implementable.
		Soil vapor extraction (SVE)*	Vacuum is applied through extraction wells within the vadose zone to create a pressure/concentration gradient to extract organics sorbed on the soil, dissolved in soil-pore water and/or present as vapor. Extracted vapors are removed from the soil through extraction wells and treated *ex situ* as needed.	Potentially limited effectiveness for CVOC removal. Heterogeneous permeability distributions, as well as layers of low permeable silt and clay and layers of sand, limit ability of vapor extraction to effectively contact all soils and results in retention of CVOC mass in the low permeable soil layers. Underground utilities may provide preferential pathways for vapor migration, potentially causing short circuiting. Effective at reducing CVOC concentrations in lower permeability silts and clays only over long time periods.	Potentially implementable for unsaturated soil.	Med capital Med O&M	Retained, potentially effective and potentially implementable.

Table 6-4: Evaluation of Remedial Technologies and Process Options for Soil

GENERAL RESPONSE ACTION	REMEDIAL TECHNOLOGY	PROCESS OPTION	DESCRIPTION	EFFECTIVENESS	IMPLEMENTABILITY	RELATIVE COST	RETAINED OR NOT RETAINED FOR FURTHER CONSIDERATION
In situ treatment (continued)	Physical/ chemical treatment (continued)	Chemical oxidation (ISCO)	Injection of oxidation agents such as hydrogen peroxide, ozone, sodium persulfate, Fenton's reagent and/or permanganate into the subsurface. Oxidation reactions chemically convert CVOCs to non-hazardous or less toxic compounds that are more stable, less mobile, and/or inert. Oxidation agents can be applied to the subsurface via injection points, deep soil mixing, or soil fracturing.	Potentially effective for reducing CVOCs in soil. Effectiveness by injection point delivery potentially limited by layers of low permeability soils, soil heterogeneity, and the heterogeneous distribution of air in the soil, which would cause the uneven distribution of oxidants. Tight well spacing or advanced oxidant delivery techniques (*i.e.*, deep soil mixing, hydraulic or pneumatic fracturing, pressure pulse) potentially necessary to improve distribution and enhance effectiveness. Use of some chemical oxidants can generate precipitates, resulting in reduced permeability over time. Use of some chemical oxidants can generate a gas phase leading to increased gas phase CVOC emissions and above ground daylighting of injected oxidants along with incompletely oxidized CVOCs. Potential for production of hazardous intermediates if incomplete oxidation occurs. Potential for uncontrolled mobilization of CVOCs with injection of fluids. Underground utilities may provide preferential pathways for fluids injected into the overburden. Oxidation would disrupt natural active anaerobic degradation processes. Treatability study and pilot test would likely be required. May require repeated treatments.	Potentially implementable in unsaturated soil. Mixing may enhance volatilization of organics. Mixing would require removal of building and slab and could also cause geotechnical problems impacting future site use. Potential health and safety issues when handling oxidant chemicals. Treatability and pilot studies would be necessary to evaluate implementability.	High capital High O&M	Not retained because limited effectiveness for low permeability subsurface conditions.
		Flushing	Water, aqueous solution, surfactants, or cosolvents are injected into the subsurface. The injected fluid is utilized to enhance CVOC solubility. CVOCs are leached into the groundwater and subsequently removed through a collection system and treated *ex situ*.	Limited effectiveness for enhancing the removal of CVOCs in soil especially in silt/clay soils. Effectiveness potentially limited by low permeability soils, heterogeneous hydraulic conductivity distributions and uneven distribution of flushing solution. Tight injection well spacing potentially necessary to improve distribution and enhance effectiveness. Likely to cause injected fluids with CVOCs to move into bedrock groundwater. Underground utilities may provide preferential pathways for fluids injected into the overburden. Surfactants and cosolvents are only applicable if NAPLs are present. No NAPLs have been detected in overburden soils therefore surfactants and cosolvents would not be effective. Treatability and pilot studies would likely be required.	Potentially implementable in unsaturated soil, but difficult to implement in subsurface with heterogeneous permeability distributions and low permeability layers of silts and clays. Requires groundwater collection system, but may not prevent migration of injected fluids with CVOCs into bedrock groundwater. Requires additional flushing with clean water if surfactants or cosolvents are used.	Med capital Med O&M	Not retained because of limited effectiveness for heterogeneous permeability distributions and low permeability subsurface layers of silts and clays.
	Biological treatment	Enhanced bioremediation	Injection of microbial populations, nutrient sources, or electron donors into the subsurface to enhance biological degradation of CVOCs to minimize their migration, and accelerate their mass removal. Bioremediation amendments can be applied to the subsurface via hydrofracturing, injection points, a modified land farming process, or mixing of the soil.	Potentially effective for reducing CVOC concentrations in soil. Effectiveness by injection point delivery potentially limited by low permeability layers of silts and clays and heterogeneous hydraulic conductivity distributions resulting in uneven distribution of injected fluids and ineffective contact with silts	Limited implementability in unsaturated soil. Hydrofracturing or enhanced mixing delivery techniques potentially necessary for low permeability soil. Mixing would require removal of building and slab and could also cause geotechnical problems impacting future site use.	Med capital Low O&M	Not retained because of limited implementability for low permeability subsurface conditions.

Table 6-4: Evaluation of Remedial Technologies and Process Options for Soil

GENERAL RESPONSE ACTION	REMEDIAL TECHNOLOGY	PROCESS OPTION	DESCRIPTION	EFFECTIVENESS	IMPLEMENTABILITY	RELATIVE COST	RETAINED OR NOT RETAINED FOR FURTHER CONSIDERATION
				and clays. Mixing likely required for effective reduction of CVOC concentrations in soil. Underground utilities may provide preferential pathways for fluids injected into the overburden. Treatability study would likely be required. May require repeated treatments.			
In situ treatment (continued)	Biological treatment	Enhanced biotic/abiotic degradation	Use of zero valent iron (ZVI) (*i.e.*, nanoscale iron or bimetallic ZVI) and a slowly degrading carbon substrate to enhance physical, chemical and biological processes to create reducing conditions, resulting in complete CVOC degradation. Biological processes result in enhanced reactivity of ZVI. ZVI and carbon amendments can be applied to the subsurface via injection points or soil mixing.	Potentially effective for reducing CVOCs in unsaturated soil. Effectiveness by injection point delivery potentially limited by low permeability soils, heterogeneous hydraulic conductivity distributions and uneven distribution of ZVI and carbon amendments. Tight injection well spacing or soil mixing potentially necessary to improve distribution and enhance effectiveness. Underground utilities may provide preferential pathways for injections into the overburden. Treatability and pilot studies would likely be required. May require repeated treatments.	Limited implementability in unsaturated soil. Hydrofracturing or enhanced mixing delivery techniques potentially necessary for low permeability soil. Potential ZVI and carbon amendments delivery limitations with solid/powdered form. Mixing would require removal of building and slab and could also cause geotechnical problems impacting future site use.	High capital Low O&M	Not retained because limited implementability for low permeability subsurface conditions.
	Thermal treatment	Hot air/steam/hot water injection	Use of hot air, steam or hot water injection into soil to dissolve and vaporize CVOCs. The volatilized CVOCs are removed by vapor extraction and treated *ex situ* as needed. Hot water injection would be implemented in conjunction with a groundwater collection system.	Potentially effective for enhancing the removal of CVOCs. Low permeability soil and sand layers result in heterogeneous permeability distributions that could limit implementation and effectiveness. Treatability and pilot studies would likely be required. CVOCs may react at high temperatures with air or water to form toxic hydrochloric acid or chlorine gas, increasing subsurface impacts. Potential for uncontrolled vapor migration. May require low permeability cap or gas capturing system above ground to capture fugitive gas emissions.	Limited implementability, due to low permeability and heterogeneous permeability distributions of soils and potential for increased vapor phase migration toward neighboring properties. Could potentially cause soil fracturing. Off-gas treatment likely required. Management of hazards associated with steam generation required.	High capital Med O&M	Not retained because of limited effectiveness and implementability for low permeability and heterogeneous permeability.
		Soil heating *	Heating of soil using various techniques, including heating wells, thermal blankets, injection points, electrodes, or electromagnetic energy to heat and volatilize CVOCs. Volatilized CVOCs are removed by vapor extraction and treated *ex situ* as needed.	Potentially effective for enhancing the removal of CVOCs in unsaturated soil. Presence of sand layers near the water table with lower permeability slits and clays above could limit effectiveness in sands. Treatability and pilot studies would likely be required. CVOCs may react at high temperatures with air or water to form toxic hydrochloric acid or chlorine gas, increasing subsurface impact. Heterogeneous permeability distributions, thermal water pumping from shallow bedrock groundwater, and periodic recharge of storm water may result in limited effectiveness by limiting ability of the system to achieve target temperatures.	Potentially implementable for *in situ* treatment in conjunction with an SVE system. Off-gas treatment likely required. Low permeable silts and clays and heterogeneous hydraulic conductivity distributions may limit implementability. Potential for soil fracturing may allow uncontrolled vapor migration. Implementability may be limited because of thermal water pumping, periodic recharge of storm water into the overburden soil limiting the ability of the system to achieve target temperatures. Dewatering may result in excessive quantities of water requiring water treatment and disposal. Management of hazards associated with high voltage required. Grounded metal shield usually used for safety and to avoid interference	High capital No O&M	Retained for further evaluation of effectiveness and implementability.

Table 6-4: Evaluation of Remedial Technologies and Process Options for Soil

GENERAL RESPONSE ACTION	REMEDIAL TECHNOLOGY	PROCESS OPTION	DESCRIPTION	EFFECTIVENESS	IMPLEMENTABILITY	RELATIVE COST	RETAINED OR NOT RETAINED FOR FURTHER CONSIDERATION
					with local radio transmissions		
		Vitrification	An electric current or plasma arc torch is utilized to melt soil at extremely high temperatures (1,600 to 2,000 °C [2,900 to 3,650 °F]) and thereby destroy organics by pyrolysis.	Likely effective for CVOCs in unsaturated soil. Treatability study would likely be required. Potential for uncontrolled vapor migration. CVOCs may react at high temperatures with air or water to form toxic hydrochloric acid or chlorine gas, increasing subsurface impacts. Requires off-gas collection. Potential for soil fracturing and uncontrolled vapor migration. Heterogeneous permeability distributions, thermal water pumping from bedrock groundwater, and periodic recharge of storm water may result in limited effectiveness by limiting the ability of the system to achieve target temperatures.	Limited implementability. Would require off-gas vapor control. Potential for uncontrolled vapor phase migration due to low permeable soil and soil fracturing. Presents geotechnical issues, unless building and slab removed. Subsurface air pockets, if present, can present safety hazard. Will destroy subsurface utilities. Significant power consumption. Off-gas treatment likely required.	High capital No O&M	Not retained, because of implementability challenges and potential for uncontrolled vapor migration.
In situ treatment enhancement	Permeability enhancement	Pneumatic fracturing	Use of high pressure air to fracture soil. Gases of evaporated chemicals are captured and treated above ground. Pneumatic fracturing increases soil permeability, improving the performance of some *in situ* treatment technologies.	Potentially effective means of increasing soil permeability to improve effectiveness of *in situ* treatments. Increased permeability tends to be local to wells. Potential decrease in permeability with time. Potential for uncontrolled migration of dissolved CVOCs through fractures to bedrock or off-site. Leaves large volume of low permeable soils unaffected.	Limited implementability, due to proximity of neighboring buildings and potential for increased vapor phase migration toward neighboring properties. Presents geotechnical issues, unless building and slab removed. Potential for fractures to extend to neighboring properties.	Medium capital No O&M	Not retained because of implementability challenges and potential for uncontrolled migration in fractures.
		Hydraulic fracturing	Use of liquid, usually water with or without propping agent, to create permeable channels in subsurface material. Hydraulic fracturing increases soil permeability, improving the performance of some in situ treatment technologies.	Potentially effective means of increasing soil permeability to improve effectiveness of *in situ* treatments. Increased permeability tends to be local to wells. Potential decrease in permeability with time, unless sand propping agent used. Potential for uncontrolled migration of dissolved CVOCs through fractures. Leaves large volume of low permeable soils unaffected.	Limited implementability, due to proximity of neighboring buildings and potential for increased vapor phase migration toward neighboring properties. Presents geotechnical issues, unless building and slab removed. Potential for fractures to extend to neighboring properties. Requires groundwater collection/hydraulic control system.	Medium capital No O&M	Not retained because of implementability challenges and potential for uncontrolled migration in fractures.
Removal	Excavation	Mechanical excavation* (in addition to the 1999 Soil Excavation)	Use of construction equipment to remove impacted soil. Excavated soil would require transportation off-site for disposal and/or consolidated on-site for treatment or containment. Excavation of impacted soils under the existing building would require building demolition and removal of the concrete slab and footings. Dewatering of excavated soil may be necessary to facilitate transportation or disposal.	Effective for removal of impacted soil. Volatilization of CVOCS from impacted groundwater into backfilled soils following excavation may limit long-term effectiveness.	Potentially implementable for source area removal. Requires removal of building, foundations, footings and slab. Geotechnical considerations to protect neighboring properties. Shoring or side slopes required for deep excavations. Further management of excavated soil would be required. Requires fill meeting NYSDEC specifications to replace excavated soils.	High capital No O&M	Retained, effective and potentially implementable
Ex situ treatment	On-site physical/ chemical treatment	Solidification/ stabilization	CVOCs are physically bound or enclosed within a stabilized mass (solidification), or chemical reactions are induced between stabilizing agent and CVOCs to reduce their mobility (stabilization) for excavated soils. Solidification and stabilization involve mixing treatment agents with the excavated impacted soil yielding a	Limited effectiveness for treatment of CVOCs. A treatability study would be necessary.	Mixing may enhance volatilization of organics. Volatilization of CVOCs through exothermic reaction of cement/kiln dust/fly ash with entrained water in soil may occur. Potential leaching of metal	High capital Low to High O&M	Not retained because of limited effectiveness and implementability challenges.

Table 6-4: Evaluation of Remedial Technologies and Process Options for Soil

GENERAL RESPONSE ACTION	REMEDIAL TECHNOLOGY	PROCESS OPTION	DESCRIPTION	EFFECTIVENESS	IMPLEMENTABILITY	RELATIVE COST	RETAINED OR NOT RETAINED FOR FURTHER CONSIDERATION
			cementitious, crystalline, glassy or polymeric framework around the impacted soil. If impacted soils under the existing building are excavated, building demolition and removal of the concrete slab and footings may be required. Treated soil would require transportation off-site for disposal and/or consolidated on-site for reuse or containment.		salts and heavy metals associated with cement/kiln dust/fly ash. Presence of high silt and clay content of soil may require additional aggregate material to provide structural integrity of the solidified/stabilized materials, resulting in increased volumes and cost of treatment. Implementability may be limited by lack of ample space at the Site to conduct on-site treatment, resulting in lengthy treatment timeframes. A treatability study would be necessary to evaluate implementability.		
		Chemical oxidation	*Ex situ* treatment of impacted soil using oxidants such as ozone, hydrogen peroxide, hypochlorites, permanganate, Fenton's reagent and/or sodium persulfate. Oxidation reactions chemically convert CVOCs to non-hazardous or less toxic compounds that are more stable, less mobile, and/or inert. If impacted soils under the existing building are excavated, building demolition and removal of the concrete slab and footings may be required. Treated soil would require transportation off-site for disposal and/or consolidated on-site for reuse or containment.	Presence of silts and clays could limit the effectiveness of chemical oxidation treatment because of the retention of CVOCs in the clay matrix. Would likely require additional mixing and potentially additional treatments. Treatability study would likely be required.	Potentially implementable. Treatment solutions (if any) and residual soil would require further management. CVOC emissions would likely be generated requiring control and treatment. Would likely need to be conducted in a negative pressure enclosed space (*e.g.*, temporary building). Implementability may be limited by lack of ample space at the Site to conduct on-site treatment, resulting in lengthy treatment timeframes.	High capital Low to High O&M	Not retained because of limited effectiveness and implementability challenges.
		Chemical dechlorination	Reagent prepared from polyethylene glycol and potassium hydroxide dechlorinates CVOCs through a nucleophilic substitution process. The products of the reaction are non-toxic, non-mutagenic, and non-bioaccumulative. In this process, reagents are mixed with soil and heated in a reactor. If impacted soils under the existing building are excavated, building demolition and removal of the concrete slab and footings may be required. Treated soil would require transportation off-site for disposal and/or consolidated on-site for reuse or containment.	Presence of silts and clays could limit the effectiveness of chemical dechlorination treatment because of the retention of CVOCs in the clay matrix. Would likely require additional mixing and potentially additional treatments. Treatability study would likely be required.	Potentially implementable. Solution (if any) and residual soil would require further management. CVOC emissions would likely be generated requiring control and treatment. Would likely need to be conducted in a negative pressure enclosed space (e.g., temporary building). Implementability may be limited by lack of ample space at the Site to conduct on-site treatment, resulting in lengthy treatment timeframes. A treatability study would be necessary to evaluate implementability.	High capital Low to High O&M	Not retained because of limited effectiveness and implementability challenges.
		Extraction/ washing	Impacted soil and extractant are mixed in an extractor, thereby dissolving the CVOCs. The extracted solution is then placed in a separator, where the CVOCs and extractant are separated for treatment and further use. If impacted soils under the existing building are excavated, building demolition and removal of the concrete slab and footings may be required. Treated soil would require transportation off-site for disposal and/or consolidated on-site for reuse or containment.	Presence of silts and clays could limit the effectiveness of extraction/washing treatment because of the retention of CVOCs in the clay matrix. Treatability study would likely be required.	Potentially implementable. Solution and residual soil would require further management. Presence of high silt and clay content makes water-particle separation difficult. Implementability may be limited by lack of ample space at the Site to conduct on-site treatment, resulting in lengthy treatment timeframes. A treatability study would be necessary to evaluate implementability.	High capital Low to High O&M	Not retained because of limited effectiveness and implementability challenges.

Table 6-4: Evaluation of Remedial Technologies and Process Options for Soil

GENERAL RESPONSE ACTION	REMEDIAL TECHNOLOGY	PROCESS OPTION	DESCRIPTION	EFFECTIVENESS	IMPLEMENTABILITY	RELATIVE COST	RETAINED OR NOT RETAINED FOR FURTHER CONSIDERATION
	On-site thermal treatment	Incineration	Combustion of CVOCs present in soil in incinerator at temperatures generally between 1600 and 2200°F. Organic substances are oxidized into products that generally include CO_2, H_2O vapor, SO_2, NOx, HCl gases and ash. If impacted soils under the existing building are excavated, building demolition and removal of the concrete slab and footings may be required. Treated soil would require transportation off-site for disposal and/or consolidated on-site for reuse or containment.	Potential for dioxin production exists when combusting CVOCs. Would likely require dioxin monitoring of combustion gases. Presence of high silt and clay content soil increase treatment costs and fly ash generation. Treatability study would likely be required.	Significant implementability challenges associated with odor/emissions and on-site permitting for thermal treatment unit. Products of thermal destruction/incineration such as particulates, SO_2, NOx, HCl and products of incomplete combustion, such as dioxin, would require air emission controls to prevent release of air pollutants to the atmosphere. Ash disposal would be required, with potential stabilization. Potential for community opposition. Implementability may be limited by lack of ample space at the Site to conduct on-site treatment, resulting in lengthy treatment timeframes. A treatability study would be necessary to evaluate implementability.	High capital Low to High O&M	Not retained because of implementability challenges.
Ex situ treatment (continued)	On-site thermal treatment (continued)	Low temperature thermal desorption	Use of direct or indirect heat to volatilize CVOCs at temperatures generally between 90 and 300 °C, creating a physical separation (volume reduction) process. The volatilized CVOCs from the thermal desorption process are typically directed to a secondary system for destruction via incineration, catalytic oxidation, adsorption on activated carbon, or recovery by condensation. If volatilized CVOCs are incinerated, further treatment of acid gases and particulates would be required. If impacted soils under the existing building are excavated, building demolition and removal of the concrete slab and footings may be required. Treated soil would require transportation off-site for disposal and/or consolidated on-site for reuse or containment.	Likely effective for removal of CVOCs. Treatability study would likely be required. Presence of silts and clays could limit the effectiveness of low temperature thermal desorption treatment because of the retention of CVOCs in the clay matrix. Clays may cause poor thermal desorption performance because they tend to increase agglomeration and caking and thereby inhibit heat and mass transfer. Additionally, clays can be carried over with desorbed CVOCs in the heated gases. The undesirable carryover can overload downstream gas-handling and treatment equipment. Some low temperature thermal desorption systems are not recommended for clay content greater than 20 percent.	Significant implementability challenges associated with odor/emissions and on-site permitting for thermal treatment unit. Air emission controls required. If volatilized CVOCs are incinerated, further treatment and management of acid gases and particulates would be required. Residuals would require management. Potential for community opposition. Implementability may be limited by lack of ample space at the Site to conduct on-site treatment, resulting in lengthy treatment timeframes. A treatability study would be necessary to evaluate implementability.	Med capital Low to High	Not retained because of implementability challenges.
		Pyrolysis	Chemical decomposition of organic materials is induced by heat in the absence of oxygen at temperatures around 800 °F. Organic materials are transformed into gaseous components and solid residue (coke) containing fixed carbon and ash. If impacted soils under the existing building are excavated, building demolition and removal of the concrete slab and footings may be required. Treated soil would require transportation off-site for disposal and/or consolidated on-site for reuse or containment.	Likely effective for destruction of CVOCs. Treatability study would likely be required. Potential for dioxin production exists when combusting CVOCs. Would likely require dioxin monitoring of combustion gases. Presence of high silt and clay content soil increase treatment costs and fly ash generation.	Significant implementability challenges associated with odor/emissions and on-site permitting for thermal treatment unit. Air emission controls required. Residuals would require further management. Potential for community opposition. Implementability may be limited by lack of ample space at the Site to conduct on-site treatment, resulting in lengthy treatment timeframes. A treatability study would be necessary to evaluate implementability.	High capital Low to High	Not retained because of implementability challenges.
Disposal	Off-site treatment/ disposal	Commercial treatment/ disposal facility	Excavated soil would be transported to an approved commercial hazardous waste treatment facility for treatment to meet land disposal restrictions.	Effective for treatment of soil to meet land disposal restrictions.	Implementable for excavated soil that does not meet land disposal restrictions. Treated soil may require transport to an off-site commercial landfill for disposal.	Med capital No O&M	Retained, effective and potentially implementable.

Table 6-4: Evaluation of Remedial Technologies and Process Options for Soil

GENERAL RESPONSE ACTION	REMEDIAL TECHNOLOGY	PROCESS OPTION	DESCRIPTION	EFFECTIVENESS	IMPLEMENTABILITY	RELATIVE COST	RETAINED OR NOT RETAINED FOR FURTHER CONSIDERATION
	On-site disposal	On-site consolidation	Disposal of excavated or treated soil in on-site containment system and/or reused as fill. Soil for on-site consolidation must meet the commercial and industrial use SCOs. Once consolidated, the area would be restored with vegetation, asphalt, or a cap.	Effective for soil and treatment residuals suitable for land disposal.	Implementable for excavated soil that meets applicable SCOs.	Med capital No O&M	Retained, effective and potentially implementable.
	Off-site disposal	Commercial disposal facility*	Excavated treated soil would be transported to a permitted hazardous commercial landfill, if it meets land disposal restriction requirements.	Effective for management of treated soil meeting land disposal restrictions.	Implementable for treated soil that meets land disposal restrictions.	High capital No O&M	Retained, effective and potentially implementable.

Notes:

* Representative Process Option - The representative process options are those that are selected to represent a given remedial technology. Representative process options are then assembled into the remedial alternatives that are evaluated in the FS.
CFR - Code of Federal Regulations
CO_2 – Carbon Dioxide
CVOC – Chlorinated Volatile Organic Compounds
DER – Division of Environmental Remediation
HCl – Hydrogen Chloride
H_2O – water
IRM – Interim Remedial Measure
ISCO – *In Situ* Chemical Oxidation
NCP - National Contingency Plan
NOx – Oxides of Nitrogen
NYCRR - New York Code of Rules and Regulations
NYSDEC – New York State Department of Environmental Conservation
O&M – Operation and Maintenance
RFM - Rochester Form Machine
SCO - Soil Cleanup Objective
SVE - Soil Vapor Extraction
SO_2 – Sulfur Dioxide
ZVI - Zero Valent Iron

Table 6-5: Evaluation of Remedial Technologies and Process Options for Bedrock Groundwater

GENERAL RESPONSE ACTION	REMEDIAL TECHNOLOGY	PROCESS OPTION	DESCRIPTION	EFFECTIVENESS	IMPLEMENTABILITY	RELATIVE COST	RETAINED OR NOT RETAINED FOR FURTHER CONSIDERATION
No further action	No further action	No further action*	No further action. Considers implementation of existing environmental easement/deed restrictions that provide for access and use restrictions.	An effective means of protection of human health and the environment. Environmental easement/deed restrictions in place provide added protection to human health.	Implemented. Environmental easement/deed restrictions currently exist for the former RFM Site.	Low capital Low O&M	Retained, effective and already implemented. Required for consideration by the NCP (40 CFR Part 300.430) and NYSDEC DER-10 Technical Guidance for Site Investigation and Remediation.
Institutional controls/limited actions	Administrative controls	Environmental easement/ deed restrictions*	Restrictions of groundwater use where applicable. The facility and off-site properties are connected to public water.	Effective means of controlling site use for protection of human health.	Readily implementable. Modifications to the environmental easement/deed restrictions would be necessary to comply with current NYSDEC policy.	Low capital No O&M	Retained, effective and already implemented.
		Site management plan*	Documentation of site restrictions and provisions for continued operation and maintenance of the remedy. Presents requirements for groundwater monitoring and includes a provision for periodic site reviews.	Effective means of controlling site use for protection of human health.	Readily implementable.	Low capital Low O&M	Retained, effective and readily implementable.
	Alternate water supply	Public water supply*	Public water currently exists at the former RFM Site and in the vicinity of the former RFM Site.	Effective means of preventing the use of impacted groundwater at the former RFM Site and in the vicinity of the Site.	Public water is available.	No capital No O&M	Retained, effective and readily implementable.
	Monitoring	Groundwater monitoring*	Periodic sampling and analyses of bedrock groundwater as a means of monitoring CVOC concentrations. Groundwater monitoring also provides a means of monitoring remedy effectiveness.	Effective method for monitoring changes in CVOC concentrations over time. Useful for evaluating remedy effectiveness.	Readily implementable.	No to Low capital Med O&M	Retained, effective and readily implementable.
Institutional controls/limited actions (continued)	Periodic reviews	Periodic site reviews*	Periodic reviews are required by 6 NYCRR Part 375 where institutional and engineering controls, monitoring plans, and/or O&M activities are implemented at a site. The purpose of periodic reviews is to evaluate the site with regard to the continuing protection of human health and the environment and to provide documentation of remedy effectiveness. Periodic site reviews would be performed in accordance with 40 CFR 300.430(f)(4)ii.	Effective means of documenting status and progress of remedies requiring long-term operation and maintenance.	Readily implementable.	No capital Low O&M	Retained, effective and readily implementable.
Natural recovery	Natural attenuation	Natural attenuation*	Long-term natural attenuation of CVOCs by *in situ* physical, chemical and/or biological processes. Over time, toxicity and mobility of CVOCs and/or volume of impacted media can be reduced by processes that include biodegradation, sorption, dilution, volatilization, transformation, diffusion of groundwater CVOCs into the bedrock matrix, desorption and back diffusion of bedrock matrix CVOCs into advective flowing groundwater. Monitoring of CVOCs only.	RI bedrock analysis data documented that matrix diffusion of CVOCs from the advective flowing groundwater in fractures to the bedrock matrix has taken place at the Site and is the dominant natural attenuation mechanism controlling the migration of CVOCs in the groundwater. Matrix diffusion, which has been documented in the RIR, has limited the extent of CVOC transport in groundwater. As part of the matrix diffusion process, back diffusion of CVOCs out of the bedrock matrix into the advective flowing groundwater is contributing to the long term presence of CVOCs in groundwater, which will likely contribute to the continued presence of CVOCs in groundwater in exceedance of ARARs for CVOCs in groundwater for decades. It is expected that matrix diffusion and associated natural attenuation processes will continue to be effective over the long-term for attenuation and limiting transport of dissolved CVOCs in	Readily implementable for bedrock groundwater.	Low capital Med O&M	Retained, effective and readily implementable.

Table 6-5: Evaluation of Remedial Technologies and Process Options for Bedrock Groundwater

GENERAL RESPONSE ACTION	REMEDIAL TECHNOLOGY	PROCESS OPTION	DESCRIPTION	EFFECTIVENESS	IMPLEMENTABILITY	RELATIVE COST	RETAINED OR NOT RETAINED FOR FURTHER CONSIDERATION
				groundwater. Groundwater monitoring for CVOCs provides ongoing documentation that natural attenuation processes continue to control the extent of migration of CVOCs in groundwater at the Site.			
Containment	Physical barrier wall	Grout curtain	Injection of grout along the perimeter of the area of groundwater CVOC ARAR exceedences on the former RFM Site. This would potentially act to contain impacted groundwater within the Eramosa Formation. The grout curtain containment wall would need to extend into a confining unit.	Potentially effective at hydraulically containing impacted groundwater if used in conjunction with a groundwater extraction system. Not effective for removal of CVOCs in bedrock matrix; therefore, would not decrease the period of time that matrix back diffusion contributes CVOCs in excess of ARARs to the groundwater. Presence of very high hydraulic conductivity fractures in Eramosa Formation may result in inability to retain grout in these zones, decreasing effectiveness of a grout curtain to hydraulically contain groundwater. Because of strong natural attenuation processes already operative at the former RFM Site, containment would likely not appreciatively decrease the extent of CVOCs exceeding groundwater ARARs. Treatability and pilot studies would be required.	Presence of highly fractured and permeability zones in Eramosa Formation may limit implementability of grout curtain installation. Requirement of groundwater extraction may not be implementable (see below). Presence of building and close proximity of adjacent properties would make implementation difficult.	High capital Low O&M	Not retained because of implementability challenges.
In situ treatment	Physical/ chemical treatment	Circulation wells	Air is injected into the water column to volatilize dissolved CVOCs. Groundwater is circulated *in situ*, with groundwater entering the well at one screen and discharging through a second screen. Air is collected and treated if necessary.	Potentially effective for enhancing the removal of dissolved CVOCs in bedrock groundwater. Circulation of groundwater and resulting oxidation could disrupt naturally active anaerobic biodegradation processes. Not effective for removal of CVOCs in bedrock matrix; therefore, would not decrease the period of time that matrix back diffusion contributes CVOCs in excess of ARARs to the groundwater. Because of strong natural attenuation processes already operative at the former RFM Site, the use of circulation wells would likely not decrease the extent of CVOCs exceeding groundwater ARARs. Numerical groundwater modeling and a pilot study would be required. Active storm water recharge well(s) on adjacent property would limit the effectiveness of this technology.	Limited implementability for bedrock groundwater. Presence of very high hydraulic conductivity fractures in Eramosa formation may result in the inability to recirculate groundwater in a well or outside of the well (a requirement of this technology) which would make implementation difficult or impossible. Off-gas treatment would likely be required.	Med to high capital High O&M	Not retained because of limited effectiveness and implementability challenges.
		Flushing	Water, aqueous solution, surfactants, or cosolvents are injected into the subsurface. The extraction fluid is utilized to enhance CVOC solubility. CVOCs are leached into the groundwater and subsequently removed through a collection system and treated *ex situ*.	Not applicable or effective for the removal of dissolved CVOCs in bedrock groundwater. Would not decrease the period of time that matrix back diffusion contributes CVOCs in excess of ARARs to the groundwater. Would decrease the effectiveness of existing natural attenuation processes by decreasing the rate of ongoing matrix diffusion. Could result in uncontrolled migration of CVOCs, increasing the extent of CVOCs in groundwater at the Site. Active storm water recharge well(s) on adjacent property would limit the effectiveness of this technology.	Presence of very high hydraulic conductivity fractures in Eramosa Formation would make implementation difficult or impossible. Requirement of groundwater extraction may not be implementable (see below) and may result in the inability to capture injected chemicals.	Med capital Med O&M	Not retained because very high hydraulic conductivity fractures in bedrock make implementation difficult or impossible.
		Air sparging	Injection of air into saturated zone to volatilize dissolved CVOCs within the groundwater and transfers the CVOCs into a gas phase. Used in conjunction with soil vapor extraction and gas phase treatment.	Limited effectiveness when used for treatment in bedrock groundwater. Not effective when used in horizontally layered highly permeable sedimentary bedrock fractures. Potential for uncontrolled off-site migration of CVOCs in vapors and in groundwater. Would not decrease the period of time that matrix back diffusion contributes CVOCs in excess of ARARs to the groundwater. Would decrease the effectiveness of existing natural attenuation anaerobic biodegradation processes by oxygenating groundwater. Active storm water recharge well(s) on the adjacent property would cause disruption of the distribution of injected air and reduce the effectiveness of the technology.	Difficult to implement. Would require groundwater and vapor extraction to prevent vapor phase migration toward neighboring properties. Requirement of groundwater extraction may not be implementable (see below) and may result in the inability to capture groundwater leading to increasing the extent of CVOCs in groundwater at the Site. Vapor collection from bedrock may not be implementable because of water saturated high permeable fractures.	Medium capital Medium O&M	Not retained because limited effectiveness and difficult to implement.

Table 6-5: Evaluation of Remedial Technologies and Process Options for Bedrock Groundwater

GENERAL RESPONSE ACTION	REMEDIAL TECHNOLOGY	PROCESS OPTION	DESCRIPTION	EFFECTIVENESS	IMPLEMENTABILITY	RELATIVE COST	RETAINED OR NOT RETAINED FOR FURTHER CONSIDERATION
In situ treatment (continued)	Physical/ chemical treatment (continued)	Chemical oxidation	Addition of oxidation agents such as hydrogen peroxide, ozone, sodium persulfate and/or permanganate into groundwater. Oxidation reactions chemically convert CVOCs to non-hazardous or less toxic compounds that are more stable, less mobile, and/or inert.	Limited effectiveness in highly permeable bedrock fractures as a result of the inability to sustain needed concentrations of injected oxidants in targeted treatment zones. Limited effectiveness for enhancing the removal of dissolved CVOCs in bedrock groundwater because of ongoing long-term back diffusion of CVOCs from the bedrock matrix into groundwater. Would not decrease the period of time that matrix back diffusion contributes CVOCs in excess of ARARs to the groundwater. Injected oxidant solutions have diffusion limited transport into the bedrock matrix. The high contrast in permeability between bedrock fractures and the bedrock matrix would limit the ability to maintain contact of oxidant with bedrock matrix for a sufficient period of time to allow aqueous phase oxidants to diffuse into the bedrock matrix. Treatability and pilot studies would be required. Active storm water recharge well(s) on the adjacent property would cause disruption of the distribution of injected oxidants and further reduce the effectiveness of the technology.	Difficult to implement due to the presence of highly permeable bedrock fractures in the Eramosa Formation that make it difficult to maintain target oxidant concentrations in the bedrock fractures for any sustained period of time thus requiring the use of very large volumes of injected oxidants and high concentrations for long time periods. The presence of highly permeable bedrock fractures could also require the use of hydraulic control to prevent the migration of oxidants or displaced groundwater onto neighboring properties. Chemical oxidants would need to be in contact with the bedrock matrix for an extended period of time for the rate limited back diffusion process to takes place.	High capital High O&M	Not retained because of limited effectiveness and implementability challenges.
	Biological treatment	Enhanced bioremediation	Injection of microbial populations, nutrient sources, or electron donors into groundwater to enhance anaerobic reductive dechlorination biological degradation reactions of CVOCs in groundwater. Increases naturally active anaerobic biodegradation processes occurring in site groundwater via biostimulation and/or bioaugmentation.	Limited effectiveness in highly permeable bedrock fractures as a result of the inability to sustain needed concentrations of injected biological amendments in targeted treatment zones caused by flushing and dilution. Limited effectiveness in highly permeable bedrock fractures as a result of the inability to retain injected biological amendments in targeted treatment zones for long time periods. Not effective because injected biological amendment reactions have diffusion limited transport into the bedrock matrix and therefore treatment is limited by matrix diffusion. The high contrast in permeability of the bedrock fractures and the bedrock matrix limit the ability to maintain contact of biological amendments with bedrock matrix for a sufficient period of time to allow aqueous biological amendments to diffuse into the bedrock matrix. The use of shear thinning fluids has the potential to increase the distribution of bioremediation amendments adjacent to the bedrock matrix; however, they would not change the rate limitation of back diffusion. Shear thinning fluids used to potentially mitigate effects of highly heterogeneous permeability distributions when applying biological amendments generally utilize surfactants, in part. The use of surfactants has the potential to decrease the effectiveness of the matrix diffusion process potentially leading to an expansion of the extent of CVOCs in the groundwater at the Site and on off-Site properties. Treatability and pilot studies would be required. Active storm water recharge well(s) on the adjacent property would cause disruption of the distribution of injected biological amendments and further reduce the effectiveness of the technology. The presence of active storm water recharge well(s) on the adjacent property results in the discharge of tens to hundreds of thousands of gallons of runoff per precipitation event into Eramosa formation groundwater proximate to the location of CVOCs in groundwater of the former RFM Site. It has been documented in the RIR that the recharge of storm water from the adjacent property recharge well(s) impacts the geochemistry of groundwater at the Site. The recharge of highly oxygenated runoff into the Eramosa formation from the adjacent property recharge well(s) would likely inhibit biotic reductive	Difficult to implement due to the presence of highly permeable bedrock fractures in the Eramosa Formation that make it difficult to maintain target biological amendment concentrations in the bedrock fractures for any sustained period of time requiring large volumes of injected biological amendments and/or microorganisms at high concentrations for long periods of time. The presence of highly permeability of bedrock fractures could also require the use of hydraulic control to prevent the migration of biological amendments and/or microorganisms or displaced groundwater onto neighboring properties.	Med capital Med O&M	Not retained because of limited effectiveness and implementability challenges.

Table 6-5: Evaluation of Remedial Technologies and Process Options for Bedrock Groundwater

GENERAL RESPONSE ACTION	REMEDIAL TECHNOLOGY	PROCESS OPTION	DESCRIPTION	EFFECTIVENESS	IMPLEMENTABILITY	RELATIVE COST	RETAINED OR NOT RETAINED FOR FURTHER CONSIDERATION
				dechlorination reactions at the Site.			
	Thermal treatment	Hot air/steam/hot water injection	Use of hot air, steam or hot water injection into wells to dissolve and vaporize CVOCs. The volatilized CVOCs are removed by vapor extraction and treated *ex situ* as needed. Hot water injection would be implemented in conjunction with a groundwater collection system.	Requires the transfer of heat from injected air, steam or hot water to the bedrock to affect any improvement in increasing the rate of back diffusion of CVOCs from the rock matrix. The high permeability of the bedrock fractures may limit the ability of this technology to effectively heat groundwater and/or the bedrock matrix, limiting effectiveness. CVOCs may react at high temperatures with air or water to form toxic hydrochloric acid or chlorine gas. Potential for uncontrolled vapor migration. May induce the migration of CVOCs in bedrock groundwater from adjacent property onto the former RFM Site. Low permeability soils in which an SVE system would be required to extract vapors may limit SVE effectiveness and result in uncontrolled release of VOCs. Treatability and pilot studies would be required.	Limited implementability, due to potential for increased vapor phase migration toward neighboring properties. Off-gas treatment likely required. Management of hazards associated with steam generation required. Not implementable with active storm water recharge well(s) on adjacent property. The recharge water would disrupt and limit the injected hot fluid and prevent effective subsurface heating.	High capital High O&M	Not retained because of limited effectiveness and implementability challenges.
		Bedrock heating *	Heating of bedrock using various techniques, including heating wells, thermal blankets, injection points, electrodes, or electromagnetic energy to heat and volatilize CVOCs. Volatilized CVOCs are removed by vapor extraction and treated *ex situ* as needed.	Potentially effective for enhancing the removal of source material in bedrock matrix. The high permeability of the bedrock fractures may limit the ability of this technology to effectively heat groundwater and/or the bedrock matrix, limiting effectiveness because of inflow of large volumes of groundwater. CVOCs may react at high temperatures with air or water to form toxic hydrochloric acid or chlorine gas. May induce the migration of CVOCs in bedrock groundwater from adjacent property onto the former RFM Site. Potential for uncontrolled vapor migration. Low permeability soils in which an SVE system would be required to extract vapors may limit SVE effectiveness and result in uncontrolled release of CVOCs. Ineffective vapor capture could lead to fugitive CVOC emissions. Treatability and pilot studies would likely be required.	The high permeability of the bedrock fractures associated with groundwater flow would limit implementation of bedrock heating. Vapor control would be necessary to prevent vapor phase migration toward neighboring properties. Hydraulic control may be required to prevent expansion of dissolved CVOC plume and increased area of CVOCs in bedrock matrix. Management of hazards associated with high voltage required. Grounded metal shield usually used for safety and to avoid interference with local radio transmissions. Off-gas treatment likely required. May require above ground low permeability cap to capture mobilized CVOC vapor phase. Not implementable with active storm water recharge well(s) located on adjacent property. The recharge water would disrupt and prevent effective subsurface heating.	High capital High O&M	Retained for further evaluation of effectiveness and implementability.
Collection/ hydraulic control	Single phase extraction	Vertical/ horizontal extraction wells	Use of vertical extraction wells to pump and collect impacted groundwater.	Not effective for enhancing the removal of CVOC mass in bedrock because groundwater extraction would not increase the rate of CVOC mass removal from the bedrock because the rate is limited by back diffusion which is not substantively affected by groundwater extraction. Would not decrease the period of time that matrix back diffusion contributes CVOCs in excess of ARARs to the groundwater. Presence of very high hydraulic conductivity fractures in Eramosa Formation may result in the inability to effectively capture groundwater based on the large volumes of groundwater that may need to be pumped in order to be effective. Because of strong natural attenuation processes already operative at the former RFM Site, groundwater extraction would likely not decrease the extent of CVOCs exceeding groundwater ARARs. Would likely induce the migration of CVOCs in bedrock groundwater from neighboring properties onto the former RFM Site.	Limited implementability. Bedrock is highly permeable, potentially resulting in high pumping rates and energy requirements. Discharge options at the Site are limited, especially particularly in consideration of the potentially high volumes of water that would need to be managed. Collected water would require treatment prior to discharge. Limited implementability because of the potential for fouling of wells, piping, pumps, and treatment system as a result of naturally-occurring inorganic constituents.	High Capital High O&M	Not retained because of implementability challenges and limited effectiveness.

Table 6-5: Evaluation of Remedial Technologies and Process Options for Bedrock Groundwater

GENERAL RESPONSE ACTION	REMEDIAL TECHNOLOGY	PROCESS OPTION	DESCRIPTION	EFFECTIVENESS	IMPLEMENTABILITY	RELATIVE COST	RETAINED OR NOT RETAINED FOR FURTHER CONSIDERATION
	Dual-phase extraction	Dual-phase extraction wells	A high vacuum is applied through extraction wells to simultaneously extract groundwater, NAPL, and vapors from the subsurface. Extracted groundwater and vapors are separated and treated *ex situ*.	NAPL has not been identified on the property, limiting the applicability and effectiveness of dual phase extraction. Potentially effective means of collecting and hydraulically controlling bedrock groundwater, in addition to vapor collection. Presence of very high hydraulic conductivity fractures in Eramosa formation may result in the inability to effectively capture groundwater using a high vacuum system, based on the large volumes of groundwater that may need to be removed in order to be effective. Not effective for enhancing the removal of CVOC mass in bedrock because groundwater extraction would not increase the rate of CVOC mass removal from the bedrock because the rate is limited by back diffusion which is not substantively affected by groundwater extraction. Would not decrease the period of time that matrix diffusion contributes CVOCs in excess of ARARs to the groundwater. Because of strong natural attenuation processes already operative at the former RFM Site, groundwater extraction would likely not decrease the extent of CVOCs exceeding groundwater ARARs. Pumping tests are required to identify well placement and appropriate pumping rates. Would likely induce the migration of CVOCs in bedrock groundwater from adjacent property onto the former RFM Site.	Limited implementability. Bedrock is highly permeable, potentially resulting in high pumping rates and energy requirements. High vacuum pumping to extract groundwater may not be implementable given the highly permeable Eramosa formation. Discharge options at the Site are limited, especially in consideration of the potentially high volumes of water that would need to be managed. Collected water would require treatment prior to discharge. Potential for fouling of wells, piping, pumps, and treatment system as a result of naturally-occurring inorganic constituents.	Med capital High O&M	Not retained because of implementability challenges and limited effectiveness.
Collection/ hydraulic control enhancement	Permeability enhancement	Hydraulic fracturing	Injection of water, with or without propping agent, into subsurface to create permeable channels in subsurface material.	Potentially effective means of increasing bedrock permeability in lower permeability zones to improve effectiveness of groundwater collection/control technologies. Increased permeability tends to be local to wells. Potential decrease in permeability of hydraulically fractured bedrock with time, unless sand propping agent used. Has potential for uncontrolled migration of CVOCs into bedrock zones where CVOC mass is not already present.	Potentially implementable, however bedrock fractures currently exist and are permeable. May be difficult to constrain new fractures to former RFM Site.	Med capital Med O&M	Not retained because limited effectiveness and fractures currently exist.

Notes:

* Representative Process Option - The representative process options are those that are selected to represent a given remedial technology. Representative process options are then assembled into the remedial alternatives that are evaluated in the FS.
Ex situ technologies for treatment of extracted groundwater not retained because no collection response action was retained.
ARAR – Applicable or Relevant and Appropriate Requirement
CFR – Code of Federal Regulations
CVOC – Chlorinated Volatile Organic Compound
DER – Department of Environmental Regulation
NAPL – Non-aqueous Phase Liquid
NCP - National Contingency Plan
NYCRR – New York Codes, Rules and Regulations
NYSDEC - New York State Department of Environmental Conservation
O&M – Operation and Maintenance
RFM – Rochester Form Machine
RI – Remedial Investigation
SPDES – State Pollutant Discharge Elimination System
SVE – Soil
VOC - Volatile organic compound
ZVI - Zero Valent Iron

Table 6-6: Evaluation of Remedial Technologies and Process Options for Indoor Air/ Sub-Slab Soil Vapor

GENERAL RESPONSE ACTION	REMEDIAL TECHNOLOGY	PROCESS OPTION	DESCRIPTION	EFFECTIVENESS	IMPLEMENTABILITY	RELATIVE COST	RETAINED OR NOT RETAINED FOR FURTHER CONSIDERATION
No further action	No further action	No further action*	Maintenance of the Access Restriction would be discontinued.	Not effective for the mitigation of potential vapor intrusion.	Implementable.	No capital No O&M	Retained, a no action alternative is required for consideration by the NCP (40 CFR Part 300.430) and NYSDEC DER-10 Technical Guidance for Site Investigation and Remediation.
Institutional controls/limited actions	Administrative controls	Environmental easement*	Provides for evaluation and mitigation of vapor intrusion if a new building(s) is constructed on the former RFM Site.	Provides for evaluation and mitigation of potential vapor intrusion for the RFM building.	Readily implementable. Easement currently exists for former RFM Site.	Low capital No O&M	Retained, effective and readily implementable.
		Site management plan*	Documentation of site restrictions and provisions for continued operation and maintenance of the remedy at the former RFM Site. Includes a provision for periodic site reviews.	Effective means of controlling site use for protection of human health.	Readily implementable.	Low capital Low O&M	Retained, effective and readily implementable.
Mitigation System	Passive Mitigation	Passive SSDS	Porous aggregate and perforated piping is installed as part of building slab construction to allow sub-slab vapors impacted by CVOCs to be vented to atmosphere, preventing vapors beneath a slab from entering a building.	Not effective for existing building. Potentially effective for new buildings for the minimization of CVOC concentrations in indoor air and sub-slab soil vapor. Indoor air monitoring would be used to evaluate the effectiveness of the system.	Implementable as part of new construction.	Low capital Medium O&M	Retained, effective and potentially implementable if new building is constructed.
	Active Mitigation	Building Pressurization	Adjustment of the building's heating, ventilation and air-conditioning system to maintain a positive pressure to prevent infiltration of subsurface vapors impacted by CVOCs from entering a building.	Potentially effective for the RFM building for the minimization of CVOC concentrations in indoor air and sub-slab soil vapor. Effectiveness relies on proper operation of heating and ventilation system. Indoor air monitoring would be used to evaluate the effectiveness of the system.	Potentially implementable.	Low capital Medium O&M	Retained, effective and potentially implementable.
		SSDS	An SSDS involves the inducement of a vacuum under a structure's concrete slab where soil vapors impacted with CVOCs have been identified during vapor intrusion sampling. An SSDS is much like a radon mitigation system, and essentially prevents vapors beneath a slab from entering a building. Vacuum is induced by a fan, mounted on the exterior of the building, which pulls sub-slab soil vapor through polyvinyl chloride (PVC) pipe that penetrates the slab (referred to as system suction points).	Potentially effective for the RFM building for the minimization of CVOC concentrations in indoor air and sub-slab soil vapor. Communication testing would be required.	Potentially implementable for the RFM building.	Low capital Med O&M	Retained, effective and readily implementable.

Notes:

* Representative Process Option - The representative process options are those that are selected to represent a given remedial technology. Representative process options are then assembled into the remedial alternatives that are evaluated in the Feasibility Study. Note that no representative process options are selected for the Mitigation System GRA, because the existing building will be demolished.

CFR – Code of Federal Regulations

Table 6-6: Evaluation of Remedial Technologies and Process Options for Indoor Air/ Sub-Slab Soil Vapor

GENERAL RESPONSE ACTION	REMEDIAL TECHNOLOGY	PROCESS OPTION	DESCRIPTION	EFFECTIVENESS	IMPLEMENTABILITY	RELATIVE COST	RETAINED OR NOT RETAINED FOR FURTHER CONSIDERATION

CVOC – Chlorinated Volatile Organic Compound
DER – Department of Environmental Regulation
NCP – National Contingency Plan
NYSDEC - New York State Department of Environmental Conservation
NYSDOH – New York State Department of Health
O&M – Operation and Maintenance
PVC – Polyvinyl Chloride
RFM – Rochester Form Machine
SSDS – Sub-slab Depressurization System

ITT Corporation
Former RFM Facility
Town of Gates, New York
Feasibility Study

Table 7-1: Components of Remedial Alternatives

Media	General Response Action	Remedial Technology	Process Option	Alternative 1	Alternative 2	Alternative 3	Alternative 4	*Alternative 5*
				No Further Action	Institutional Controls/ Limited Soil Excavation/ Containment/ NA/GWM	Institutional Controls/Limited Soil Excavation/*In-situ* Soil Treatment/ NA/GWM	Institutional Controls/ Soil Excavation/ NA/GWM	Institutional Controls/Limited Soil Excavation/ *In Situ* Thermal Treatment/ GWM
Soil	No further action	No further action	No further action	X				
	Institutional controls/limited actions	Use restrictions/ administrative controls (Interim Remedial Measure)	Environmental easement/Deed Restrictions	X	X	X	X	X
		Use restrictions/ administrative controls	Site Management Plan		X	X	X	X
			Periodic site reviews		X	X	X	X
	Removal	Excavation (Interim Remedial Measure)	1999 Soil Removal	X	X	X	X	X
		Excavation	Mechanical Excavation (in addition to 1999 Soil Excavation)		X	X	X	X
	In situ treatment	Physical/chemical treatment	Soil Vapor Extraction (SVE)			X		
	In situ treatment	Thermal treatment	In situ Thermal Treatment					X
	Natural recovery	Natural attenuation	Natural attenuation	X	X			
	Containment	Capping	Surface covers (*e.g.*, vegetative soil/asphalt/building slab cover)		X	X		
	Disposal	Off-Site Disposal	Commercial Disposal Facility				X	
Bedrock Groundwater	No further action	No further action	No further action	X				
	Institutional controls/limited actions	Use restrictions/ administrative controls (Interim Remedial Measures)	Environmental easement/ Deed Restrictions	X	X	X	X	X
		Use restrictions/ administrative controls	Site Management Plan		X	X	X	X
			Periodic site reviews		X	X	X	X
		Alternate Water Supply	Public water supply (Existing)	X	X	X	X	X
		Monitoring	Groundwater monitoring		X	X	X	X
	Natural recovery	Natural attenuation	Natural Attenuation	X	X	X	X	X
	In situ treatment	Thermal treatment	In situ Thermal Treatment					X
Indoor Air/ Sub-slab Soil Vapor	No further action	No further action	No further action	X				
	Institutional controls/limited actions	Use restrictions/ administrative controls (Interim Remedial Measures)	Environmental easement/Deed restrictions	X	X	X	X	X
		Use restrictions/ administrative controls	Site Management Plan		X	X	X	X
			Periodic site reviews		X	X	X	X

Notes: ITT-W-1 recharge well to be closed for each active alternative, the drain lines leading to ITT-W-1 are currently sealed. Former RFM building was removed in late 2015 (building slab to remain for Alternatives 2 and 3).
GWM - Groundwater Monitoring
NA - Natural Attenuation

Table 7-2: Detailed Analysis of Remedial Alternatives

Criterion	Alternative 1 - No Further Action	Alternative 2 – Institutional Controls/Limited Soil Excavation/Containment/Natural Attenuation/Groundwater Monitoring	Alternative 3 – Institutional Controls/ Limited Soil Excavation/*In situ* Soil Treatment/Natural Attenuation/Groundwater Monitoring	Alternative 4 – Institutional Controls/Soil Excavation/Natural Attenuation/Groundwater Monitoring
Alternative Components	• 1999 soil excavation • Environmental easement, Deed restrictions (existing) • Natural attenuation • Use of public water source (existing)	• 1999 soil excavation • Environmental easement, Deed restrictions • Site Management Plan • Periodic site reviews • Excavation of soil to meet Commercial SCOs • Off-site disposal of soils • Natural attenuation with groundwater monitoring • Use of public water source (existing) • Surface covers (*e.g.*, vegetated soil, asphalt and concrete surfaces) serve as cap for impacted soils exceeding SCOs for Protection of Groundwater	• 1999 soil excavation • Environmental easement, Deed restrictions • Site Management Plan • Periodic site reviews • Excavation of soil to meet Commercial SCOs • Off-site disposal of soils • Natural attenuation with groundwater monitoring • Use of public water source(existing) • Surface covers (*e.g.*, vegetated soil, asphalt and concrete surfaces) serve as cap for impacted soils • *In situ* Treatment of soil using Soil Vapor Extraction (SVE) to meet SCOs for the Protection of Groundwater	• 1999 soil excavation • Environmental easement, Deed restrictions • Site Management Plan • Periodic site reviews • Natural attenuation with groundwater monitoring • Use of public water source (existing) • Excavation of soil to meet SCOs for Protection of Groundwater • Off-site disposal of soils
Overall Protection of Human Health and the Environment				
Overall protection of human health	Provides a degree of protectiveness to human health. Existing deed restrictions preclude the disturbance of soil and restrict the use of groundwater at the Site without first obtaining approval from a Relevant Agency. The lack of periodic reviews precludes confirmation that deed restrictions continue to be protective of human health. Use of the existing public drinking water source is protective of human health. Building removal has provided for mitigation of potentially unacceptable risks to human health associated with indoor air/sub-slab soil vapors. Not protective of human health with respect to indoor air/sub-slab vapor should a new building be constructed on Site. While there are no known receptors of CVOCs in groundwater and CVOC impacts are not expected to expand in magnitude or extent, the lack of monitoring does not enable a means for confirming that CVOC migration in groundwater does not result in either an increasing magnitude and/or extent beyond current conditions.	Protective for human health. Implementation of a Site Management Plan and modifications to the environmental easement/deed restrictions (necessary to comply with current NYSDEC policy) would minimize potentially unacceptable risks to public health and would provide for mitigation of exposures to soils and indoor air/sub-slab soil vapor. Periodic reviews would provide for evaluation of continued protectiveness of human health. Use of the existing public drinking water source is protective of human health. Maintenance of the surface covers (*e.g.*, vegetated soil, asphalt and concrete surfaces) would be protective of human health by minimizing contact with soil. Building removal has provided for mitigation of potentially unacceptable risks to human health associated with indoor air/sub-slab soil vapors. Implementation of a Site Management Plan allows for a means for vapor intrusion mitigation if another building is constructed on the Site should this be necessary. While there are no known receptors of CVOCs for groundwater and the CVOC impacts are not expected to expand in magnitude or extent, natural attenuation with groundwater monitoring for CVOCs provides a means for confirming that CVOC migration in groundwater does not result in an increasing magnitude and/or extent beyond current conditions.	Protective for human health. Implementation of a Site Management Plan and modifications to the environmental easement/deed restrictions (necessary to comply with current NYSDEC policy) would minimize potentially unacceptable risks to public health and would provide for mitigation of exposures to soils and indoor air/sub-slab soil vapor. Periodic reviews would provide for evaluation of continued protectiveness of human health. Use of the existing public drinking water source is protective of human health. SVE treatment of soils provides for mitigation of potentially unacceptable risks associated with indoor air/sub-slab vapors. Maintenance of the surface covers (*e.g.*, vegetated soil, asphalt and concrete surfaces) would be protective of human health by minimizing contact with soil. Building removal has provided for mitigation of potentially unacceptable risks to human health associated with indoor air/sub-slab soil vapors. Implementation of a Site Management Plan allows for a means for vapor intrusion mitigation if another building is constructed, should this be necessary. While there are no known receptors of CVOCs for groundwater and the CVOC impacts are not expected to expand in magnitude or extent, natural attenuation with groundwater monitoring for CVOCs provides a means for confirming that CVOC migration in groundwater does not result in an expanded magnitude and/or extent beyond	Protective for human health. Implementation of a Site Management Plan and modifications to the environmental easement/deed restrictions (necessary to comply with current NYSDEC policy) would minimize potentially unacceptable risks to public health and would provide for mitigation of exposures to soils and indoor air/sub-slab soil vapor. Periodic reviews would provide for evaluation of continued protectiveness of human health. Use of the existing public drinking water source is protective of human health. Soil excavation would be protective of human health by removing the risk for contact with impacted soil. Maintenance of the surface covers (*e.g.*, vegetated soil, asphalt and concrete surfaces) would be protective of human health by minimizing contact with soil. Building removal has provided for mitigation of potentially unacceptable risks to human health associated with indoor air/sub-slab soil vapors. Implementation of a Site Management Plan allows for a means for vapor intrusion mitigation if another building is constructed, should this be necessary. While there are no known receptors of CVOCs in groundwater and the CVOC impacts are not expected to expand in magnitude or extent, natural attenuation with groundwater monitoring for CVOCs provides a means for confirming that CVOC migration in groundwater does not result in an increasing magnitude and/or extent beyond

Table 7-2: Detailed Analysis of Remedial Alternatives

Criterion	Alternative 1 - No Further Action	Alternative 2 – Institutional Controls/Limited Soil Excavation/Containment/Natural Attenuation/Groundwater Monitoring	Alternative 3 – Institutional Controls/ Limited Soil Excavation/*In situ* Soil Treatment/Natural Attenuation/Groundwater Monitoring	Alternative 4 – Institutional Controls/Soil Excavation/Natural Attenuation/Groundwater Monitoring
Alternative Components	• 1999 soil excavation • Environmental easement, Deed restrictions (existing) • Natural attenuation • Use of public water source (existing)	• 1999 soil excavation • Environmental easement, Deed restrictions • Site Management Plan • Periodic site reviews • Excavation of soil to meet Commercial SCOs • Off-site disposal of soils • Natural attenuation with groundwater monitoring • Use of public water source (existing) • Surface covers (*e.g.*, vegetated soil, asphalt and concrete surfaces) serve as cap for impacted soils exceeding SCOs for Protection of Groundwater	• 1999 soil excavation • Environmental easement, Deed restrictions • Site Management Plan • Periodic site reviews • Excavation of soil to meet Commercial SCOs • Off-site disposal of soils • Natural attenuation with groundwater monitoring • Use of public water source(existing) • Surface covers (*e.g.*, vegetated soil, asphalt and concrete surfaces) serve as cap for impacted soils • *In situ* Treatment of soil using Soil Vapor Extraction (SVE) to meet SCOs for the Protection of Groundwater	• 1999 soil excavation • Environmental easement, Deed restrictions • Site Management Plan • Periodic site reviews • Natural attenuation with groundwater monitoring • Use of public water source (existing) • Excavation of soil to meet SCOs for Protection of Groundwater • Off-site disposal of soils
			current conditions.	current conditions.
Overall protection of the environment	Provides a degree of protectiveness of the environment. Natural attenuation would restore bedrock groundwater quality over time. It is expected that Eramosa bedrock formation groundwater TCA concentrations will continue to decline. The lack of monitoring in this alternative does not enable a means for confirming that CVOC migration to and in groundwater does not result in either an increasing magnitude and/or extent beyond current conditions.	Protective of the environment. Implementation of a Site Management Plan and maintenance of surface covers (e.g., vegetated soil, asphalt and concrete surfaces) are protective of the environment by minimizing the migration of CVOCs in soil to groundwater. Natural attenuation would restore bedrock groundwater quality over time. It is expected that Eramosa bedrock formation groundwater TCA concentrations will continue to decline. Groundwater monitoring included in this alternative provides a means for confirming that CVOC migration to and in groundwater does not result in either an increasing magnitude and/or extent beyond current conditions. Periodic reviews would provide for evaluation of continued protectiveness of the environment.	Protective of the environment. SVE treatment of soil to meet SCOs for the Protection of Groundwater provides additional protection of the environment through mitigation of CVOCs in soil that could result in impacting groundwater.. Natural attenuation would restore bedrock groundwater quality over time. It is expected that Eramosa bedrock formation groundwater TCA concentrations will continue to decline. Groundwater monitoring included in this alternative provides a means for confirming that CVOC migration to and in groundwater does not result in either an increasing magnitude and/or extent beyond current conditions. Periodic reviews would provide for evaluation of continued protectiveness of the environment.	Protective of the environment. Excavation of soil to meet Unrestricted Use SCOs provides additional protection of the environment. Natural attenuation would restore bedrock groundwater quality over time. It is expected that Eramosa bedrock formation groundwater TCA concentrations will continue to decline. Groundwater monitoring included in this alternative provides a means for confirming that CVOC migration to and in groundwater does not result in either an increasing magnitude and/or extent beyond current conditions. Periodic reviews would provide for evaluation of continued protectiveness of the environment.
Attainment of Remedial Action Objectives (RAOs)	Alternative 1 does not meet all RAOs. Specifically, RAOs related to indoor air/sub-slab vapor are not addressed under Alternative 1.	Alternative 2 addresses RAOs.	Alternative 3 meets RAOs.	Alternative 4 meets RAOs.
Compliance with Applicable or Relevant and Appropriate Requirements				

Table 7-2: Detailed Analysis of Remedial Alternatives

Criterion	Alternative 1 - No Further Action	Alternative 2 – Institutional Controls/Limited Soil Excavation/Containment/Natural Attenuation/Groundwater Monitoring	Alternative 3 – Institutional Controls/ Limited Soil Excavation/*In situ* Soil Treatment/Natural Attenuation/Groundwater Monitoring	Alternative 4 – Institutional Controls/Soil Excavation/Natural Attenuation/Groundwater Monitoring
Alternative Components	• 1999 soil excavation • Environmental easement, Deed restrictions (existing) • Natural attenuation • Use of public water source (existing)	• 1999 soil excavation • Environmental easement, Deed restrictions • Site Management Plan • Periodic site reviews • Excavation of soil to meet Commercial SCOs • Off-site disposal of soils • Natural attenuation with groundwater monitoring • Use of public water source (existing) • Surface covers (*e.g.*, vegetated soil, asphalt and concrete surfaces) serve as cap for impacted soils exceeding SCOs for Protection of Groundwater	• 1999 soil excavation • Environmental easement, Deed restrictions • Site Management Plan • Periodic site reviews • Excavation of soil to meet Commercial SCOs • Off-site disposal of soils • Natural attenuation with groundwater monitoring • Use of public water source(existing) • Surface covers (*e.g.*, vegetated soil, asphalt and concrete surfaces) serve as cap for impacted soils • *In situ* Treatment of soil using Soil Vapor Extraction (SVE) to meet SCOs for the Protection of Groundwater	• 1999 soil excavation • Environmental easement, Deed restrictions • Site Management Plan • Periodic site reviews • Natural attenuation with groundwater monitoring • Use of public water source (existing) • Excavation of soil to meet SCOs for Protection of Groundwater • Off-site disposal of soils
Compliance with Chemical-Specific ARARs and TBCs	Soil removal conducted to date has partially addressed soil ARARs. The existing vegetated soil/asphalt/building slab currently provides protection of human health; however, this alternative does not include continued maintenance of these surface covers. Does not meet TBCs for indoor air, should any new on Site buildings become occupied. Does not meet groundwater ARARs in the short-term, but protects human health through the existing institutional controls and availability of public water. This alternative may achieve groundwater ARARs in the long term by continuing reductions of CVOCs through natural attenuation processes to nontoxic byproducts (i.e., carbon dioxide and ethane), ultimately reducing both the concentration and mass of the CVOCs in the groundwater. A waiver of the chemical-specific ARARs for groundwater may be indicated due to the technical impracticability of restoring CVOCs in heterogeneous fractured bedrock systems to Class GA groundwater standards.	Soil removal conducted to date has partially addressed soil ARARs. Maintenance of vegetated soil, asphalt and/or concrete surfaces, institutional controls and natural attenuation addresses remaining soil ARARs for current and anticipated future Site use. Soil removal to meet Commercial SCOs to be conducted under Alternative 2 would not meet the soil ARARs associated with the protection of groundwater; however, the existing site soils do not appear to represent a significant source of groundwater impact. TBCs for indoor air would be addressed through building removal and a means for vapor intrusion mitigation if another building is constructed on Site. Does not meet groundwater ARARs in the short-term, but protects human health through the existing institutional controls. This alternative may achieve groundwater ARARs in the long term by continuing reductions of CVOCs through natural attenuation processes to nontoxic byproducts (i.e., carbon dioxide and ethane), ultimately reducing both the concentration and mass of the CVOCs in the groundwater. A waiver of the chemical-specific ARARs for groundwater may be indicated due to the technical impracticability of restoring CVOCs in heterogeneous fractured bedrock systems to Class GA groundwater standards.	Soil removal conducted to date has partially addressed soil ARARs. Implementation of SVE to treat CVOCs in soil, maintenance of vegetated soil, asphalt and/or concrete surfaces, institutional controls and natural attenuation address remaining soil ARARs for current and anticipated future Site use. TBCs for indoor air would be addressed through building removal and a means for vapor intrusion mitigation if another building is constructed on Site or if CVOCs volatilize from groundwater once the SVE system is turned off. Does not meet groundwater ARARs in the short-term, but protects human health through the existing institutional controls. This alternative may achieve groundwater ARARs in the long term by continuing reductions of CVOCs through natural attenuation processes to nontoxic byproducts (i.e., carbon dioxide and ethane), ultimately reducing both the concentration and mass of the CVOCs in the groundwater. A waiver of the chemical-specific ARARs for groundwater may be indicated due to the technical impracticability of restoring CVOCs in heterogeneous fractured bedrock systems to Class GA groundwater standards.	Soil removal conducted to date has partially addressed soil ARARs. Removal of the building foundation and concrete slab and further soil excavation addresses remaining soil ARARs for current and anticipated future site use. TBCs for indoor air would be addressed through a means for vapor intrusion mitigation if another building is constructed on Site or if CVOCs volatilize from groundwater into post-excavation backfilled soils. Does not meet groundwater ARARs in the short-term, but protects human health through the existing institutional controls. This alternative may achieve groundwater ARARs in the long term by continuing reductions of CVOCs through natural attenuation processes to nontoxic byproducts (i.e., carbon dioxide and ethane), ultimately reducing both the concentration and mass of the CVOCs in the groundwater. A waiver of the chemical-specific ARARs for groundwater may be indicated due to the technical impracticability of restoring CVOCs in heterogeneous fractured bedrock systems to Class GA groundwater standards.
Compliance with Location-Specific ARARs and TBCs	No Location-Specific ARARs were identified for the former RFM Site.	No Location-Specific ARARs were identified for the former RFM Site.	No Location-Specific ARARs were identified for the former RFM Site.	No Location-Specific ARARs were identified for the former RFM Site.

Table 7-2: Detailed Analysis of Remedial Alternatives

Criterion	Alternative 1 - No Further Action	Alternative 2 – Institutional Controls/Limited Soil Excavation/Containment/Natural Attenuation/Groundwater Monitoring	Alternative 3 – Institutional Controls/ Limited Soil Excavation/*In situ* Soil Treatment/Natural Attenuation/Groundwater Monitoring	Alternative 4 – Institutional Controls/Soil Excavation/Natural Attenuation/Groundwater Monitoring
Alternative Components	• 1999 soil excavation • Environmental easement, Deed restrictions (existing) • Natural attenuation • Use of public water source (existing)	• 1999 soil excavation • Environmental easement, Deed restrictions • Site Management Plan • Periodic site reviews • Excavation of soil to meet Commercial SCOs • Off-site disposal of soils • Natural attenuation with groundwater monitoring • Use of public water source (existing) • Surface covers (*e.g.*, vegetated soil, asphalt and concrete surfaces) serve as cap for impacted soils exceeding SCOs for Protection of Groundwater	• 1999 soil excavation • Environmental easement, Deed restrictions • Site Management Plan • Periodic site reviews • Excavation of soil to meet Commercial SCOs • Off-site disposal of soils • Natural attenuation with groundwater monitoring • Use of public water source(existing) • Surface covers (*e.g.*, vegetated soil, asphalt and concrete surfaces) serve as cap for impacted soils • *In situ* Treatment of soil using Soil Vapor Extraction (SVE) to meet SCOs for the Protection of Groundwater	• 1999 soil excavation • Environmental easement, Deed restrictions • Site Management Plan • Periodic site reviews • Natural attenuation with groundwater monitoring • Use of public water source (existing) • Excavation of soil to meet SCOs for Protection of Groundwater • Off-site disposal of soils
Compliance with Action-Specific ARARs and TBCs	No actions are proposed for this alternative.	Site activities would be conducted in accordance with OSHA safety requirements.	Site activities would be conducted in accordance with OSHA safety requirements. Management, transportation, and disposal of waste generated during SVE system construction and operation would be in accordance with regulatory requirements.	Site activities would be conducted in accordance with OSHA safety requirements. Management, transportation, and disposal of excavated soil would be in accordance with regulatory requirements.
Long-Term Effectiveness and Permanence				
Magnitude of residual risk	Residual risk to human health would be managed through existing environmental easement/deed restrictions and the existing public water source. Residual risks associated with soil, bedrock groundwater and indoor air/sub-slab soil vapor (for future buildings) would remain. This alternative relies on natural attenuation to mitigate these risks. The lack of periodic reviews precludes a means of confirming that deed restrictions continue to be protective of residual risks. The lack of monitoring in this alternative precludes a means of confirming that CVOC migration to and in groundwater does not result in either an increasing magnitude and/or extent beyond current conditions. Not effective at managing long-term Site risks.	Minimal long-term residual risks. This alternative combines natural attenuation and engineering controls (surface covers and a means for vapor intrusion mitigation) to mitigate risks associated with CVOC concentrations in soil, bedrock groundwater, and indoor air/sub-slab soil vapor should another building be constructed on Site. Residual risks to human health are minimized through modified environmental easement/deed restrictions and the existing public water source. Maintained covers, a means for vapor intrusion mitigation and natural attenuation coupled with institutional controls, groundwater monitoring, and periodic reviews are effective means of managing long-term risks at the Site.	No long-term residual risks with respect to soil. No current risks associated with indoor air vapor intrusion as the building has been removed. This alternative combines natural attenuation, soil treatment and a means for vapor intrusion mitigation to mitigate risks associated with CVOC concentrations in soil, bedrock groundwater and indoor air/sub-slab soil vapor should another building be constructed on Site. Residual risks to human health are minimized through modified environmental easement/deed restrictions and the existing public water source. Soil treatment using SVE and natural attenuation coupled with institutional controls, groundwater monitoring, and periodic reviews are effective means of managing long-term risks at the Site.	No long-term residual risks with respect to soil. No current risks associated with indoor air vapor intrusion as the building has been removed. This alternative combines natural attenuation, soil removal and a means for vapor intrusion mitigation to mitigate risks associated with CVOC concentrations in soil, bedrock groundwater and indoor air/sub-slab soil vapor should another building be constructed on Site. Residual risks to human health are minimized through modified environmental easement/deed restrictions and the existing public water source. Soil excavation and natural attenuation coupled with institutional controls, groundwater monitoring, and periodic reviews are effective means of managing long-term risks at the Site.
Adequacy and reliability of controls	Existing environmental easement/deed restrictions are reliable means of minimizing potential for future exposure to soil and bedrock groundwater. However, the lack of groundwater monitoring or periodic reviews does not allow evaluation of continued adequacy and reliability of the remedy.	Maintained surface covers and a means for vapor intrusion mitigation are adequate and reliable means of controlling Site risks related to soil and to indoor air/sub-slab soil vapor should another building be constructed on Site. Modified environmental easement/deed restrictions are a reliable means of minimizing potential for future exposure to soil and bedrock groundwater. Monitoring and periodic reviews are a reliable means of assessing adequacy of the remedy. A Site	SVE treatment of soil is an adequate and reliable means of controlling Site risks related to soil and a means for vapor intrusion mitigation is an adequate and reliable means of controlling risk related to indoor air/sub-slab soil vapor should another building be constructed on Site. However, based on soil borings under the former RFM building, SVE reliability may be limited due to subsurface heterogeneity associated with the presence of layers of silt/clay and sands	Removal of the building foundation and concrete slab and excavation of soil, in conjunction with a means for vapor intrusion mitigation, are adequate and reliable means of controlling Site risks related to soil and indoor air/sub-slab soil vapor should another building be constructed on Site. Modified environmental easement/deed restrictions are a reliable means of minimizing potential for future exposure to soil and bedrock groundwater. Monitoring and periodic

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Alternative Components	• 1999 soil excavation • Environmental easement, Deed restrictions (existing) • Natural attenuation • Use of public water source (existing)	• 1999 soil excavation • Environmental easement, Deed restrictions • Site Management Plan • Periodic site reviews • Excavation of soil to meet Commercial SCOs • Off-site disposal of soils • Natural attenuation with groundwater monitoring • Use of public water source (existing) • Surface covers (*e.g.*, vegetated soil, asphalt and concrete surfaces) serve as cap for impacted soils exceeding SCOs for Protection of Groundwater	• 1999 soil excavation • Environmental easement, Deed restrictions • Site Management Plan • Periodic site reviews • Excavation of soil to meet Commercial SCOs • Off-site disposal of soils • Natural attenuation with groundwater monitoring • Use of public water source(existing) • Surface covers (*e.g.*, vegetated soil, asphalt and concrete surfaces) serve as cap for impacted soils • *In situ* Treatment of soil using Soil Vapor Extraction (SVE) to meet SCOs for the Protection of Groundwater	• 1999 soil excavation • Environmental easement, Deed restrictions • Site Management Plan • Periodic site reviews • Natural attenuation with groundwater monitoring • Use of public water source (existing) • Excavation of soil to meet SCOs for Protection of Groundwater • Off-site disposal of soils
		Management Plan is an effective means of controlling exposure to CVOCs in soil, bedrock groundwater and indoor air/sub-slab vapor should another building be constructed on Site. Attenuation processes, including matrix diffusion, sorption, and/or abiotic and biotic degradation can be expected to significantly reduce the rate of downgradient migration to the Cinemark property of the TCA concentrations and will at some point result in the stabilization and eventual contraction of the extent of TCA downgradient migration. The abandonment of AMSF recharge wells as part of planned remediation at the former AMSF Site is expected to mitigate the groundwater exceedances to Class GA standards at the Cinemark property. As such, it is anticipated that potential long-term vapor intrusion concerns related to impacted groundwater at the Cinemark property may also be mitigated once surface water recharge is controlled.	at varying depths requiring treatment to meet soil SCOs. Modified environmental easement/deed restrictions are a reliable means of minimizing potential for future exposure to soil and bedrock groundwater. Monitoring and periodic reviews are a reliable means of assessing adequacy of the remedy. A Site Management Plan is an effective means of controlling exposure to CVOCs in soil, bedrock groundwater and indoor air/sub-slab soil vapor should another building be constructed on Site. Attenuation processes, including matrix diffusion, sorption, and/or abiotic and biotic degradation can be expected to significantly reduce the rate of downgradient migration to the Cinemark property of the TCA concentrations and will at some point result in the stabilization and eventual contraction of the extent of TCA downgradient migration. The abandonment of AMSF recharge wells as part of planned remediation at the former AMSF Site is expected to mitigate the groundwater exceedances to Class GA standards at the Cinemark property. As such, it is anticipated that potential long-term vapor intrusion concerns related to impacted groundwater at the Cinemark property may also be mitigated once surface water recharge is controlled.	reviews are reliable means of assessing adequacy of the remedy. A Site Management Plan is an effective means of controlling exposure to CVOCs in soil, bedrock groundwater and in indoor air/sub-slab soil vapor should another building be constructed on Site. Attenuation processes, including matrix diffusion, sorption, and/or abiotic and biotic degradation can be expected to significantly reduce the rate of downgradient migration to the Cinemark property of the TCA concentrations and will at some point result in the stabilization and eventual contraction of the extent of TCA downgradient migration. The abandonment of AMSF recharge wells as part of planned remediation at the former AMSF Site is expected to mitigate the groundwater exceedances to Class GA standards at the Cinemark property. As such, it is anticipated that potential long-term vapor intrusion concerns related to impacted groundwater at the Cinemark property may also be mitigated once surface water recharge is controlled.
Long-term sustainability	No active remedial components in this alternative; therefore, no environmental or sustainability impacts are associated with implementation of this alternative.	No long-term environmental or sustainability impacts are associated with implementation of this alternative (limited excavation is being considered a short-term duration).	No long-term environmental or sustainability impacts are associated with implementation of this alternative (limited excavation and SVE are being considered a short-term duration).	No long-term environmental or sustainability impacts are associated with implementation of this alternative.

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Alternative Components	• 1999 soil excavation • Environmental easement, Deed restrictions (existing) • Natural attenuation • Use of public water source (existing)	• 1999 soil excavation • Environmental easement, Deed restrictions • Site Management Plan • Periodic site reviews • Excavation of soil to meet Commercial SCOs • Off-site disposal of soils • Natural attenuation with groundwater monitoring • Use of public water source (existing) • Surface covers (*e.g.*, vegetated soil, asphalt and concrete surfaces) serve as cap for impacted soils exceeding SCOs for Protection of Groundwater	• 1999 soil excavation • Environmental easement, Deed restrictions • Site Management Plan • Periodic site reviews • Excavation of soil to meet Commercial SCOs • Off-site disposal of soils • Natural attenuation with groundwater monitoring • Use of public water source(existing) • Surface covers (*e.g.*, vegetated soil, asphalt and concrete surfaces) serve as cap for impacted soils • *In situ* Treatment of soil using Soil Vapor Extraction (SVE) to meet SCOs for the Protection of Groundwater	• 1999 soil excavation • Environmental easement, Deed restrictions • Site Management Plan • Periodic site reviews • Natural attenuation with groundwater monitoring • Use of public water source (existing) • Excavation of soil to meet SCOs for Protection of Groundwater • Off-site disposal of soils
Reduction of Toxicity, Mobility, or Volume through Treatment				
Treatment process used and materials treated	No treatment processes are included in this alternative.	Limited excavation and off-Site disposal are included in this alternative to address SVOCs in soil.	Limited excavation and off-Site disposal are included in this alternative to address SVOCs in soil. SVE is included in this alternative to address CVOCs in soil.	Excavation and off-Site disposal are included in this alternative.
Amount of hazardous material destroyed or treated	No hazardous materials have been identified at the former RFM Site.	No hazardous materials have been identified at the former RFM Site.	No hazardous materials have been identified at the former RFM Site.	No hazardous materials have been identified at the former RFM Site.
Degree of expected reduction in toxicity, mobility, or volume	Reduction in volume and environmental mobility of 968 tons of CVOC-impacted soil associated with the 1999 excavation. No reduction in toxicity, mobility or volume in soil impacted with SVOCs is anticipated under this alternative. Natural attenuation is expected to decrease CVOC concentrations in bedrock groundwater and is expected to result in reduction in volume of CVOCs in soil. Lack of monitoring in this alternative does not provide a means of confirming reduction in the toxicity, mobility and volume of CVOC impacted soil or bedrock groundwater.	Reduction in volume and environmental mobility of 968 tons of CVOC-impacted soil associated with the 1999 excavation and the proposed removal of approximately 18 tons of SVOC-impacted soil. Continued reduction of mobility of CVOC-impacted soil exceeding Protection of Groundwater SCOs as a result of the reduction of precipitation infiltration due to the vegetated soil, asphalt and concrete surfaces. Reduction of toxicity, mobility and volume of CVOCs in bedrock groundwater by reducing the CVOC mass in the bedrock matrix and subsequently in the bedrock groundwater as a result of natural attenuation processes. Surface water recharge plays a significant role in the transport of VOCs in groundwater at the site. Abandonment of ITT-W-1 included in each alternative coupled with abandonment of AMSF recharge wells as part of planned remediation at the former AMSF Site is anticipated to result in plume stability. As discussed in Section 3.4.3, natural attenuation processes, including matrix diffusion, sorption, and/or abiotic and biotic degradation can also be expected to significantly reduce the rate of downgradient migration to the Cinemark property of the TCA concentrations and will at some point result in the stabilization and eventual contraction of the	Reduction in volume and environmental mobility of 968 tons of CVOC impacted soil associated with the 1999 excavation and the proposed removal of approximately 18 tons of SVOC-impacted soil and possibly the removal of approximately 48 tons of CVOC-impacted soil. Further reduction in toxicity, mobility and volume would result from SVE treatment of soil and associated soil vapor. Reduction of toxicity, mobility and volume of CVOCs in bedrock groundwater by reducing the CVOC mass in the bedrock matrix and subsequently in the bedrock groundwater as a result of natural attenuation processes. Surface water recharge plays a significant role in the transport of VOCs in groundwater at the site. Abandonment of ITT-W-1 included in each alternative coupled with abandonment of AMSF recharge wells as part of planned remediation at the former AMSF Site is anticipated to result in plume stability. As discussed in Section 3.4.3, natural attenuation processes, including matrix diffusion, sorption, and/or abiotic and biotic degradation can also be expected to significantly reduce the rate of downgradient migration to the Cinemark property of the TCA concentrations and will at some point	Reduction in volume and environmental mobility of 968 tons of CVOC impacted soil associated with the 1999 excavation and the proposed removal of approximately 2,268 tons of SVOC-impacted soil. Further reduction in toxicity, mobility and volume would result from excavation of soil. Reduction of toxicity, mobility and volume of CVOCs in bedrock groundwater by reducing the CVOC mass in the bedrock matrix and subsequently in the bedrock groundwater as a result of natural attenuation processes. Surface water recharge plays a significant role in the transport of VOCs in groundwater at the site. Abandonment of ITT-W-1 included in each alternative coupled with abandonment of AMSF recharge wells as part of planned remediation at the former AMSF Site is anticipated to result in plume stability. As discussed in Section 3.4.3, natural attenuation processes, including matrix diffusion, sorption, and/or abiotic and biotic degradation can also be expected to significantly reduce the rate of downgradient migration to the Cinemark property of the TCA concentrations and will at some point result in the stabilization and eventual contraction of the extent of TCA

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Alternative Components	• 1999 soil excavation • Environmental easement, Deed restrictions (existing) • Natural attenuation • Use of public water source (existing)	• 1999 soil excavation • Environmental easement, Deed restrictions • Site Management Plan • Periodic site reviews • Excavation of soil to meet Commercial SCOs • Off-site disposal of soils • Natural attenuation with groundwater monitoring • Use of public water source (existing) • Surface covers (*e.g.*, vegetated soil, asphalt and concrete surfaces) serve as cap for impacted soils exceeding SCOs for Protection of Groundwater	• 1999 soil excavation • Environmental easement, Deed restrictions • Site Management Plan • Periodic site reviews • Excavation of soil to meet Commercial SCOs • Off-site disposal of soils • Natural attenuation with groundwater monitoring • Use of public water source(existing) • Surface covers (*e.g.*, vegetated soil, asphalt and concrete surfaces) serve as cap for impacted soils • *In situ* Treatment of soil using Soil Vapor Extraction (SVE) to meet SCOs for the Protection of Groundwater	• 1999 soil excavation • Environmental easement, Deed restrictions • Site Management Plan • Periodic site reviews • Natural attenuation with groundwater monitoring • Use of public water source (existing) • Excavation of soil to meet SCOs for Protection of Groundwater • Off-site disposal of soils
		extent of TCA downgradient migration. Groundwater monitoring included in this alternative provides a means of evaluating potential reduction in the toxicity, mobility and volume of CVOC-impacted bedrock groundwater.	result in the stabilization and eventual contraction of the extent of TCA downgradient migration. Groundwater monitoring included in this alternative provides a means of evaluating potential reduction in the toxicity, mobility and volume of CVOC-impacted bedrock groundwater.	downgradient migration. Groundwater monitoring included in this alternative provides a means of evaluating potential reduction in the toxicity, mobility and volume of CVOC-impacted bedrock groundwater.
Degree to which treatment is irreversible	No treatment processes are included in this alternative.	Soil excavation and off-Site disposal are considered irreversible.	SVE and soil removal/off-Site disposal are considered to be irreversible.	Soil excavation and off-Site disposal are considered irreversible.
Type and quantity of residuals remaining after treatment	No treatment residuals associated with this alternative.	No treatment residuals associated with this alternative.	Effluent vapors from the SVE system may require treatment prior to release to the atmosphere.	No treatment residuals associated with this alternative.
Short-Term Impact and Effectiveness				
Protection of community during remedial actions	No active components are related to this alternative.	Proper community health and safety measures would be employed during implementation of this alternative. Dust, surface runoff, erosion, and volatile emissions, if any, would be controlled during construction activities associated with the surface covers (*e.g.*, vegetated soil, asphalt and concrete surfaces), abandonment of recharge well ITT-W-1, and excavation of soil.	Proper community health and safety measures would be employed during implementation of this alternative. Dust, surface runoff, erosion, and volatile emissions, if any, would be controlled during construction activities associated with the surface covers (*e.g.*, vegetated soil, asphalt and concrete surfaces), abandonment of recharge well ITT-W-1, and excavation of soil. Extracted vapors would be treated, if necessary, prior to release to the atmosphere.	Proper community health and safety measures would be employed during implementation of this alternative. Dust, surface runoff, erosion, and volatile emissions, if any, would be controlled during abandonment of recharge well ITT-W-1, removal of the building foundation, concrete slab, and excavation of soil.
Protection of workers during remedial actions	No active components are related to this alternative.	Proper health and safety measures would be established and employed during implementation of this alternative, and would be effective in protecting workers from exposure to adverse conditions.	Proper health and safety measures would be established and employed during implementation of this alternative, and would be effective in protecting workers from exposure to adverse conditions.	Proper health and safety measures would be established and employed during implementation of this alternative, and would be effective in protecting workers from exposure to adverse conditions.

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Short-term sustainability	No fuel or energy consumption nor greenhouse gas or pollutant emissions would be produced because of the lack of active components associated with this alternative. No water or resource use and no impacts to water or ecology because of the lack of active components associated with this alternative.	Dust, surface water runoff controls, and erosion control measures would be instituted to minimize impacts to the environment during implementation of this alternative. Negligible short-term fuel/energy use, greenhouse gas emissions and water use would be necessary. Minimal resource use and impacts to water and ecology. Green remediation techniques, as detailed in NYSDEC DER-31, would be considered to reduce short-term impacts of the remedy.	Dust, surface water runoff controls, and erosion control measures would be instituted to minimize impacts to the environment during implementation of this alternative. Greenhouse gas emissions would exist associated with construction equipment, fuel/energy use during SVE. Moderate fuel/energy consumption, minimal water and resource use, and minimal impacts to water or ecology. Green remediation techniques, as detailed in NYSDEC DER-31, would be considered to reduce short-term impacts of the remedy.	Dust, surface water runoff controls, and erosion control measures would be instituted to minimize impacts to the environment during implementation of this alternative. Greenhouse gas emissions would exist associated with construction equipment, fuel/energy use during removal of building foundation and concrete slab, excavation of soil, and transportation of excavated soil to an off-site disposal facility. Moderate fuel/energy consumption, minimal water and resource use, and minimal impacts to water or ecology. Green remediation techniques, as detailed in NYSDEC DER-31, would be considered to reduce short-term impacts of the remedy. Construction debris would be recycled to the extent practicable with the remaining materials requiring landfilling.
Time until remedial action objectives are achieved	RAOs for human health exposure to groundwater are currently met with existing institutional controls and public water supply. The RAO for human health exposure to indoor air would not be achieved with this alternative should any newly constructed building at the Site become occupied. RAOs related to protection of the environment would not be met in the short-term with this alternative. It should be noted that it may not be technically feasible to restore groundwater to pre-disposal conditions at this Site.	RAOs for the protection of human health exposure to groundwater are currently achieved and would continue to be achieved upon completion of the remedy. The RAO for potential human health exposure to indoor air would be achieved upon implementation of the remedy. The RAO for protection of the environment related to migration of CVOCs in soil to groundwater is currently addressed by site covers and would continue to be addressed upon completion of the remedy. The soil remedy would be completed in approximately 6 months. This alternative is not expected to achieve the RAO related to groundwater restoration in the short-term. It should be noted that it may not be technically feasible to meet the RAO related to the restoration of groundwater to pre-disposal conditions at this Site in the short-term. The RAO related to groundwater restoration may be met in the long-term through natural attenuation processes.	RAOs for the protection of human health exposure to groundwater are currently achieved and would continue to be achieved upon completion of the remedy. The RAO for potential human health exposure to indoor air would be achieved upon implementation of the remedy. The RAO for protection of the environment related to migration of CVOCs in soil to groundwater would be addressed by soil treatment upon completion of the remedy. The soil remedy would be completed in approximately 5½ years. This alternative is not expected to achieve the RAO related to groundwater restoration in the short-term. It should be noted that it may not be technically feasible to meet the RAO related to the restoration of groundwater to pre-disposal conditions at this Site in the short-term. The RAO related to groundwater restoration may be met in the long-term through natural attenuation processes.	RAOs for the protection of human health exposure to groundwater are currently achieved and would continue to be achieved upon completion of the remedy. The RAO for human health exposure to indoor air would be achieved upon implementation of the remedy. The RAO for protection of the environment related to migration of CVOCs in soil would be addressed upon completion of the remedy. The soil remedy would be completed in approximately 2½ years. This alternative is not expected to achieve the RAO related to groundwater restoration in the short-term. It should be noted that it may not be technically feasible to meet the RAO related to the restoration of groundwater to pre-disposal conditions at this Site in the short-term. The RAO related to groundwater restoration may be met in the long-term through natural attenuation processes.

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Implementability				
Ability to construct and operate the technology	Technically and administratively feasible to implement. The 1999 soil excavation has already been implemented. Institutional controls to address groundwater use and exposures to soil have already been implemented.	Technically and administratively feasible to implement. The 1999 soil excavation has already been implemented. Institutional controls to address groundwater use and exposures to soil have already been implemented. Implementation of vapor intrusion mitigation for a new building, if necessary, is implementable. Soil excavation and off-Site disposal are readily implementable.	Technically and administratively feasible to implement. The 1999 soil excavation has already been implemented. Institutional controls to address groundwater use and exposures to soil have already been implemented. SVE would be technically difficult to implement because of layered air permeability heterogeneity associated with the presence of silt/clay and sands requiring treatment to meet soil SCOs. SVE wells would be targeted in the sand layers to maximize interception of soil vapors volatilizing from groundwater located under the former RFM building. Implementation of vapor intrusion mitigation for a new building, if necessary, is implementable. Soil excavation and off-Site disposal are readily implementable.	Technically and administratively feasible to implement. The 1999 soil excavation has already been implemented. Institutional controls to address groundwater use and exposures to soil have already been implemented. Implementation of vapor intrusion mitigation for a new building, if necessary, is implementable. Additional soil excavation and off-Site disposal are readily implementable.
Reliability of technology	There are no technologies to be constructed in this alternative.	Surface covers that are maintained are a reliable containment method. Soil excavation and off-Site disposal is a reliable means of addressing soil exposure.	Surface covers that are maintained are a reliable containment method. Soil excavation and off-Site disposal is a reliable means of addressing soil exposure. SVE is a reliable technology for treating CVOCs in soil. Based on soil borings under the former RFM building, SVE reliability may be limited due to subsurface heterogeneity associated with the presence of layers of silt/clay and sands at varying depths requiring treatment to meet soil SCOs. SVE wells would target the sand layers to maximize interception of soil vapors located under the former RFM building.	Excavation and off-Site disposal is a reliable means of addressing impacted soil.
Ease of undertaking additional remedial actions, if necessary	Implementation of this alternative would not preclude consideration of a new and/or innovative alternative, if necessary, should new technological advances be made at a future date.	Implementation of this alternative would not preclude consideration of a new and/or innovative alternative, if necessary, should new technological advances be made at a future date.	Implementation of this alternative would not preclude consideration of a new and/or innovative alternative, if necessary, should new technological advances be made at a future date.	Implementation of this alternative would not preclude consideration of a new and/or innovative alternative, if necessary, should new technological advances be made at a future date.

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Ability to monitor effectiveness of remedy	No means to monitor effectiveness are included in this alternative.	Groundwater monitoring would indicate changes in groundwater quality. Periodic reviews would monitor the effectiveness of the remedy.	Post-soil treatment sampling would indicate the effectiveness of the SVE system. Groundwater monitoring would indicate changes in groundwater quality. Periodic reviews would monitor the effectiveness of the remedy.	Groundwater monitoring would indicate changes in groundwater quality. Periodic reviews would monitor the effectiveness of the remedy.
Coordination with other agencies and property owners	No coordination necessary to implement this alternative.	Coordination with local agencies is necessary to implement this alternative on-site	Coordination with local agencies is necessary to implement this alternative on-site.	Coordination with local agencies is necessary to implement this alternative on-site.
Availability of off-site treatment, storage and disposal services and capacities	No off-site treatment, storage or disposal services identified for this alternative.	Off-site treatment, storage and disposal facilities are readily available.	Off-site treatment, storage and disposal facilities are readily available.	Off-site treatment, storage and disposal facilities are readily available.
Availability of necessary equipment, specialists, and materials	No equipment, specialists, or materials are required for this alternative.	Equipment, specialists and materials are readily available.	Equipment, specialists and materials are readily available.	Equipment, specialists and materials are readily available.
Cost Effectiveness				
Total estimated capital cost	$0	$104,100	$1,195,000	$943,000
Present worth of operation and maintenance cost (30 years, 7% discount factor)	$0	$702,000	$2,200,500	$600,500
Total estimated net present worth cost	$0	$806,000	$3,396,000	$1,544,000

Table 7-2: Detailed Analysis of Remedial Alternatives

Criterion	Alternative 1 - No Further Action	Alternative 2 – Institutional Controls/Limited Soil Excavation/Containment/Natural Attenuation/Groundwater Monitoring	Alternative 3 – Institutional Controls/ Limited Soil Excavation/*In situ* Soil Treatment/Natural Attenuation/Groundwater Monitoring	Alternative 4 – Institutional Controls/Soil Excavation/Natural Attenuation/Groundwater Monitoring
Alternative Components	• 1999 soil excavation • Environmental easement, Deed restrictions (existing) • Natural attenuation • Use of public water source (existing)	• 1999 soil excavation • Environmental easement, Deed restrictions • Site Management Plan • Periodic site reviews • Excavation of soil to meet Commercial SCOs • Off-site disposal of soils • Natural attenuation with groundwater monitoring • Use of public water source (existing) • Surface covers (*e.g.*, vegetated soil, asphalt and concrete surfaces) serve as cap for impacted soils exceeding SCOs for Protection of Groundwater	• 1999 soil excavation • Environmental easement, Deed restrictions • Site Management Plan • Periodic site reviews • Excavation of soil to meet Commercial SCOs • Off-site disposal of soils • Natural attenuation with groundwater monitoring • Use of public water source(existing) • Surface covers (*e.g.*, vegetated soil, asphalt and concrete surfaces) serve as cap for impacted soils • *In situ* Treatment of soil using Soil Vapor Extraction (SVE) to meet SCOs for the Protection of Groundwater	• 1999 soil excavation • Environmental easement, Deed restrictions • Site Management Plan • Periodic site reviews • Natural attenuation with groundwater monitoring • Use of public water source (existing) • Excavation of soil to meet SCOs for Protection of Groundwater • Off-site disposal of soils
Land Use				
Evaluation of land use factors	Remedy is not consistent with reasonably anticipated future use of the property (does not allow for use of building on the property because there is no restriction requiring vapor intrusion protection in future buildings).	Remedy is consistent with current and reasonably anticipated future use for the property.	Remedy is consistent with current and reasonably anticipated future use for the property.	Remedy is consistent with current and reasonably anticipated future use for the property.

Note: Under each active alternative (Alternatives 2, 3 and 4), the surface water recharge well ITT W-1 is assumed to be abandoned.

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Table 7-3: Alternative 1; No Further Action

	QTY	UNIT	UNIT COST	TOTAL COST	Notes/Assumptions
DIRECT CAPITAL CONSTRUCTION COSTS					
TOTAL DIRECT CAPITAL COST					
Engineering/Design/Field Oversight			0%	$0	
Legal			0%	$0	
Contingency			0%	$0	
TOTAL ALTERNATIVE CAPITAL COST (rounded)				**$0**	
OPERATION AND MAINTENANCE COSTS					

PRESENT WORTH ANALYSIS (YEARS 1-30)

Cost Type	**Total Cost**	**Discount Factor (7%)**	**Present Value**
Capital Cost - Year 0	$0	1.000	$0
Annual O&M - Years 1-30	$0		$0
TOTAL PROJECT PRESENT WORTH (rounded)			**$0**

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Table 7-4: Alternative 2; Institutional Controls/Limited Soil Excavation/Containment/Natural Attenuation/Groundwater Monitoring

	QTY	UNIT	UNIT COST	TOTAL COST (rounded)	Notes/Assumptions
DIRECT CAPITAL CONSTRUCTION COSTS					
Mobilization	1	ea	$6,500	$6,500	Job site trailer, tools equipment and materials
General Conditions	2	wk	$8,500	$17,000	Trailer, electrical and maintenance
Surveys and Permits	32	hr	$150	$4,800	
Institutional Controls					
Develop site management plan	1	LS	$25,000	$25,000	
Abandon Existing Stormwater Injection Well					
Abandon Well in accordance with CP-43	1	LS	$25,000	$25,000	Recharge well W-1 ; 137 ft deep and 6 inch diameter
Excavation of surface soils					
Excavation of impacted soil	14	cy	$35	$500	assume maximum cut = 1-ft
Impacted soil - transportation and disposal	18	ton	$80	$1,500	Assumes non-haz disposal; 1.3 tons per cy
Restoration	14	cy	$32	$400	suitable backfill to grade; topsoil and seed
Pavement Repair					
Excavation for pavement restoration	2	cy	$35	$70	removal to 6-inches
Impacted soil - transportation and disposal	3	ton	$80	$200	Assumes non-haz disposal; 1.3 tons per cy
Place asphalt repair	100	sf	$10.00	$1,000	stone subgrade and asphalt course; total 6-inches
TOTAL DIRECT CAPITAL COST				**$82,000**	
Engineering/Design/Field Oversight			10%	8,200	
Legal			2%	1,600	
Contingency			15%	12,300	
TOTAL ALTERNATIVE CAPITAL COST (rounded)				**$104,100**	

Table 7-4: Alternative 2; Institutional Controls/Limited Soil Excavation/Containment/Natural Attenuation/Groundwater Monitoring

	QTY	UNIT	UNIT COST	TOTAL COST	Notes/Assumptions
OPERATION AND MAINTENANCE COSTS					
Annual Costs (Years 1-30)					
Natural Attenuation Monitoring (on-site and off-site) and Institutional Controls					
Groundwater Sampling and Analysis	20	ea	$1,700	$34,000	Annual; VOCs + TICS; Water level measurement; IDW disposal
Groundwater Reporting	1	LS	$10,000	$10,000	Annual; Validation and Reporting
Investigation Derived Waste	1	LS	$2,000	$2,000	Based on T& D of 8 drums of non-hazardous waste
Cover system maintenance					
Mowing	40	wk	$100	$4,000	
Pavement Repair	1	ea	$1,200	$1,000	
Vegetation Repair	1	ea	$1,200	$1,000	assumed 1 cy topsoil and seed repair per year
Site Inspection					
Annual Site Inspection	1	ea	$1,500	$1,500	2 persons, 2 days
Periodic Costs (Years 5, 10, 15, 20, 25, 30)					
Asphalt sealing	50,000	sf	$0.25	$12,500	assumes complete paved area sealing
5-yr reviews	1	ea	$5,000	$5,000	

PRESENT WORTH ANALYSIS (YEARS 1-30)		**Avg. Discount**	
Cost Type	**Cost**	**Factor (7%)**	**Present Value**
Capital Cost - Year 0	$104,100	1.000	$104,100
Annual O&M - Years 1-30	$53,500	0.4136	$664,000
Periodic Costs - Years 5, 10, 15, 20, 25, 30	$17,500	0.3596	$38,000
TOTAL PROJECT PRESENT WORTH (rounded)			**$ 806,000**

Note: CP-43 is NYSDEC Policy CP-43: Groundwater Monitoring Well Decommissioning Policy, November 3, 2009

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Town of Gates, New York
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Table 7-5: Alternative 3; Institutional Controls/Limited Soil Excavation/*In-situ* Soil Treatment/Natural Attenuation/Groundwater Monitoring

	QTY	UNIT	UNIT COST	TOTAL COST (rounded)	Notes/Assumptions
DIRECT CAPITAL CONSTRUCTION COSTS					
Mobilization	1	LS	$10,000	$10,000	Job site trailer, tools equipment and materials
General Conditions	8	wk	$8,500	$68,000	Trailer, electrical and maintenance
Surveys and Permits	1	LS	$25,000	$25,000	
Pre-Design Investigation					
SVE Pilot Testing	1	LS	$185,000	$185,000	communication testing and pilot scale testing; 90 days operation
Institutional Controls					
Develop site management plan	1	LS	$25,000	$25,000	
Abandon Existing Stormwater Injection Well					
Abandon Well in accordance with CP-43	1	LS	$25,000	$25,000	Recharge well W-1 ; 137 ft deep and 6 inch diameter
Soil Vapor Extraction					
SVE Extr. Well Installation	48	ea	$1,800	$86,400	48 SVE wells (20-ft on center) to 10-ft bgs
Air Inlet Well Installation	32	ea	$1,800	$57,600	32 SVE wells for air inlet
Vapor Monitoring Point Installation	25	ea	$1,800	$45,000	25 SVE wells for vapor monitoring
Install SVE Blower package	7	ea	$8,500	$59,500	20 hp blower, Air/Water and Oil/Water separators; inc. mounting pad
Install well-field and interconnecting piping/valves	1,200	lf	$125	$149,500	2-inch PVC piping, with 4" dia. and 6" dia.fittings and valves
Vapor-Phase GAC Vessel	4	ea	$7,700	$30,800	Two - 1,000 lb vessels per treatment area
Vapor-Phase Carbon	4,000	lbs	$1.70	$6,800	
Electrical and Instrumentation	1	LS	$132,000	$132,000	as a percentage of total per USACE EM 1110-1-4012, Nov. 15, 2001
Full scale startup and testing of systems	1	LS	$25,000	$25,000	
Focused Excavation					
Excavation of impacted soil	37	cy	$35	$1,300	assume maximum cut = 10-ft
Impacted soil - transportation and disposal	48	ton	$80	$3,900	Assumes non-haz disposal; 1.3 tons per cy
Restoration	48	cy	$32	$1,500	suitable backfill to grade; compacted; topsoil and seed
Excavation of surface soils					
Excavation of impacted soil	14	cy	$35	$500	assume maximum cut = 1-ft
Impacted soil - transportation and disposal	18	ton	$80	$1,500	Assumes non-haz disposal; 1.3 tons per cy
Restoration	14	cy	$32	$400	suitable backfill to grade; topsoil and seed

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Town of Gates, New York
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Table 7-5: Alternative 3; Institutional Controls/Limited Soil Excavation/*In-situ* Soil Treatment/Natural Attenuation/Groundwater Monitoring

	QTY	UNIT	UNIT COST	TOTAL COST	Notes/Assumptions
Pavement Repair					
Excavation for pavement restoration	2	cy	$35	$70	removal to 6-inches
Impacted soil - transportation and disposal	3	ton	$80	$200	Assumes non-haz disposal; 1.3 tons per cy
Place asphalt repair	100	sf	$10.00	$1,000	stone subgrade and asphalt course; total 6-inches
TOTAL DIRECT CAPITAL COST				**$941,000**	
Engineering/Design/Field Oversight			10%	94,000	
Legal			2%	19,000	
Contingency			15%	141,000	
TOTAL ALTERNATIVE CAPITAL COST (rounded)				**$1,195,000**	

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Table 7-5: Alternative 3; Institutional Controls/Limited Soil Excavation/*In-situ* Soil Treatment/Natural Attenuation/Groundwater Monitoring

	QTY	UNIT	UNIT COST	TOTAL COST	Notes/Assumptions
OPERATION AND MAINTENANCE COSTS					
Annual Costs (Years 1-5)					
SVE Operation and maintenance					
Maintenance	84	da	$1,000	$84,000	monthly operation checks and routine maintenance
Electrical Costs	901,404	kWh	$0.19	$171,300	Seven 20 HP blowers operating continuously, inc misc electrical
Carbon Replacement	16,000	lbs	$3.00	$48,000	quarterly changes per year; inc labor and GAC disposal
Condensate Waste Disposal	12,775	gal	$1.00	$12,800	35 gpd condensate; handling and disposal
Performance Monitoring and Reporting	12	mo	$6,500.00	$78,000	Monthly SVE, soil vapor monitoring by summa canister
Annual Costs (Years 1-30)					
Natural Attenuation Monitoring (on-site and off-site) and Institutional Controls					
Groundwater Sampling and Analysis	20	ea	$1,700	$34,000	Annual; VOCs + TICS; Water level measurement; IDW disposal
Groundwater Reporting	1	LS	$10,000	$10,000	Annual; Validation and Reporting
Investigation Derived Waste	1	LS	$2,000	$2,000	Based on T& D of 8 drums of non-hazardous waste
Site Inspection					
Annual Site Inspection	1	ea	$1,500	$1,500	2 persons, 2 days
Periodic Costs (Years 5, 10, 15, 20, 25, 30)					
5-yr reviews	1	ea	$5,000	$5,000	

PRESENT WORTH ANALYSIS (YEARS 1-30)		**Avg. Discount**	
Cost Type	**Cost**	**Factor (7%)**	**Present Value**
Capital Cost - Year 0	$1,195,000	1.000	$1,195,000
Annual O&M - Years 1-5	$441,600	0.8199	$1,810,500
Annual O&M - Years 6-30	$47,500	0.3323	$379,000
Periodic Costs - Years 5, 10, 15, 20, 25, 30	$5,000	0.3596	$11,000
TOTAL PROJECT PRESENT WORTH (rounded)			**$ 3,396,000**

Note: CP-43 is NYSDEC Policy CP-43: Groundwater Monitoring Well Decommissioning Policy, November 3, 2009

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Town of Gates, New York
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Table 7-6: Alternative 4; Institutional Controls/Soil Excavation/Natural Attenuation/Groundwater Monitoring

	QTY	UNIT	UNIT COST	TOTAL COST (rounded)	Notes/Assumptions
DIRECT CAPITAL CONSTRUCTION COSTS					
Mobilization	1	ea	$6,500	$6,500	
General Conditions	8	wk	$8,500	$68,000	Trailer, electrical and maintenance
Surveys and Permits	32	hr	$150	$4,800	
Pre-Design Investigation					
Delineation borings	40	ea	$250	$10,000	geoprobes to 10-ft bgs, PID and logs
Delineation sample analysis	120	ea	$85.00	$10,200	assumes 3 per boring; VOCs + TIC (1,4-Dioxane)
Site security					
Install temporary 8' Chain link fence	1,488	lf	$48	$70,700	8 ft high fence installed along property perimeter
Install temporary 8' Chain link gate	2	ea	$2,600	$5,200	Double swing gate, 12' opening, at front entrance
Institutional Controls					
Develop site management plan	1	LS	$25,000	$25,000	
Abandon Existing Stormwater Injection Well					
Abandon Well in accordance with CP-43	1	LS	$25,000	$25,000	Recharge well W-1 ; 137 ft deep and 6 inch diameter
Demolish Existing building and Slab					
Slab/Foundation demolition and disposal	13,850	sf	$8	$110,800	slab and 1-ft subgrade material; including disposal as C&D
Excavation of impacted soil	2,250	cy	$35	$78,800	assume maximum cut = 10-ft
Impacted soil - transportation and disposal	2,925	ton	$80	$234,000	Assumes non-haz disposal; 1.3 tons per cy
Compacted Earth Backfill	2,340	cy	$32	$74,900	compacted backfill to achieve low permeability; to 2-ft below grade
Surface Restoration - Stone	450	cy	$32	$14,400	Stone to 2-ft thickness to match surrounding grade/slab elevation
Excavation of surface soils					
Excavation of impacted soil	14	cy	$35	$500	assume maximum cut = 1-ft
Impacted soil - transportation and disposal	18	ton	$80	$1,500	Assumes non-haz disposal; 1.3 tons per cy
Restoration	14	cy	$32	$400	suitable backfill to grade; topsoil and seed
Pavement Repair					
Excavation for pavement restoration	2	cy	$35	$70	removal to 6-inches
Impacted soil - transportation and disposal	3	ton	$80	$200	Assumes non-haz disposal; 1.3 tons per cy
Place asphalt repair	100	sf	$10.00	$1,000	stone subgrade and asphalt course; total 6-inches

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Table 7-6: Alternative 4; Institutional Controls/Soil Excavation/Natural Attenuation/Groundwater Monitoring

	QTY	UNIT	UNIT COST	TOTAL COST	Notes/Assumptions
TOTAL DIRECT CAPITAL COST				**$742,000**	
Engineering/Design/Field Oversight			10%	74,000	
Legal			2%	15,000	
Contingency			15%	111,500	
TOTAL ALTERNATIVE CAPITAL COST (rounded)				**$943,000**	
OPERATION AND MAINTENANCE COSTS					
Annual Costs (Years 1-30)					
Natural Attenuation Monitoring (on-site and off-site) and Institutional Controls					
Groundwater Sampling and Analysis	20	ea	$1,700	$34,000	Annual; VOCs + TICS; Water level measurement; IDW disposal
Groundwater Reporting	1	LS	$10,000	$10,000	Annual; Validation and Reporting
Investigation Derived Waste	1	LS	$2,000	$2,000	Based on T& D of 8 drums of non-hazardous waste
Site Inspection					
Annual Site Inspection	1	ea	$1,500	$1,500	2 persons, 2 days
Periodic Costs (Years 5, 10, 15, 20, 25, 30)					
5-yr reviews	1	ea	$5,000	$5,000	

PRESENT WORTH ANALYSIS (YEARS 1-30)		**Discount**	
Cost Type	**Total Cost**	**Factor (7%)**	**Present Value**
Capital Cost - Year 0	$943,000	1.000	$943,000
Annual O&M - Years 1-30	$47,500	0.4136	$589,500
Periodic Costs - Years 5, 10, 15, 20, 25, 30	$5,000	0.3596	$11,000
TOTAL PROJECT PRESENT WORTH (rounded)			**$1,544,000**

Note: CP-43 is NYSDEC Policy CP-43: Groundwater Monitoring Well Decommissioning Policy, November 3, 2009

Figures

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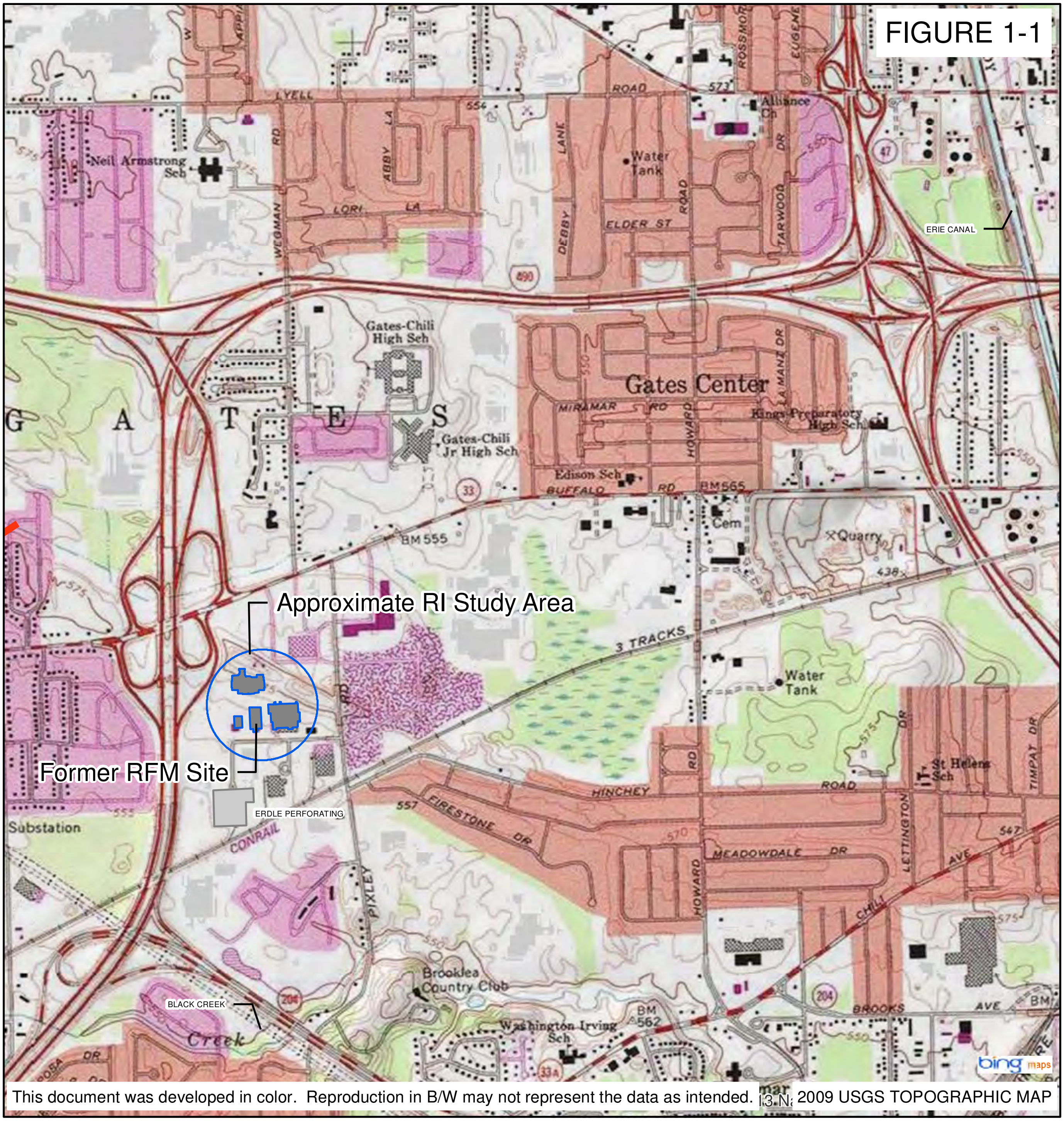
PLOTDATE: 04/07/15 2:00:24 PM NewtonJM

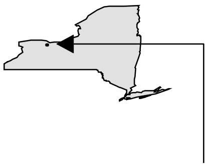
FIGURE 1-1



This document was developed in color. Reproduction in B/W may not represent the data as intended. 2009 USGS TOPOGRAPHIC MAP

ADAPTED FROM: (BING) USGS ROCHESTER WEST QUADRANGLE

FORMER ITT ROCHESTER FORM MACHINE FACILITY
TOWN OF GATES, NEW YORK
SITE #8-28-112



MAP LOCATION

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SITE LOCATION

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Feet

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1:24,000

O'BRIEN & GERE

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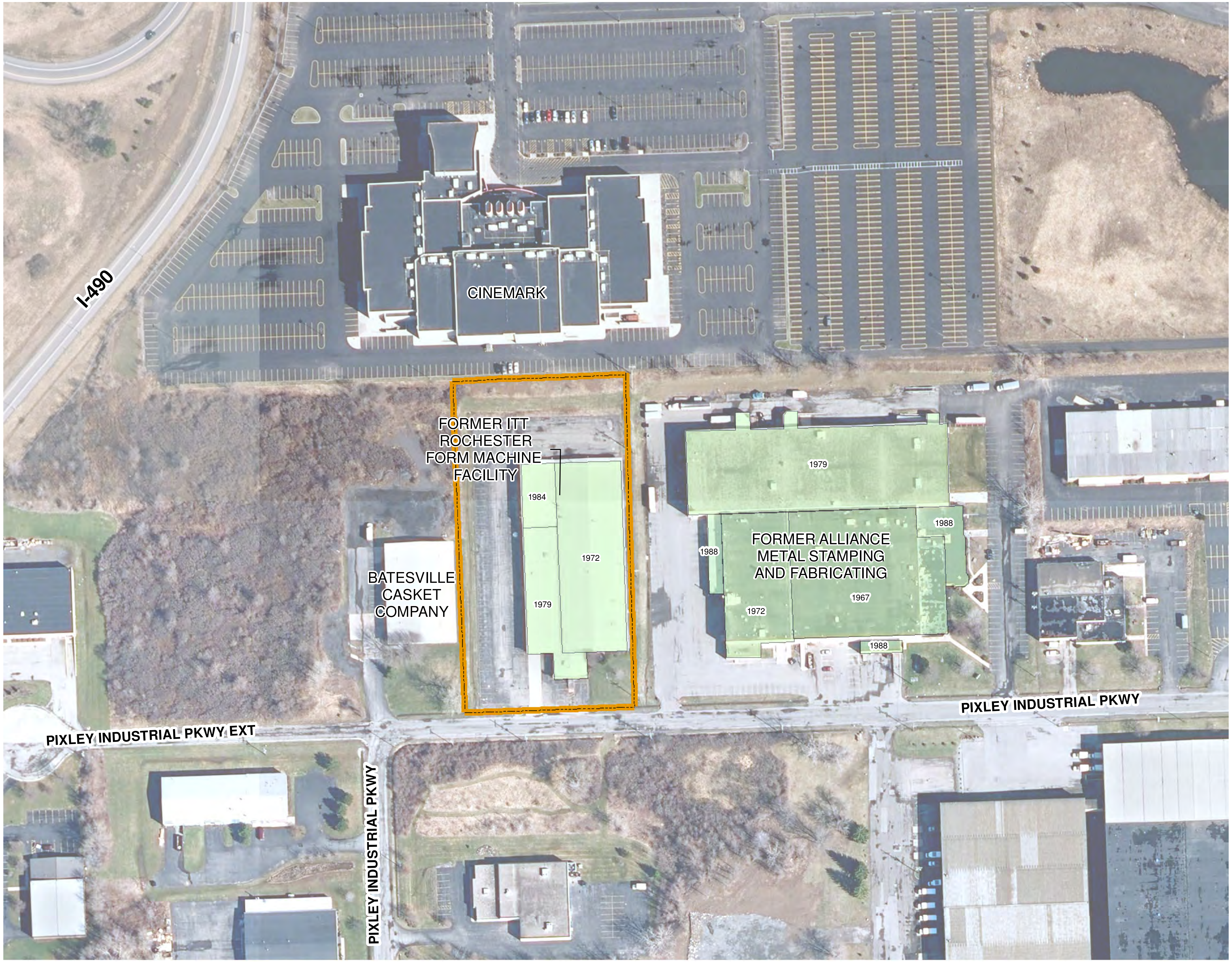
FIGURE 1-2



N

LEGEND

🟩 FACILITY ADDITIONS
YEAR OF ADDITION
▬ PROPERTY LINE

NOTE:

ADDITIONS TO THE ORIGINAL AMSF FACILITY FOOTPRINT WERE APPROXIMATELY DEFINED USING BUILDING PLANS OBTAINED IN THE GEOSERVICES 1992 BASELINE ENVIRONMENTAL CHARACTERIZATION OF THE AMSF PROPERTY, FIGURE 2.

ADDITIONS TO THE ORIGINAL RFM FACILITY FOOTPRINT WERE APPROXIMATELY DEFINED USING BUILDING PLANS OBTAINED FROM HISTORIC SITE DRAWINGS.

FORMER ITT ROCHESTER FORM MACHINE FACILITY
TOWN OF GATES, NEW YORK
SITE #8-28-112

SITE PLAN

0 75 150 300
Feet

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AERIAL IMAGERY PROVIDED BY NYS GIS CLEARINGHOUSE, DATE APRIL 2009

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AERIAL IMAGERY PROVIDED BY NYS GIS CLEARINGHOUSE, DATE APRIL 2009

FIGURE 3-1

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LEGEND

- ◆ OVERBURDEN MONITORING WELL
- ◆ UPPER ERAMOSA DOLOMITE WELL
- ◆ LOWER ERAMOSA DOLOMITE WELL
- ◆ UPPER PENFIELD FORMATION WELL
- ◆ OTHER DEEP BEDROCK WELL
- ◉ RECHARGE WELL
- ◑ RI PHASE I ABANDONED DEEP BORING
- ◑ ABANDONED MULTIPORT BEDROCK BORING
- ⊙ PRE-RI MISSING WELL
- ⊗ PRE-RI ABANDONED WELL
- ⊕ PRE-RI DAMAGED WELL

FORMER ITT ROCHESTER FORM
MACHINE FACILITY
TOWN OF GATES, NEW YORK
SITE #8-28-112

MONITORING WELL LOCATIONS

0 125 250
Feet

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FIGURE 3-3

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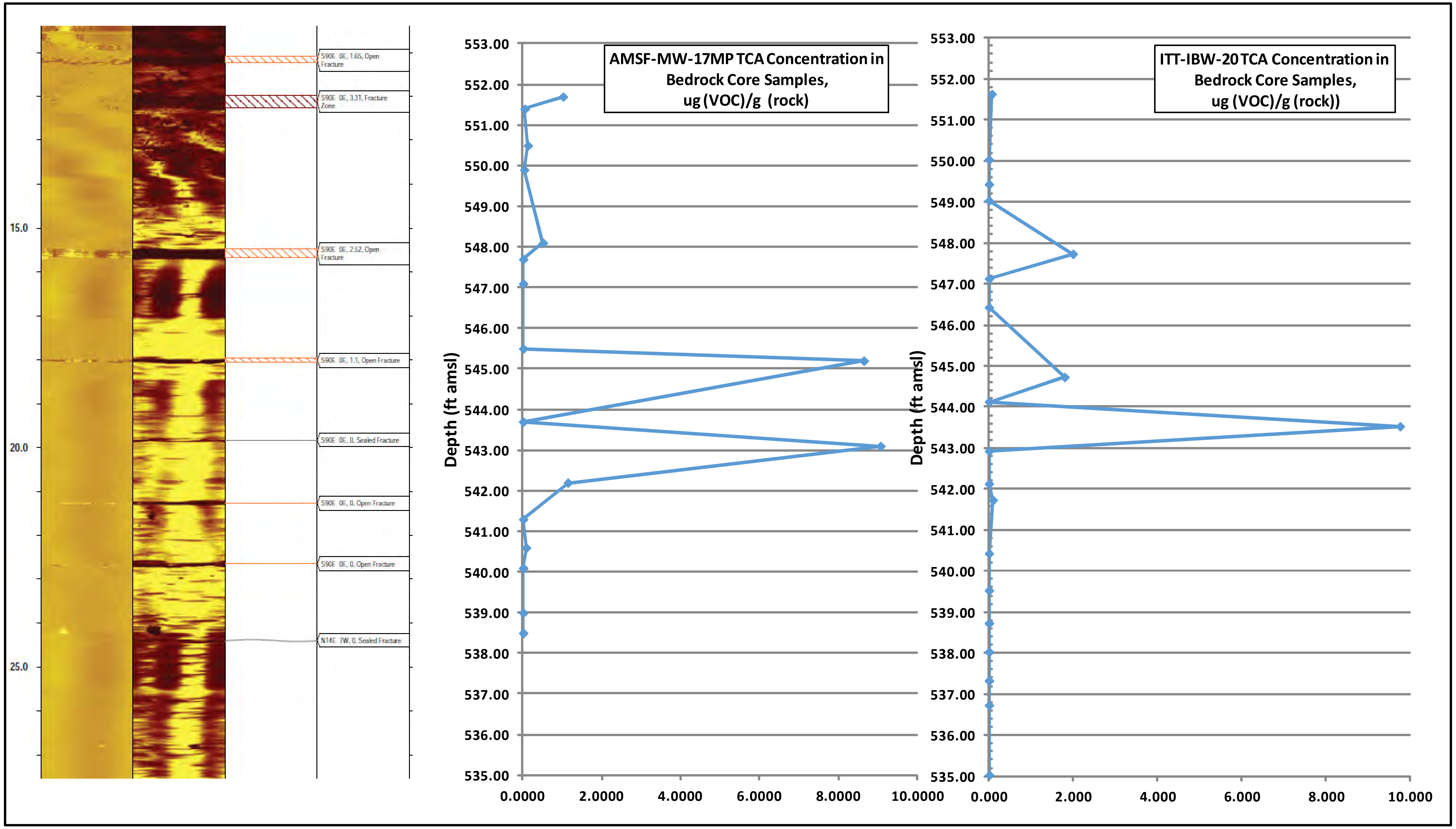
LEGEND

AMSF-MW-17MP
ACOUSTIC
TELEVIEWER LOG



FORMER ITT ROCHESTER FORM
MACHINE FACILITY
TOWN OF GATES, NEW YORK
SITE #8-28-112

AMSF-MW-17MP ACOUSTIC TELEVIEWER LOG WITH TCA IN BEDROCK

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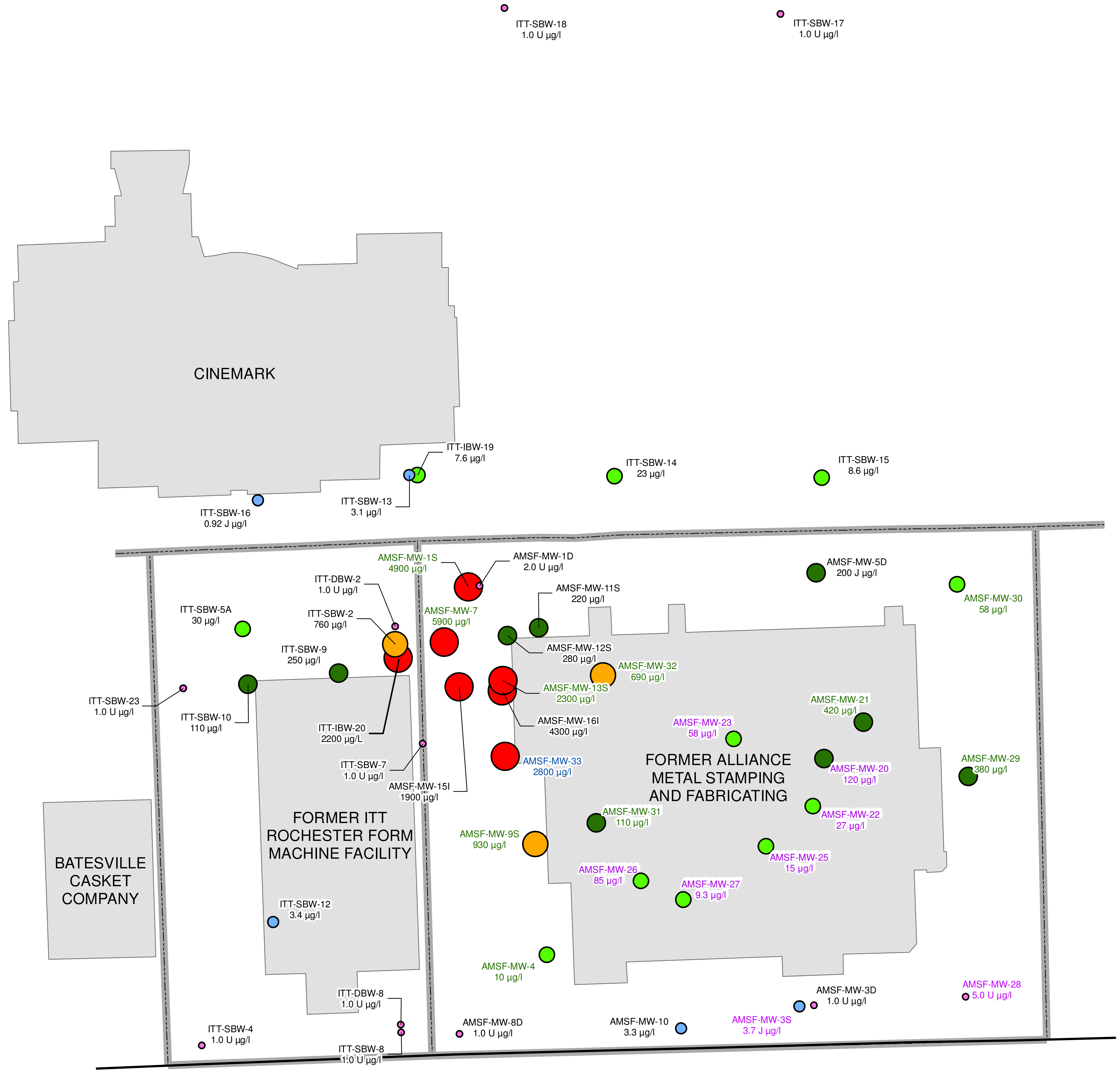
FIGURE 3-4



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N

LEGEND

- ● ND
- ● >0 - 5 µg/l
- ● >5 - 100 µg/l
- ● >100 - 500 µg/l
- ● >500 - 1,000 µg/l
- ● >1,000 - 10,000 µg/l

AMSF-MW-5D 200 J µg/l	JUNE 2013 ITT DATA*
AMSF-MW-30 13 J µg/l	JUNE 2013 MFP DATA**
AMSF-MW-5D 200 J µg/l	SEPTEMBER 2013 MFP DATA**
AMSF-MW-30 13 J µg/l	MAY 2014 MFP DATA**

NOTE:
- NYS TOGS 1.1.1 Class GA Standard for TCA is 5 µg/l
- J = Estimated Value
- U = Not Detected at the Detection Limit shown
- MFP = Maguire Family Properties
- * = O'Brien & Gere. 2014a. 2013 Periodic Groundwater Sampling Report. Former ITT Rochester Form Machine Facility, Site # 8-28-112, Town of Gates, Monroe County. August 2014.
- ** = Stantec. 2014. Remedial Investigation Report, Brownfield Cleanup Program Site #C828101. October 2014.
- If location sampled multiple times, highest concentration reported.

FORMER ITT ROCHESTER
FORM MACHINE FACILITY
TOWN OF GATES, NEW YORK
SITE #8-28-112

JUNE 2013 - MAY 2014 GROUNDWATER MONITORING EVENTS TCA CONCENTRATIONS

0 55 110 220
Feet

APRIL 2015
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O'BRIEN & GERE

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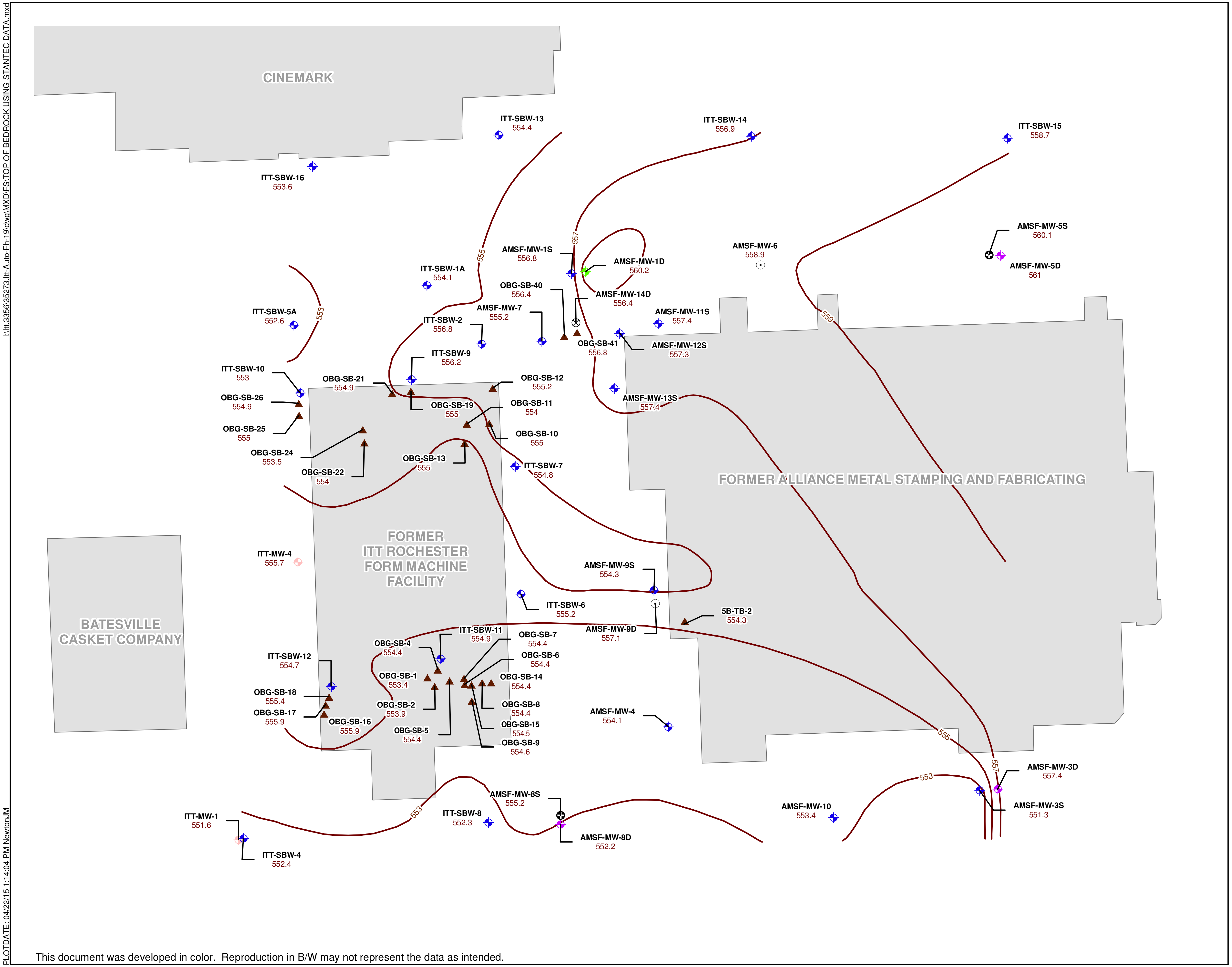

This document was developed in color. Reproduction in B/W may not represent the data as intended.

FIGURE 3-5

N

- ◑ ABANDONED MULTIPORT BEDROCK BORING
- ⊕ OVERBURDEN MONITORING WELL
- ⊕ UPPER ERAMOSA DOLOMITE WELL
- ⊕ LOWER ERAMOSA DOLOMITE WELL
- ⊕ UPPER PENFIELD FORMATION WELL
- ⊕ OTHER DEEP BEDROCK WELL
- ▲ SOIL BORING (POST 2003)
- ⊗ PRE-RI ABANDONED WELL
- ⊕ PRE-RI DAMAGED WELL
- ⊙ PRE-RI MISSING WELL
- — 2 FOOT CONTOUR
- ┴┴┴ DEPRESSION
- ▭ BUILDING

NOTE:
- VALUES ARE IN FEET ABOVE MEAN SEA LEVEL.
- FIGURE DEVELOPED USING CRITERIA DESCRIBED IN RFM RIR AND AMSF RI BORINGS INDICATING COMPETENT BEDROCK WERE USED. FOR AMSF RI BORINGS ONLY 5B-TB-2 MET CRITERIA.

FORMER ITT ROCHESTER FORM
MACHINE FACILITY
TOWN OF GATES, NEW YORK
SITE #8-28-112

TOP OF BEDROCK USING RFM RI AND AMSF RI DATA

0 37.5 75 150
Feet

APRIL 2015
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O'BRIEN & GERE

FIGURE 3-6

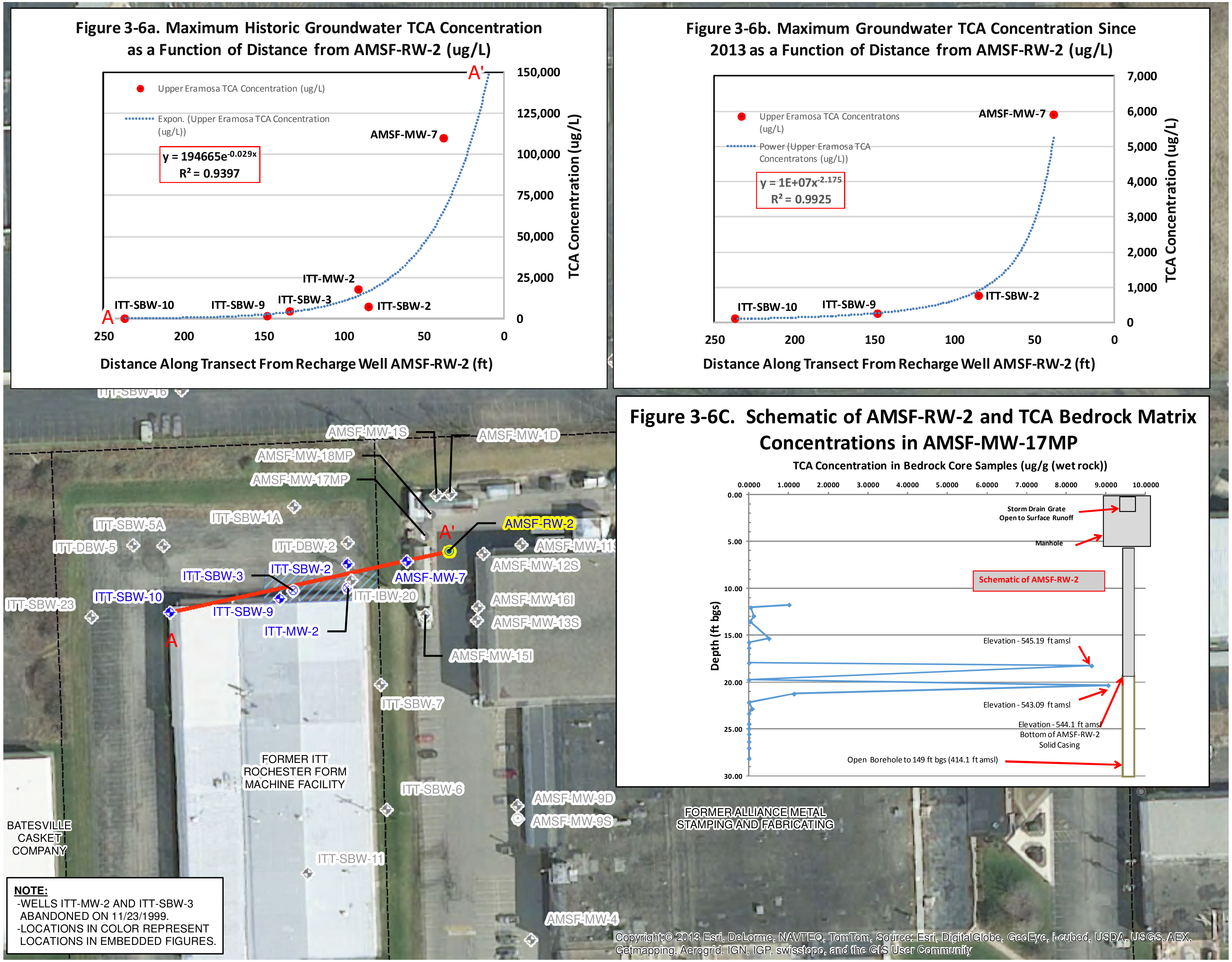

Figure 3-6a. Maximum Historic Groundwater TCA Concentration as a Function of Distance from AMSF-RW-2 (ug/L)

Figure 3-6b. Maximum Groundwater TCA Concentration Since 2013 as a Function of Distance from AMSF-RW-2 (ug/L)

Figure 3-6C. Schematic of AMSF-RW-2 and TCA Bedrock Matrix Concentrations in AMSF-MW-17MP

NOTE:
- WELLS ITT-MW-2 AND ITT-SBW-3 ABANDONED ON 11/23/1999.
- LOCATIONS IN COLOR REPRESENT LOCATIONS IN EMBEDDED FIGURES.

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AERIAL IMAGERY PROVIDED BY NYS GIS CLEARINGHOUSE, DATE APRIL 2009

N

LEGEND

----	PROPERTY BOUNDARY
▨	1999 FORMER RFM SOIL REMEDIATION AREA
⊗	ABANDONED WELL
◆	MONITORING WELL LOCATION
◉	BEDROCK RECHARGE WELL

FORMER ITT ROCHESTER FORM
MACHINE FACILITY
TOWN OF GATES, NEW YORK
SITE #8-28-112

GROUNDWATER AND BEDROCK MATRIX TCA CONCENTRATIONS

0 40 80 160
Feet

APRIL 2015
3356.35273

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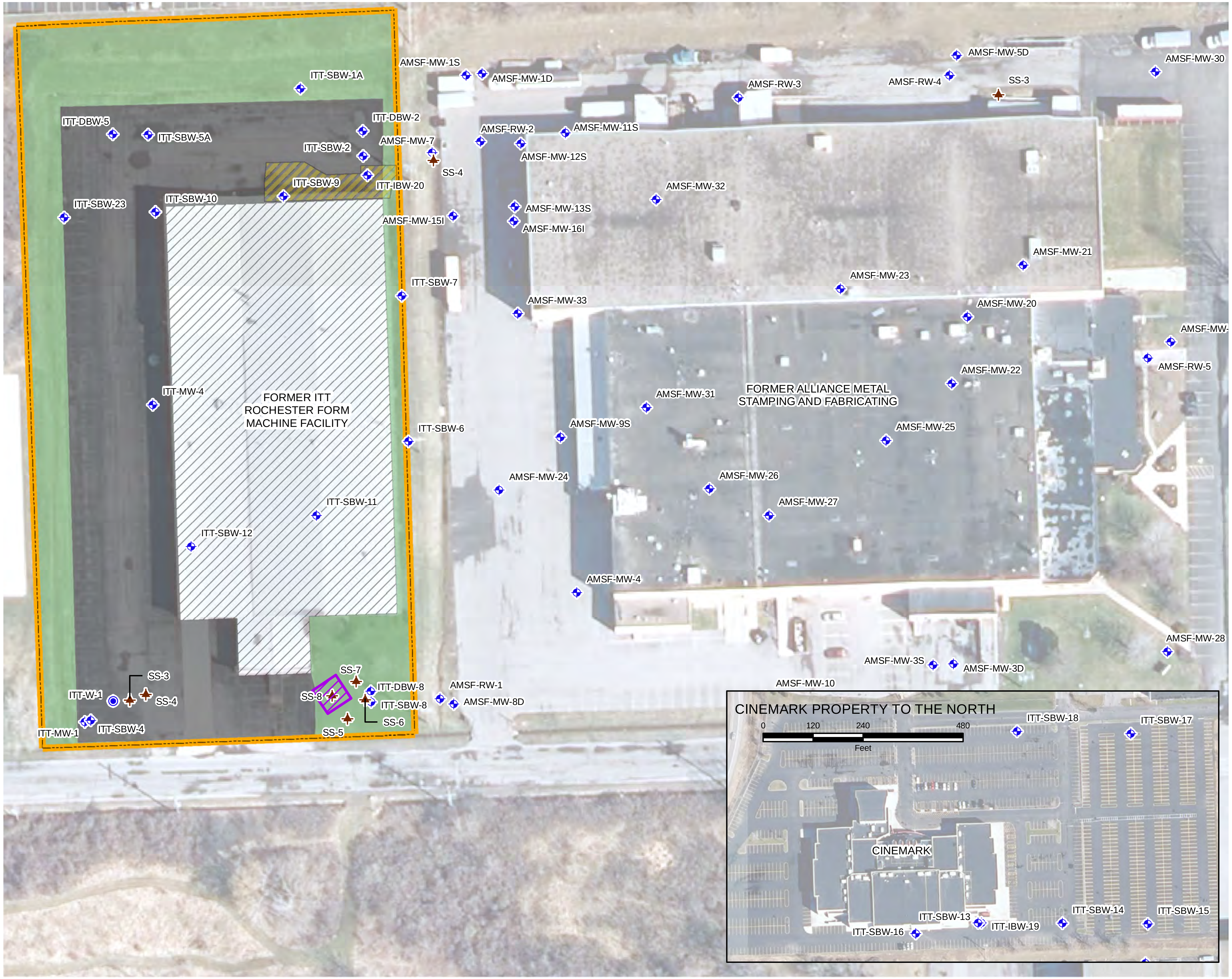
FIGURE 7-1



AERIAL IMAGERY PROVIDED BY NYS GIS CLEARINGHOUSE, DATE APRIL 2009

LEGEND

- ◉ RECHARGE WELL
- ◆ MONITORING WELL
- ✦ SURFACE SOIL SAMPLE
- --- PROPERTY LINE
- ▨ 1999 FORMER RFM SOIL REMEDIATION AREA
- ▨ PROPOSED EXCAVATION AREA

COVER AREAS

- ▨ CONCRETE SLAB (46,148 SQFT)
- ■ PAVEMENT (49,217 SQFT)
- 🟩 VEGETATIVE COVER (37,650 SQFT)

NOTE:
- ITT-W-1 TO BE ABANDONED.
- FORMER ITT RFM BUILDING REMOVED IN 2015, CONCRETE SLAB REMAINS.
- AERIAL IMAGE SHOWN DOES NOT REFLECT BUILDING REMOVED.

FORMER ITT ROCHESTER FORM
MACHINE FACILITY
TOWN OF GATES, NEW YORK
SITE #8-28-112

ALTERNATIVE 2

INSTITUTIONAL CONTROLS,
LIMITED SOIL EXCAVATION,
CONTAINMENT,
NATURAL ATTENUATION
AND GROUNDWATER
MONITORING

0 35 70 140
Feet

3356.63224
APRIL 2016

O'BRIEN & GERE ENGINEERS, INC.

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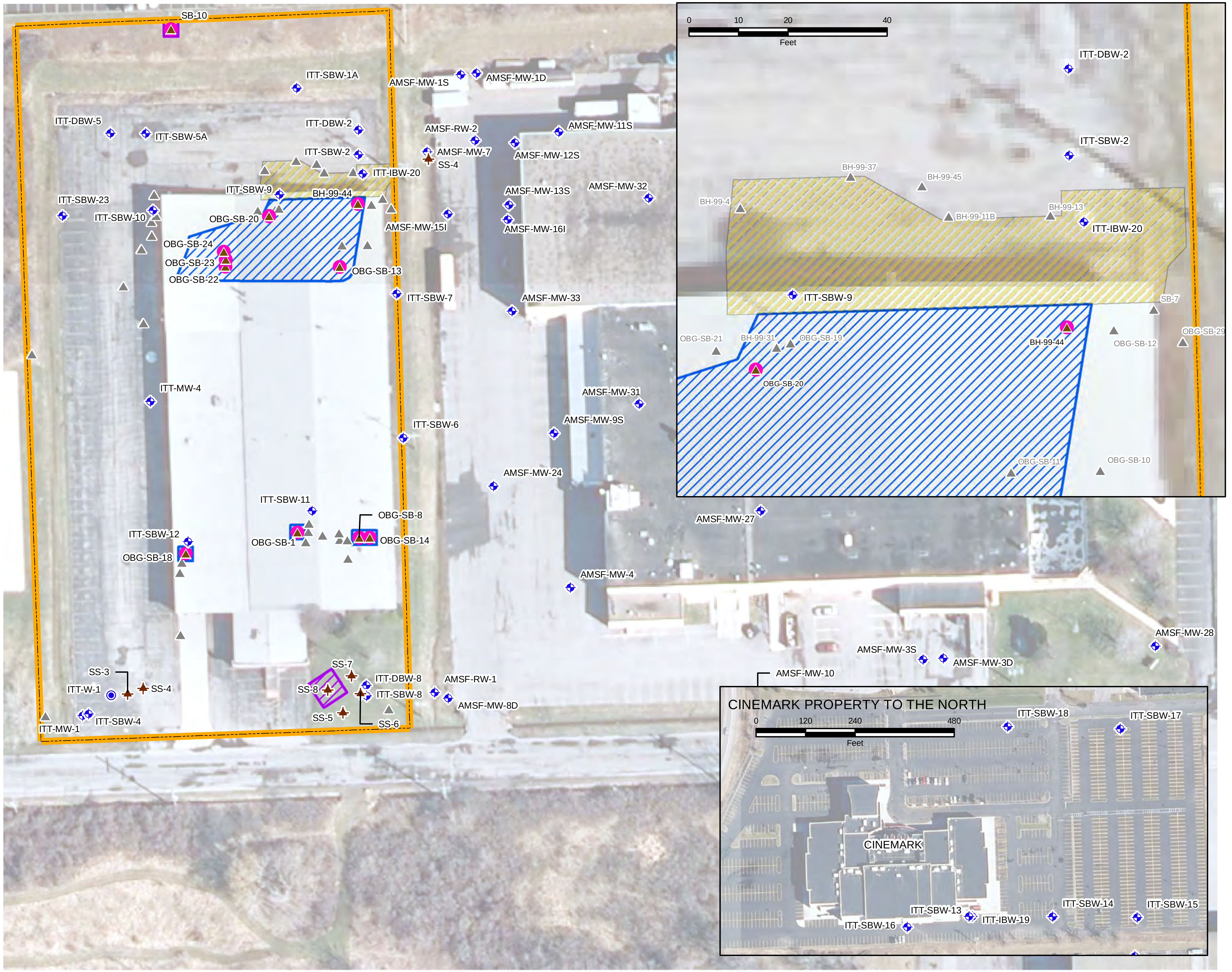

AERIAL IMAGERY PROVIDED BY NYS GIS CLEARINGHOUSE, DATE APRIL 2009

N

LEGEND

✦	SURFACE SOIL SAMPLE
◉	RECHARGE WELL
◈	MONITORING WELL
▲	PART 375 PROTECTION OF GROUNDWATER SCO EXCEEDANCE
▲	SOIL BORING
- - -	PROPERTY LINE
▨	1999 FORMER RFM SOIL REMEDIATION AREA
▨	PROPOSED SOIL VAPOR EXTRACTION AREA
▨	PROPOSED EXCAVATION AREA

NOTE:
- ITT-W-1 TO BE ABANDONED.
- FORMER ITT RFM BUILDING REMOVED IN 2015, CONCRETE SLAB REMAINS.
- AERIAL IMAGE SHOWN DOES NOT REFLECT BUILDING REMOVED.
- THE AREAS TO BE TREATED HAVE BEEN INTERPRETED TO EXTEND HALFWAY BETWEEN A LOCATION WHERE AN EXCEEDANCE OF AN SCO IS OBSERVED AND THE NEAREST ADJACENT POINT WITHOUT AN EXCEEDANCE. WHERE NO ADJACENT LOCATION EXISTS, A DISTANCE OF 10-FT FROM THE EXCEEDANCE HAS BEEN APPLIED.

FORMER ITT ROCHESTER FORM
MACHINE FACILITY
TOWN OF GATES, NEW YORK
SITE #8-28-112

ALTERNATIVE 3

INSTITUTIONAL CONTROLS,
LIMITED SOIL EXCAVATION,
IN-SITU SOIL TREATMENT,
NATURAL ATTENUATION,
AND GROUNDWATER
MONITORING

0 35 70 140
Feet

3356.63224
APRIL 2016

O'BRIEN & GERE ENGINEERS, INC.

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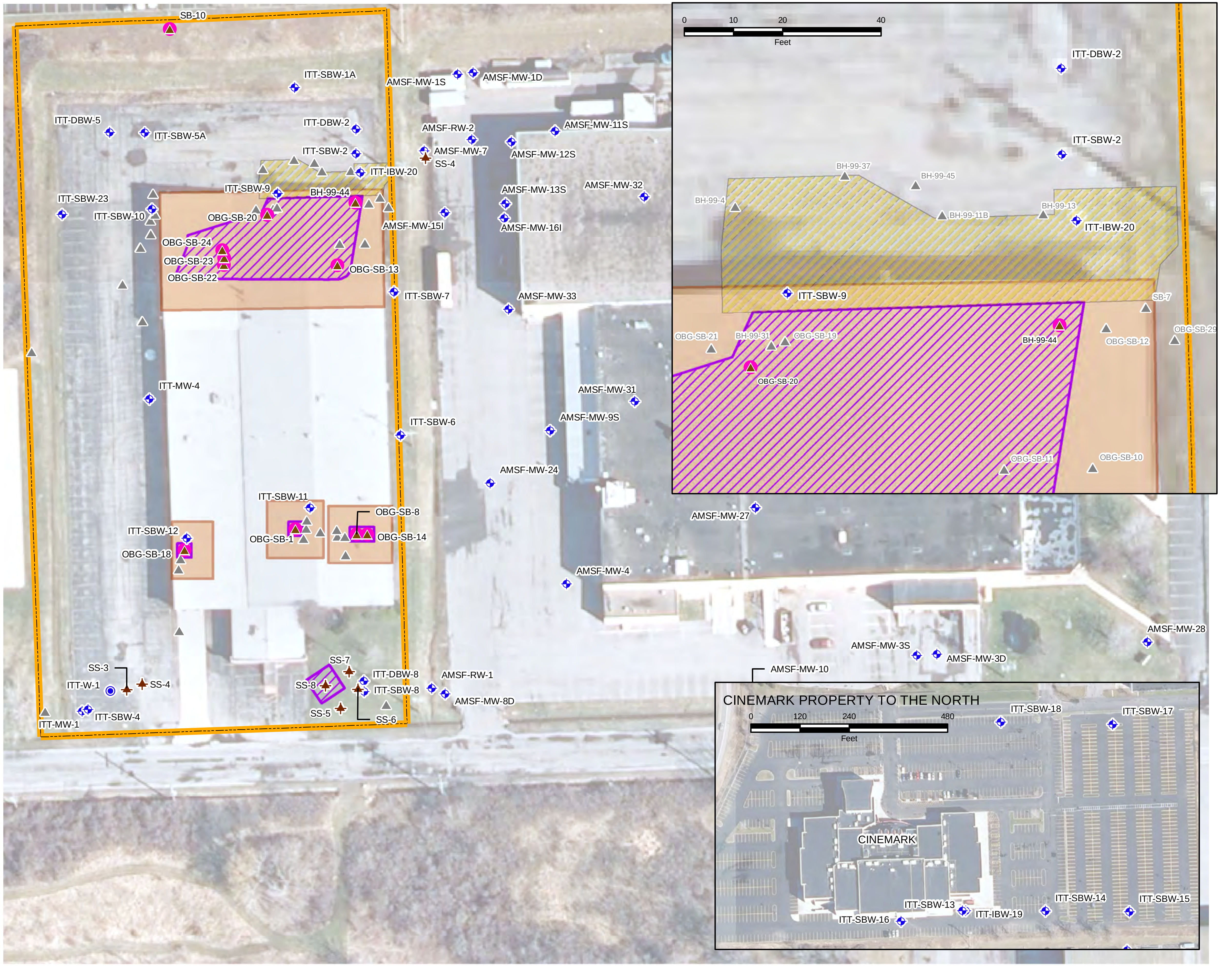
FIGURE 7-3



AERIAL IMAGERY PROVIDED BY NYS GIS CLEARINGHOUSE, DATE APRIL 2009

N

LEGEND

✦	SURFACE SOIL SAMPLE
◉	RECHARGE WELL
⊕	MONITORING WELL
▲	PART 375 PROTECTION OF GROUNDWATER SCO EXCEEDANCE
▲	SOIL BORING
----	PROPERTY LINE
▨	1999 FORMER RFM SOIL REMEDIATION AREA
▨	PROPOSED EXCAVATION AREA
■	CONCRETE SLAB REMOVAL

NOTE:

- ITT-W-1 TO BE ABANDONED.
- FORMER ITT RFM BUILDING REMOVED IN 2015, CONCRETE SLAB TO BE REMOVED AS NOTED.
- AERIAL IMAGE SHOWN DOES NOT REFLECT BUILDING REMOVED.
- THE AREAS OF EXCAVATION HAVE BEEN INTERPRETED TO EXTEND HALFWAY BETWEEN A LOCATION WHERE AN EXCEEDANCE OF AN SCO IS OBSERVED AND THE NEAREST ADJACENT POINT WITHOUT AN EXCEEDANCE. WHERE NO ADJACENT LOCATION EXISTS, A DISTANCE OF 10-FT FROM THE EXCEEDANCE HAS BEEN APPLIED.

FORMER ITT ROCHESTER FORM
MACHINE FACILITY
TOWN OF GATES, NEW YORK
SITE #8-28-112

ALTERNATIVE 4

INSTITUTIONAL
CONTROLS,
SOIL EXCAVATION,
NATURAL ATTENUATION,
AND GROUNDWATER
MONITORING

0 35 70 140
Feet

3356.63224
APRIL 2016

O'BRIEN & GERE ENGINEERS, INC.

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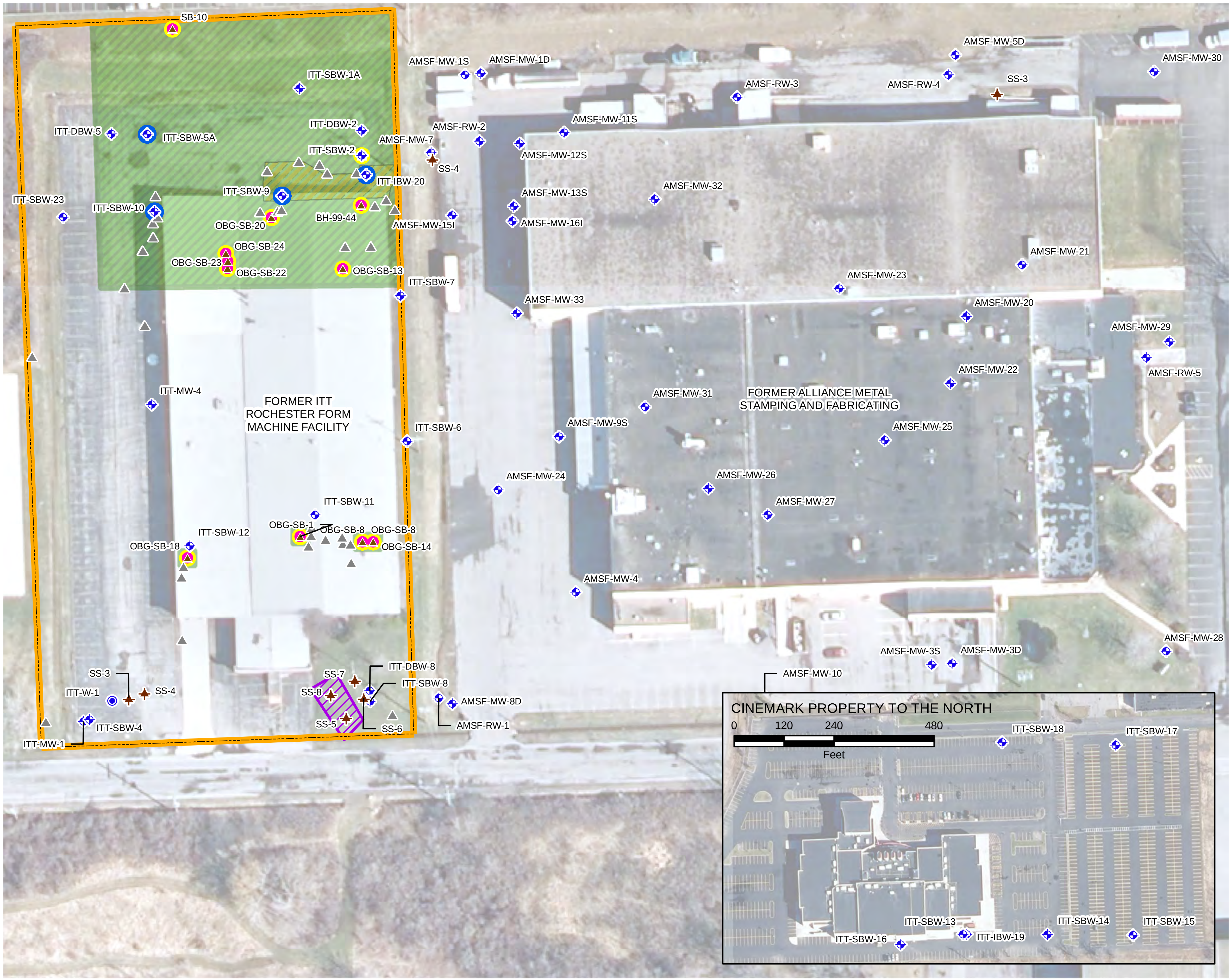
FIGURE 7-4



AERIAL IMAGERY PROVIDED BY NYS GIS CLEARINGHOUSE, DATE APRIL 2009

N

LEGEND

- ◉ RECHARGE WELL
- ⌖ MONITORING WELL
- ▲ PART 375 PROTECTION OF GROUNDWATER SCO EXCEEDANCE
- ▲ ONE OR MORE RESULT EXCEEDS PART 375 UNRESTRICTED USE SCO OR CP-51 RESIDENTIAL USE SCO CRITERIA
- ● CLASS GA STANDARDS EXCEEDANCE OF TCA
- ---- PROPERTY LINE
- ▨ PROPOSED EXCAVATION AREA
- ▨ 1999 FORMER RFM SOIL REMEDIATION AREA
- 🟩 IN-SITU THERMAL (LIMITS BASED ON 2013/2014 GROUNDWATER RESULTS)

NOTE:
- ITT-W-1 TO BE ABANDONED.
- FORMER ITT RFM BUILDING REMOVED IN 2015, CONCRETE SLAB TO BE REMOVED.
- GROUNDWATER EXCEEDANCES FROM JUNE 2013 AND MAY 2014 GROUNDWATER MONITORING EVENTS.

FORMER ITT ROCHESTER FORM MACHINE FACILITY
TOWN OF GATES, NEW YORK
SITE #8-28-112

ALTERNATIVE 5

INSTITUTIONAL CONTROLS, LIMITED SOIL EXCAVATION *IN-SITU* THERMAL TREATMENT AND GROUNDWATER MONITORING

0 35 70 140
Feet

3356.63224
APRIL 2016

O'BRIEN & GERE ENGINEERS, INC.

PLOTDATE: never never tuckersm

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Appendices

Appendix A

Remedial Investigation Report Soil Addendum

(November 21, 2014)

Remedial Investigation Report Soil Addendum

Former ITT Rochester Form Machine Facility
Site # 8-28-112
Town of Gates, NY
3356 / 35273

Prepared for:

ITT Corporation

Prepared by:

O’Brien & Gere Engineers, Inc.

November 21, 2014

O'BRIEN & GERE

Remedial Investigation Report
Soil Addendum
Former ITT Rochester Form Machine Facility
Site # 8-28-112

Town of Gates, New York

Prepared for:
ITT Corporation

Douglas M. Crawford

DOUGLAS M. CRAWFORD, P.E., VP
O'BRIEN & GERE ENGINEERS, INC.

Remedial Investigation Report
Soil Addendum
Former ITT Rochester Form Machine Facility
Site # 8-28-112

Town of Gates, New York

I, Douglas M. Crawford, certify that I am currently a NYS registered professional engineer and that this Remedial Investigation 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) and that all activities were performed in full accordance with the DER-approved work plan and any DER-approved modifications.

Douglas M. Crawford

DOUGLAS M. CRAWFORD, P.E., VICE PRESIDENT
PROFESSIONAL ENGINEER LICENSE NO. NY 066649
O'BRIEN & GERE ENGINEERS, INC.
333 W. WASHINGTON STREET.
SYRACUSE, NY 13202

TABLE OF CONTENTS

LIST OF TABLES

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LIST OF ACRONYMS

1,1-DCE	1,1-dichloroethylene
AMSF	Alliance Metal Stamping and Fabricating Site
AMSF RIR	RIR for the former AMSF Site
AOCs	Areas of Concern
ASTDR	Agency for Toxic Substances and Disease Registry
ASTs	Aboveground Storage Tanks
Batesville	Batesville Casket Company
BBL	BBL Environmental Services, Inc.
BCP	Brownfield Cleanup Agreement
Bgs	below ground surface
BTEX	benzene, toluene, ethylbenzene, and total xylene
^{o}C	Centigrade
Cinemark	Cinemark Tinseltown USA and IMAX Movie Theatre Complex
COCs	Constituents of Concern
DNAPL	dense non-aqueous phase liquid
DUSR	Data Usability Summary Report
E	Estimated
ELAP	Environmental Laboratory Accreditation Program
eV	electron volt
FID	Flame Ionization Detector
FS	Feasibility Study
GC/MS	Gas Chromatography Mass Spectrometry
HHRA	Human Health Risk Assessment
ITT	ITT Corporation
MFP	Maguire Family Properties, Inc.
ND	non-detected
NELAP	National Environmental Laboratory Accreditation Program
NPL	National Priority List
NYS	New York State
NYSDEC	New York Department of Environmental Conservation
NYSDOH	New York State Department of Health
O'Brien & Gere	O'Brien & Gere Engineers, Inc.

PCE	tetrachloroethylene
PID	Photoionization Detector
ppm	parts per million
RAOs	Remedial Action Objectives
RFM	Former Rochester Form Machine
RI	Remedial Investigation
RIR	Remedial Investigation Report
Stantec	Stantec Consulting Services, Inc.
SVOCs	semi-volatile organic compounds
TCA	1,1,1-trichloroethane
TCE	trichloroethylene
USEPA	United States Environmental Protection Agency
USTs	Underground Storage Tanks
UV	ultraviolet
VOC	volatile organic compound

1 INTRODUCTION

1.1 ADDENDUM BACKGROUND

This document is an Addendum to the Remedial Investigation Report (RIR) for the Former Rochester Form Machine (RFM) Facility Site (Site # 8-28-112) located at 40 Pixley Industrial Parkway in the Town of Gates, New York (former RFM Site). The RIR was prepared by O'Brien & Gere Engineers, Inc. (O'Brien & Gere) and was submitted by ITT Corporation (ITT) on October 21, 2014 to the New York State Department of Environmental Conservation (NYSDEC). The Remedial Investigation (RI) was conducted by ITT Corporation (ITT) pursuant to an Order on Consent with NYSDEC, dated August 19, 2003 (Consent Order), with an effective date of August 29, 2003 (Index # B8-0614-02-05). A modification to the Consent Order, dated November 2, 2006, substitutes ITT Corporation for ITT Automotive, Inc. In addition, at the time the RI began, the site name was changed from ITT Automotive, Inc. to Former ITT Rochester Form Machine Facility Site, the former RFM Facility, or the former RFM Site. For the purposes of this Addendum, the RIR that addresses the former RFM Site will be referred to as the RFM RIR.

The purpose of this Addendum to the RFM RIR is to provide an expanded presentation of soil sampling results obtained from the former RFM Site, and particularly to soil conditions that existed prior to a 1999 excavation that took place immediately north of the former RFM building. This excavation area was defined and based on pre-RI investigations that identified 1,1,1-trichloroethane (TCA) impacted soils immediately north of the former RFM building (Golder Associates, Inc. [Golder], 2000a and 2000b), (H2M Group [H2M], 1993). Soil sampling results presented in the RFM RIR did not include those data obtained from the soil sampling that took place within the boundaries of the 1999 excavation area prior to excavation. The focus of the presentation of soil sampling results in the RFM RIR was to provide information on conditions that existed on the former RFM Site during the RI to address the nature, extent, fate and transport of the primary constituents of concern (COCs) associated with the former RFM Site. Site related COCs were identified as TCA, associated degradation products, and 1,4-dioxane. Presentation of soil sampling results in the RFM RIR provided appropriate existing conditions for the development of a Human Health Risk Assessment (HHRA), preliminary Remedial Action Objectives (RAOs) and a Feasibility Study (FS) for the former RFM Site.

A major focus of this Addendum to the RFM RIR is on the northern portion of the former RFM building and property because of its proximity to the significant groundwater impacts in and around the northeast portion for the former RFM Site and the northwest portion of the former Alliance Metal Stamping and Fabricating (AMSF) Site and proximate to recharge well AMSF-RW-2 located on the former AMSF Site.

1.2 SITE LOCATION

A Site Location Map is presented in **Figure 1-1**. For the purposes of this report, the former RFM Site is considered the "Site" and the adjacent former AMSF, Cinemark Tinseltown USA and IMAX movie theater complex (Cinemark), and Batesville Casket Company (Batesville) properties are considered "off-Site" properties. The Site and off-Site properties, as presented in the RFM RIR, are presented in **Figure 1-2**. In the RFM RIR, the combined Site and off-Site properties were presented as the "RI Study Area." In this Addendum to the RFM RIR the presentation of soil characterization and discussion of these results will be limited to the former RFM Site.

Recent soil, groundwater and soil vapor sampling on the neighboring former AMSF Site have been conducted by the current owner of that property, Maguire Family Properties, Inc. (MFP), as part of a separate Remedial Investigation under the New York State (NYS) Brownfield Cleanup Program (BCP) and in accordance with a Brownfield Cleanup Agreement (BCA) entered into by MFP with NYSDEC.

Recently, an RIR for the former AMSF Site (AMSF RIR) was submitted to NYSDEC by Stantec Consulting Services, Inc. [Stantec], 2014. There were no new soil sampling results from the former RFM Site presented in the AMSF RIR, therefore the results of the AMSF RIR will not be addressed in this Addendum to the RFM RIR.

2 SOIL SAMPLING AT THE FORMER RFM SITE

Prior to RI soil sampling on the former RFM Site for the RFM RIR, several surface and subsurface soil sampling events took place and were conducted by H2M (1993) and Golder (2000a and 2000b), as well as by NYSDEC (2001). During the data collection phase of the RFM RI, O'Brien & Gere also collected soil samples from the former RFM Site. A focus of soil sampling conducted by O'Brien & Gere was to characterize overburden COCs in the 7 Areas of Concern (AOCs) on the former RFM Site, as identified in the RFM RIR. The AOCs identified on the former RFM Site are listed below and are discussed in detail in the RFM RIR.

- AOC-1: Between the Former 1999 RFM Soil Remediation Area and Recharge Well AMSF-RW-2
- AOC-2: Northern Portion of the Former RFM Building
- AOC-3: Former RFM Degreaser Areas - AOC-3 (Northern Degreaser Area) and AOC-3 (Southern Degreaser Area)
- AOC-4: Former RFM Brazing Dumpster Area
- AOC-5: Former RFM Acid Wash Underground Storage Tanks (USTs)
- AOC-6: Former RFM TCA Aboveground Storage Tanks (ASTs)
- AOC-7: Former RFM Heating Oil UST

AOC-2, AOC-3 (Northern Degreaser Area), AOC-4, and AOC-7 are located entirely on the former RFM Site and are also located in or abutting the northern portion of the former RFM Building. AOC-1 is primarily located on the former AMSF Site; however, a narrow strip of AOC-1 is located on the northeast corner of the former RFM Site. AOC-3 (Southern Degreaser Area), AOC-5 and AOC-6 are also located entirely on the former RFM Site and are located inside of the southern portion of the former RFM Building.

Surface and subsurface soil sampling locations from pre-RI and RI investigations at the former RFM Site are presented in **Figure 2-1**. Locations of the AOCs on the former RFM property are also presented in this figure. An expanded view of the 1999 excavation area (Golder, 2000b) is also presented in **Figure 2-2** indicating soil sampling locations conducted prior to and following excavation. A summary of various soil sampling activities conducted on the former RFM Site is presented in **Table 2-1**. Listed in the table are the report dates, entity conducting the work, boring and soil sampling methods, identification of specific soil borings, volatile organic compound (VOC) and 1,4-dioxane analytical methods and soil vapor methods of soil screening with the type of Flame Ionization Detector (FID) or Photoionization Detector (PID) lamp used, if known. Collection of soil samples at the former RFM Site took place over a 14-year period (1991 -2004).

Soil boring methodologies used by H2M for the borings listed in **Table 2-1** were described in H2M (1993) Section 2.4 Soil Sampling Methodology. Soil vapor screening of the split spoon cores was described in H2M (1993) Section 2.5.2 Field Sampling and utilized a HNu PID detector with an unspecified PID lamp voltage. Soil boring logs with PID soil screening results are reported in H2M (1993) Appendix C and by O'Brien & Gere (2014) in Appendix C of the RFM RIR.

Soil boring methodologies used by Golder for the borings, soil sampling and enclosed headspace PID measurements listed in **Table 2-1** were described in Golder (2000a) Section 4.2 Overburden Soil Borings. Soil samples collected at 2-foot (ft) depth intervals were placed in enclosed headspace Ziploc® bags and were sealed, then warmed to stabilize temperature and subsequently sampled with a MinniRae® PID detector with an unspecified PID lamp voltage. Additionally, soil samples were screened with an ultraviolet (UV) fluorescence lamp to detect the potential presence of Non Aqueous Phase Liquids (NAPLs). Soil boring logs were presented in Golder (2000a) and also in O'Brien & Gere (2014) Appendix C. Enclosed field headspace PID measurements were reported in Golder (2000a) Table 2 – Soil Headspace Analysis Results.

Soil boring methodologies used by Golder for additional soil borings were described in Golder (2000b), Section 2.2.1 Soil Boring Installation and Groundwater Sampling. Soil vapor UV fluorescence screening methods were the same as those described in Golder (2000a). Soil boring logs were presented in Golder (2000b) Appendix A and also in O'Brien & Gere (2014) Appendix C. Enclosed field headspace PID measurements were reported in Golder (2000b) Table 1 – Field Headspace Analysis Results.

Soil boring methodologies and soil vapor screening used by NYSDEC were reported in NYSDEC (2001), Section 3.2 Subsurface Soil Sampling and Analysis. Soil vapor screening was conducted using both PID and FID detectors and on both surficial soil vapor screening of the split spoon soil core once opened and then again for enclosed field headspace FID and PID measurements from a sealed container with soil present. Soil boring logs, PID and FID soil core screening and enclosed field headspace PID and FID measurements were reported in NYSDEC Appendix B.

Soil boring methodologies used by O'Brien & Gere were reported in the RFM RIR (2014). Soil vapor screening was conducted using enclosed field headspace baggies with temperature stabilization and then analyzed with an 11.7 electron volt (eV) PID lamp. Soil samples were screened with a UV fluorescence lamp to detect the potential presence of NAPLs. Soil boring logs, enclosed field headspace PID measurements and UV fluorescence screening results were reported in soil boring logs presented in O'Brien & Gere (2014) Appendix C.

The only soil analytical results presented in the RFM RIR and in this Addendum, that have undergone data validation and that have been included in a Data Usability Summary Report (DUSR), are those collected by O'Brien & Gere as part of the RFM RI. Specific data validation procedures and DUSR methods used by O'Brien & Gere are discussed in the RFM RIR and presented in detail in Appendix O of the RFM RIR. United States Environmental Protection Agency (USEPA) analytical methods used to analyze VOCs in soils reported by H2M (1993), Golder (2000a and 2000b), NYSDEC (2001) and O'Brien &Gere (2014) are presented in **Table 2-1.** Each of these VOC analytical methods were well established and generally accepted methods for analyzing VOCs in soils at the time the work was conducted, and the laboratories conducting these analyses were all certified laboratories under the New York State Department of Health (NYSDOH) Environmental Laboratory Accreditation Program (ELAP) or National Environmental Laboratory Accreditation Program (NELAP).

During the 1990s and throughout the last decade, 1,4-dioxane has become an emerging environmental compound (USEPA, 2009). USEPA has recognized that there are limitations to the analytical methods used for the analysis of 1,4-dioxane and as a result it has been difficult to identify 1,4-dioxane in the environment (USEPA, 2006), (USEPA, 2009), (USEPA, 2014), (Agency for Toxic Substances and Disease Registry [ASTDR], 2012). The analytical method approved for the analysis of 1,4-dioxane in the NYSDEC approved RFM RI Phase I Work Plan (O'Brien and Gere, 2004) and the RFM RI Phase II Work Plan

Addendum (O'Brien and Gere, 2008) was USEPA Method 8270C, with Category B deliverables. NYSDEC (2001) used USEPA Method 8270 for the analysis of 1,4-dioxane in samples analyzed from the former RFM Site; however, Category B deliverables were not provided and the data was not validated and did not go through a DUSR analysis. Analyses of 1,4-dioxane in samples collected by H2M (1993) were conducted using USEPA Method 8240, while Golder (2000a and 2000b) conducted analyses of samples using USEPA Method 8260, both of which utilize a purge and trap based extraction method, prior to analysis using Gas Chromatography Mass Spectrometry (GC/MS).

Challenges in the analysis of 1,4-dioxane using unmodified purge and trap based analytical methods, including USEPA Methods 8240 and 8260, are very well documented in the literature (USEPA, 2006), (BBL Environmental Services, Inc. [BBL], 2006), (USEPA, 2009), (USEPA, 2014), (ASTDR,2012). The difficulties of analyzing 1,4-dioxane in environmental samples using purge and trap methods arises from its physical and chemical properties in comparison to other VOCs, particularly because 1,4-dioxane is miscible in water and has a very low Henry's Law constant of 3×10^{-6} (atm-m^3)/mol (Mohr, 2001) making it a poorly purgeable compound. Problems with 8240 and 8260 based analytical methods for the measurement of 1,4-dioxane in environmental samples include high detection limits, high response factors, interferences, and quantitation difficulties. Modifications of USEPA purge and trap methods have been made to increase purging efficiency, quantify spike recovery and confirm identification of 1,4-dioxane, by increasing purging temperature from ambient to 80 degrees Centigrade (^{o}C), using deuterated d-8 1,4-dioxane in internal standards and by using Single Ion Monitoring (SIM), respectively (USEPA Region I, 2004). Methods of 1,4-dioxane analysis reported by Golder (2000a and 2000b) did not utilize any of the above modifications. H2M (1993) used SIM with 40^{o}C purging on some of the soil samples analyzed during their work.

2.1 SCREENING AND DEFINITIVE DATA

In the RFM RIR, screening and definitive data were defined and are also applicable for this Addendum to the RFM RIR O'Brien & Gere (2014).

2.1.1 Screening Data Defined in RFM RIR

Screening data are generated by rapid, less precise methods of analysis with less rigorous sample preparation. Sample preparation steps may be restricted to simple procedures such as dilution with a solvent, instead of elaborate extraction/digestion and cleanup. Screening data provide analyte identification and quantitation, although the quantitation may be relatively imprecise. Where appropriate, at least 10% of the screening data should be confirmed using analytical methods and QA/QC procedures and criteria associated with definitive data. Screening data without associated confirmation data are not considered to be data of known quality. For the RFM RI, laboratory screening analyses included the following: VOCs, dissolved gases, semi-volatile organic compounds (SVOCs), metals, alkalinity (total, bicarbonate and carbonate), chloride, sulfate and total organic carbon.

2.1.2 Definitive Data and Research Data Defined in RFM RIR

Definitive and research data are generated using rigorous analytical methods, such as USEPA methods. Data are analyte-specific, with confirmation of analyte identity and concentration. Methods produce tangible raw data in the form of paper printouts or computer-generated electronic files. Data may be generated at the Site or at an off-Site location, as long as the QA/QC requirements are satisfied. For the data to be definitive, either analytical or total measurement error must be determined. For the RFM RI, the laboratory definitive and research analyses included the following: VOCs, 1,4-dioxane (by USEPA Method 8270 SVOC analysis), porosity, organic carbon, and extractable chlorinated target analytes.

2.1.3 Use of Screening and Definitive Data in this RIR Addendum

For the purposes of this Addendum to the RFM RIR, the VOC measurements of chlorinated and non-chlorinated compounds are considered to be definitive data, even though VOC analyses reported by H2M (1993), Golder (2000a and Golder 2000b) and NYSDEC (2001) did not undergo data validation and a DUSR analysis. H2M (1993) and Golder (2000a and 2000b) VOC analyses followed standard USEPA analytical methods specifically developed for the analysis of hydrophobic VOCs, including TCA and associated degradation products, as well as chloroethenes and benzene, toluene, ethylbenzene, and total xylene (BTEX) compounds detected in the subsurface at the former RFM Site. The only definitive 1,4-dioxane data are those analyzed by USEPA Method 8270. These definitive data include 1,4-dioxane results reported by NYSDEC (2001) and O'Brien & Gere (2014). Prior 1,4-dioxane analyses performed by H2M (1993) and Golder (2000a and 2000b) are considered screening data. Discussion of 1,4-dioxane analysis of soils at the former RFM Site will focus on the use of the definitive data only.

3 SOIL SAMPLING RESULTS

3.1 SURFACE SOIL SAMPLING RESULTS

Two former RFM Site surface soil samples (SS-1 and SS-2) and one soil sample collected immediately under a concrete floor drain in the former RFM building (TD-1) were analyzed for VOCs and one of the samples, TD-1, was also analyzed for 1,4-dioxane by USEPA Method 8270. Surface and subsurface VOC soil sampling results are found in **Table 3-1** and the TD-1 1,4-dioxane surface soil sampling result is located in **Table 3-2**.

Sample SS-1 was located in the southeast corner of the former RFM Site on the boundary with the former AMSF Site and sample SS-2 was located in the northeast portion of the former RFM Site on the boundary with the former AMSF Site (**Figure 2-1**). Sample TD-1 was obtained from the AOC-3 Southern Degreaser Area from soil located under cracks in a concrete lined trench drain (**Figure 2-1**). COCs were non-detected (ND) for surface soil samples SS-1 and SS-2, as reported by Golder (2000a). No analysis of 1,4-dioxane was conducted on these samples. TCA and 1,4-dioxane were not detected in sample TD-1. Trace concentrations of trichloroethylene (TCE), tetrachloroethylene (PCE) and 1,1-dichloroethylene (1,1-DCE) were reported in sample TD-1 at 0.004 mg/kg, 0.003 mg/kg and 0.009 mg/kg, respectively and were the only chlorinated compounds detected.

3.2 SUBSURFACE SOIL SAMPLING RESULTS

Results of subsurface soil sampling from the northern portion of the former RFM Site will be presented in the following sections: VOCs in Section 3.2.1 and 1,4-dioxane in Section 3.2.2.

3.2.1 – VOC Results

The main impacts to groundwater at the former RFM Site and former AMSF Site are associated with TCA. The majority of impacts to soils on the former RFM Site are associated with TCA. Subsurface soil TCA and other VOC results from the southern portion of the former RFM Site were presented and discussed in the RFM RIR and therefore will not be further addressed in this Addendum. Therefore, the focus of the presentation of VOC impacts to subsurface soils on the former RFM Site in this Addendum will be primarily on TCA impacts to the northern portion of the former RFM Site. TCA concentrations in subsurface soil samples, along with other VOCs are presented in **Table 3-1**. **Figure 3-1** was developed for the purpose of understanding vertically distributed impacts of TCA in subsurface soils in the northern portion of the former RFM Site, including the former 1999 excavation area.

The depth of excavation in the former 1999 excavation area was to the top of bedrock and varied from 6 to 11 ft bgs with specific excavation depths identified in Figure 7 of the Golder (2000b) report. To allow for as much removal of overburden soil as practicable during excavation, portions of the fractured bedrock at the base of the excavation were removed. Approximately 968 tons of soil were excavated and it was noted that no NAPL was observed during excavation of impacted soils (Golder, 2000b). Five confirmatory sidewall soil samples (CS-1 through CS-5) were collected prior to backfilling. TCA concentrations in CS-1 through CS-5 varied from non-detected to 0.029 mg/kg (Golder, 2000b). It was not possible to take confirmation soil samples from the bottom of the former 1999 excavation area because the bottom of the excavation was at bedrock.

TCA subsurface soil concentrations from the Northern portion of the former RFM Site are presented as various colored dots for three subsurface depth intervals, as follows: **Figure 3-1a**, 0 to 4 ft below ground surface (bgs) depth interval; **Figure 3-1b**, 4 to 6 ft bgs depth interval; and **Figure 3-1c**, greater than 6 ft bgs depth interval. In each figure, non-detected concentrations of TCA are indicated by a black dot and four ranges of TCA concentrations are shown as increasing larger sized circles with various colors to signify increasingly greater concentrations. The highest concentration range of 10.001 mg/kg to 570 mg/kg is represented by red colored circles.

3.2.2 Subsurface Soil TCA Concentrations in the 0 to 4 ft bgs Depth Interval

In the 0 to 4 ft bgs depth interval, only one soil sample was detected in the northern portion of the former RFM Site with a TCA soil concentration greater than 10 mg/kg (**Figure 3-1.a**). The sample BH-99-7 (0 to 4 ft depth interval) was reported with a TCA soil concentration of 12 E mg/kg. A second soil sample was also collected from this boring, BH-99-7 (6 to 8 ft bgs depth interval) and was reported with a soil TCA concentration of 1.6 E mg/kg (**Figure 3-1c**). The location of BH-99-7 was within the 1999 excavation area, approximately 5 ft from the northern wall of the former RFM building. A TCA soil concentration versus depth plot for BH-99-7 is also presented in **Figure 3-1a** and includes enclosed soil headspace PID measurements at various depths in this boring. Field soil vapor enclosed headspace screening measurements used in the soil gas versus depth concentration plot in **Figure 3-1a** were presented in Table 1, reported in Golder (2000b). Both TCA soil concentrations and enclosed field headspace PID measurements decreased with depth. The decreasing concentrations with depth indicate that impacts to bedrock were at very low concentration levels. UV fluorescence screening was performed on soil samples from the same depth intervals that enclosed field headspace PID measurements were measured and the results were negative, indicating the absence of NAPLs associated with this boring. The highest TCA soil concentration in the 0 to 4 ft bgs depth interval of 1.6 E mg/kg is more than 3 orders of magnitude lower than the 10,000 mg/kg soil concentration suggested by USEPA (1994) as an indicator of dense non-aqueous phase liquid (DNAPL) in soil.

3.2.3 Subsurface Soil TCA Concentrations in the 4 to 6 ft bgs Depth Interval

In the 4 to 6 ft bgs depth interval, TCA was detected in only one soil sample in the northern portion of the former RFM Site with a TCA soil concentration greater than 10 mg/kg (**Figure 3-1b**). The sample BH-99-19 (4 to 6 ft bgs depth interval) was reported with a TCA soil concentration of 51 mg/kg. A second soil sample was also collected from this boring BH-99-19 (6 to 8 ft bgs depth interval) and was reported with a concentration of 570 E mg/kg. The location of BH-99-19 was within the 1999 excavation area. A TCA concentration versus depth plot along with enclosed field headspace measurements from this soil boring BH-99-19 is also presented in **Figure 3-1b**. The concentration of TCA in soils increased with respect to depth at this soil boring location. A similar trend was observed with the enclosed field headspace PID measurements with respect to depth in this boring. UV fluorescence screening was performed on soils from the same depth intervals that enclosed field headspace PID measurements were measured and the results were negative, indicating the absence of NAPLs associated with this boring. The highest TCA soil concentration in the 4 to 6 ft bgs depth interval was 51 mg/kg and is more than two orders of magnitude lower than the 10,000 mg/kg soil concentration suggested by USEPA (1994) as an indicator of DNAPL in soil.

Several adjacent borings to BH-99-19 in the 4 to 6 ft bgs depth interval had TCA soil concentrations less than 2 mg/kg as follows: BH-99-22 (1.5 mg/kg); BH-99-25 (0.2 mg/kg); BH-99-35 (0.015 mg/kg); BH-99-36A (0.65 mg/kg); and ITT-SBW-3 (0.93 mg/kg). These borings were adjacent to BH-99-19, between 5 to 15 feet away, and indicate a localized impact of TCA in soils associated with the immediate area of BH-99-19.

3.2.4 Subsurface Soil TCA Concentrations in the Greater than 6 ft bgs Depth Interval

In the greater than 6 ft bgs depth interval, three soil samples in the northern portion of the former RFM Site had TCA soil concentrations greater than 10 mg/kg (**Figure 3-1c**). As presented in Section 3.2.2, above, the sample BH-99-19 (6 to 8 ft bgs depth interval) was reported with a TCA soil concentration of 570 E mg/kg. Several adjacent borings to BH-99-19, in the greater than 6 ft bgs depth interval, had TCA soil concentrations less than 10 mg/kg. BH-99-6 (6 to 8 ft bgs depth interval) and BH-99-23 (8 to 10 ft bgs depth interval) were reported with TCA soil concentrations of 4.2 E mg/kg and 0.37 mg/kg, respectively. Both of these borings were located within 3 ft of BH-99-19. BH-99-18 (6 to 8 ft bgs depth interval), BH-99-23 (8 to 10 ft bgs depth interval), BH-99-37 (6 to 8 ft bgs depth interval), BH-99-38 (6 to 8 ft bgs depth interval) and ITT-SBW-3 (8 to 10 ft bgs depth interval) all were reported with TCA concentrations less than 0.37 mg/kg. These additional adjacent borings to BH-99-19 were between 5 to 10 feet away indicating a localized impact of TCA in soils associated with the immediate area of BH-99-19.

BH-99-10 (6 to 8 ft bgs depth interval) and BH-99-10 (8 to 10 ft bgs depth interval) were reported with TCA concentrations in soil of 10 mg/kg and 27 mg/kg, respectively. This soil boring is located in the former 1999 excavation area and in the northeast portion of the former RFM Site. A TCA concentration versus depth plot along with enclosed field headspace measurements from the soil boring BH-99-10 is also presented in **Figure 3-1c**. The trend of increasing TCA soil concentrations and enclosed field headspace PID measurements with respect to depth is similar to that of BH-99-19. Two adjacent soil borings that are located within 10 ft of BH-99-10 are BH-99-44 and ITT-MW-2, with TCA soil concentrations reported at 0.92 mg/kg (8 to 10 ft bgs depth interval) and 0.79 mg/kg (6 to 8 ft bgs depth interval), respectively. Two additional borings that are located approximately 11 to 15 feet away from BH-99-10 are BH-99-29 and BH-99-30 with TCA soil concentrations reported at 2.3 mg/kg (6 to 7 ft bgs depth interval) and 2.2 mg/kg, (6 to 7 ft bgs depth interval), respectively. The four adjacent borings to BH-99-10 were less than 15 feet away and TCA concentrations in these four borings did not exceed 2.3 mg/kg, indicating a localized impact of TCA concentrations in soils associated with the immediate area of BH-99-10.

While not shown in **Figure 3-1c**, the enclosed field headspace PID measurement with respect to depth for BH-99-44 also reveals a similar increasing concentration trend versus depth with a PID measurement of 3.5 parts per million (ppm) (0 to 2 ft bgs depth interval) and increasing to 11.5 ppm (6 to 8 ft bgs depth interval) and then to 40.6 ppm (8 to 11 ft bgs depth interval. Field PID soil screening measurements at ITT-MW-2 were not collected using an enclosed headspace method.

BH-99-40B (8 to 10 ft bgs depth interval) was reported with a TCA concentration in soil of 11 mg/kg. A TCA concentration versus depth plot along with enclosed field headspace measurements from this soil boring BH-99-40B is also presented in **Figure 3-1c**. The trend of increasing enclosed field headspace PID measurements with respect to depth is similar to that of BH-99-19 and BH-99-10. Two adjacent borings that are located within 10 ft of BH-99-40B are BH-99-46 and BH-99-41 with TCA soil concentrations reported at 0.085 mg/kg (6 to 8 ft bgs depth interval) and 0.8 mg/kg (8 to 10 ft bgs depth interval), respectively. These additional adjacent borings to BH-99-40B were between 5 to 10 feet away indicating a localized impact of TCA in soils associated with the immediate area of BH-99-40B. Soil borings BH-99-29 and BH-99-30, were also located between 11 and 15 feet from BH-99-40B, between BH-99-40B and BH-99-10. Additionally, a row of soil samples on the former RFM Site and between the 1999 excavation area and the location of ASMF-RW-2 in the greater than 6 ft bgs depth interval were reported in the RFM RIR with TCA soil concentrations as follows: BH-99-1 (6 to 6.9 ft bgs depth interval) at 0.012 mg/kg, BH-99-41 (8 to 10 ft bgs depth interval) at 0.8 mg/kg, BH-99-43 (8 to 10 ft bgs depth interval) at 0.045 mg/kg, BH-99-46 (6 to 8 ft bgs depth interval) at 0.085 mg/kg, CS-1 (7 ft bgs depth) at 0.011 mg/kg, and OBG-SB-29 (5.0 to 6.5 ft bgs depth interval) at 0.021 mg/kg.

As noted above, the highest TCA soil concentration in the northeastern portion of the former RFM Site, in the greater than 6 ft bgs depth interval, was 27 mg/kg and is more than two orders of magnitude lower than the 10,000 mg/kg soil concentration suggested by USEPA (1994) as an indicator of DNAPL in soil.

While not shown in **Figure 3-1c**, the enclosed field headspace PID measurements with respect to depth in BH-99-29, BH-99-30, BH-99-41 and BH-99-46 also reveal a similar increasing concentration trend versus depth.

The highest TCA soil concentration in the greater than 6 ft bgs depth interval at the former RFM Site was 570 E mg/kg reported in sample BH-99-19 (6 to 8 ft bgs depth interval) located in the western portion of the 1999 excavation area. This concentration is more than 1.5 orders of magnitude lower than the 10,000 mg/kg soil concentration suggested by USEPA (1994) as an indicator of DNAPL in soil. Soil samples in the greater than 6 ft bgs depth interval tested negative for DNAPLs using the UV fluorescence method.

3.2.5 1,4-Dioxane Results

Results from the analysis of 1,4-dioxane in subsurface soils at the former RFM Site are reported in **Table 3-2 Figure 3-2** in a bubble plot.

In the northern half of the former RFM Site, 1,4-dioxane was analyzed using USEPA Method 8270C in subsurface soils from 17 sampling locations (36 discrete soil samples) (O'Brien & Gere, 2014). 1,4-Dioxane was reported as non-detected at 15 of the 17 subsurface sampling locations and in 32 of 34 discrete soil samples analyzed. Non-detectable reporting limits in subsurface soils from the northern portion of the former RFM Site varied from 0.37 mg/kg to 0.43 mg/kg. The highest 1,4-dioxane concentration detected in subsurface soils sampled in the northern portion of the former RFM Site was 0.93 mg/kg in a duplicate sample from OBG-SB-20 (2 to 4 ft depth interval). The original sample from OBG-SB-20 (2 to 4 ft depth interval) was 0.17 J mg/kg. A deeper soil sample was also analyzed for 1,4-dioxane at OBG-SB-20 (6 to 7 ft depth interval) and was reported at 0.6 mg/kg. One additional subsurface soil sample from the northern portion of the former RFM building was reported to have a detection of 1,4-dioxane at 0.039 J mg/kg from OBG-SB-21 (4 to 6 ft depth interval). OBG-SB-21 was located adjacent to, and approximately 5 ft from, OBG-SB-20. Both OBG-SB-20 and OBG-SB-21 were located in AOC-3 (Northern Degreaser Area). An additional boring OBG-SB-19 was also located adjacent to OBG-SB-20 approximately 5 ft to the northeast of OBG-SB-20 and two subsurface soil samples from OBG-SB-19 (4 to 7 ft and 8.5 to 10 ft depth intervals) were reported as non-detected.

In the southern half of the former RFM Site, 1,4-dioxane was analyzed using USEPA Method 8270C in subsurface soils from 14 sampling locations (28 discrete soil samples) (O'Brien & Gere, 2014). 1,4-Dioxane was reported as non-detected at 12 of the 14 subsurface soil sampling locations and in 26 of 28 discrete soil samples. Non-detectable reporting limits in subsurface soils from the southern portion of the former RFM Site varied from 0.37 mg/kg to 0.42 mg/kg. The highest 1,4-dioxane concentration reported in subsurface soils sampled in the southern portion of the former RFM Site was 0.69 mg/kg in sample OBG-SB-18 (6 to 7 ft depth interval). A deeper soil sample was obtained from OBG-SB-18 (7 to 9.5 ft depth interval) and was reported as non-detected. OBG-SB-18 is located in AOC-6. There were two additional soil sampling locations in AOC-6 with 1,4-dioxane concentrations reported as non-detected. One of the two additional soil boring locations was adjacent to OBG-SB-18 and approximately 5 ft away. The second subsurface soil sampling location in the southern portion of the former RFM Site with a detection of 1,4-dioxane was OBG-SB-8, located in AOC-5, with a concentration of 0.11 J mg/kg (7 to 9 ft depth interval). An additional soil sample from this soil boring was reported to be non-detected at OBG-SB-8 (1.5 to 3 ft depth interval).

Each of the above borings with detections of 1,4-dioxane in soils, both the northern and southern sections of the former RFM building, were isolated with either very low or non-detected concentrations of 1,4-dioxane in adjacent borings.

It is important to illustrate the qualitative and quantitative differences between screening 1,4-dioxane subsurface soil analyses previously conducted at the former RFM Site using USEPA Method 8240 by H2M (1993) and USEPA Method 8260 by Golder (2000a) and the definitive 1,4-dioxane subsurface soil data reported by O’Brien & Gere using USEPA Method 8270C.

- Subsurface soil sample ITT-MW-2 (6 to 8 ft bgs depth interval) (**Figures 2-1 and 2-2**) was reported by H2M (1993) to have a 1,4-dioxane concentration of 170 mg/kg with a TCA concentration of 0.79 mg/kg. Immediately adjacent to ITT-MW-2 and approximately 4 to 5 ft away, BH-99-28 (4 to 6 ft bgs depth interval) was reported by Golder (2000a) with 1,4-dioxane at 4.1 E mg/kg and TCA at 0.04 mg/kg. The results in both cases of ITT-MW-2 and BH-99-28 produce a ratio of 1,4-dioxane to TCA of 215 and 103, respectively. Virgin TCA typically contains approximately 2.5 percent 1,4-dioxaneresulting in a 1,4-dioxane to TCA ratio of 0.025. The high 1,4-dioxane to TCA ratios from the H2M and Golder analytical results suggest that the 1,4-dioxane concentrations are anomalously high.
- Only one subsurface soil sampling location reported by O’Brien & Gere (2014) was immediately proximate to a subsurface soil sample location conducted by either Golder (2000a and 2000b) or H2M (1993). Two soil samples from BH-99-31 (1 to 4 ft bgs depth interval) and BH-99-31 (4 to 6 ft bgs depth interval) were reported by Golder (2000a) with 0.072 mg/kg and 0.21 mg/kg TCA concentrations, respectively. Two soil samples from OBG-SB-19 (4 to 7 ft bgs depth interval) and OBG-SB-19 (8.5 to 10 ft bgs depth interval) were reported by O’Brien & Gere (2014) with 0.09 mg/kg and 0.62 mg/kg TCA concentrations, respectively. These TCA concentrations reported by Golder (2000a) and O’Brien & Gere (2014) are in relatively close agreement in soil borings that were located approximately 2 to 3 ft away from one another. In contrast, the 1,4-dioxane screening data concentrations in BH-99-31 (1 to 4 ft bgs depth interval) and BH-99-31 (4 to 6 ft bgs depth interval) were reported by Golder (2000a) with 17 E mg/kg and 11 E mg/kg, respectively. The 1,4-dioxane concentrations in OBG-SB-19 (4 to 7 ft bgs depth interval) and OBG-SB-19 (8.5 to 10 ft bgs depth interval) were reported by O’Brien & Gere (2014) both with non-detected concentrations. It is evident that the VOC methods of analysis for soils used by both Golder (2000b) and O’Brien & Gere (2014) generated TCA soil concentration results that were in close agreement. However, the screening 1,4-dixoane data generated by Golder (2000a) were more than two orders of magnitude greater than those definitive data non-detected results reported by O’Brien & Gere (2014) that were also validated and underwent a DUSR analysis.

4 DISCUSSION

USEPA (1994) provided guidance on DNAPL site characterization methods, including soil sampling, to determine the presence of DNAPLs at a site. In USEPA (1994) guidance is provided for the determinant, inferential and suggestive indications of DNAPL presence as follows: 1) determined directly by visual examination of subsurface samples; 2) inferred by interpretation of chemical analysis or subsurface samples; and/or 3) suspected by interpretation of anomalous chemical distribution or hydrogeologic data. USEPA (1993) provided guidance on the likelihood of finding DNAPLs at National Priority List (NPL) Sites and included similar criteria for the inference of DNAPLs based on soil and groundwater concentrations. USEPA (1994) lists UV fluorescence as a method to enhance inspection of a soil sample for DNAPL. Golder (2000b) screened 189 discrete subsurface soil samples on the former RFM Site using UV fluorescence for the potential presence of NAPL and each of the samples was reported as negative for the presence of NAPLs. O'Brien & Gere (2014) also tested 27 subsurface soil samples for the presence of NAPLS using UV fluorescence and the samples were reported as negative for the presence of NAPLs. The USEPA (1994) guidance on inferring DNAPL presence by interpretation of soil concentrations of DNAPL constituents is established at 10,000 mg/kg and higher concentrations.

The highest concentration of TCA measured in any soil sample collected from the former RFM site was reported to be 570 E mg/kg from BH-99-19 (6 to 8 ft bgs depth interval) which is more than a factor of 17 times lower than the USPEA (1994) guidance value of 10,000 mg/kg for the potential presence of DNAPL in soils. Additionally, no other VOC compounds were detected in sample BH-99-19 (6 to 8 ft bgs depth interval). At the BH-99-19 (6 to 8 ft bgs depth interval) location in the 1999 excavation area, with the highest TCA reported concentration in overburden soils at the former RFM Site, this sample location is surrounded above and adjacent to other sample locations with lower or non-detected TCA concentrations in overburden soils at the sampled depth intervals, indicating a localized and isolated impact.

The distribution of TCA concentrations in overburden soil at greater than 10 mg/kg indicates limited and sporadic areal distributions in the 1999 excavation area on the former RFM Site. Results of the analysis of TCA in overburden soils at the former RFM Site in and around the former excavation area, prior to excavation, indicated that no continuous distribution of TCA concentrations indicative of NAPL level concentrations existed in the overburden soil. Similarly, no continuous distribution of TCA concentrations indicative of NAPL level concentrations existed in the overburden soil in the former RFM excavation area away from the location at BH-99-19 in any direction, and particularly in an easterly direction towards the former AMSF Site and particularly towards the TCA groundwater impacts located at AMSF-MW-7 and AMSF-RW-2.

Residual saturation capacity measurements of non-wetting phase hydrophobic petroleum distillates in selected sands were first experimentally measured by Hoag (1986). Residual saturation was defined as the saturation that is attained after an initially NAPL saturated porous media is allowed to drain by gravity to equilibrium conditions (Hoag, et al., 1986). The residual saturation capacity can generally be defined as the volume of NAPL retained under drainage conditions in the unsaturated zone divided by the volume of voids. In addition to residual saturation, Schwille (1984, 1988), Mercer and Cohen (1990) and Zytner et al., (1993) define the term retention capacity to describe residual saturation of the non-wetting phase in the vadose zone in terms of volume of NAPL per unit volume of soil. The importance of NAPL residual saturation in soils above the water table is that a portion of mass of NAPL is retained in soils before NAPL can flow advectively, either horizontally or vertically, through the soil. Therefore, if NAPLs are discharged to vadose zone soils, NAPLs tend to create areas of high concentrations of NAPL compounds (i.e., residual saturation concentrations) in soils. In addition to there being no TCA soil samples reported in excess of the USPEA (1994) guidance value of 10,000 mg/kg for the potential presence of DNAPL in soils, no TCA soil concentrations approached residual saturation capacities, as residual saturation concentrations are significantly greater than the USEPA (1994) guidance value.

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TABLES

Table 2-1
Summary of Soil Sampling Activities (1991 - 2004)
Former ITT Rochester Form Machine Facility
Site #8-28-112
Town of Gates, New York

Entity	Report	Report Date	Sampling Dates	Soil Sampling Method	Applicable Soil Boring Locations	Source References	Soil Vapor Screening Method	Instrument Used	Lamp	VOC Analysis USEPA Method	1,4-Dioxane Analysis USEPA Method
H2M Group	Quantitative Environmental Survey	April 1993	October 22, 1991 to November 13, 1991	Split Spoon	ITT-MW-4, SB-3, SB-4, SB-5, SB-6	Boreholes were constructed by advancing hollow stem augers into the soil to the desired sampling depth using a truck mounted drill rig. A split-spoon sampler, 2 feet in length was then attached to a drill rod, lowered through the auger to the desired depth of collection, and driven into the soil for the length of the spoon. [Page 5] The groundwater monitoring wells were constructed with a truck mounted drill rig, using 8-inch inner diameter hollow stem augers. [Page 9]	Soil Boring Screening	PID	N/A	8240	8240
					ITT-MW-1, ITT-MW-2, ITT-MW-3,		Soil Boring Screening	PID	N/A	8240 SIM	8240 SIM
				Bucket Auger	APC2-1, APC2-2, APC3-1, APC3-2, SB-1, SB-2, SB-7, SB-9, SB-10	Soil borings located inside the building were collected from beneath the concrete floor of the plant. An electric hammer was used to penetrate the concrete slab. Soil samples were collected by boring down to the desired sampling depth using a hand held bucket auger. Samples were collected at a depth of 6 to 8 feet below grade. [Page 5] Concurrent with the soil boring program, five (5) shallow soil borings (SB-I, SB-2,SB-7, SB-9, and SB-IO) were collected utilizing a stainless steel hand-held bucket auger. [Page 6]	Soil Boring Screening	PID	N/A		
NYSDEC	Site Investigation Report ITT Automotive Fluid Handling Systems and Former Alliance Metal Stamping and Fabricating	December 2001	July 28, 1998 to August 17, 1998	Split Spoon	SBW-1, SBW-1A, SBW-2, and SBW-3	Subsurface soil samples were collected from each soil boring advanced during the investigation. Soil samples were collected continuously using a standard 2" outside diameter (O.D.) split-spoon sampler. [Page 3-2]	Soil Boring Screening and Enclosed Headspace Sealed Jar	PID and FID	N/A	8260	8270
				Plastic Scoop	SS-1 through SS-4	Surface soil samples were collected from the first two inches of soil using a new disposable plastic scoop after sod and surface debris was removed. [Page 3-1]	N/A	N/A	N/A	8260	N/A
Golder	Groundwater Investigation	March 2000	March1, 1999 to April 12, 1999	Split Spoon	SBW-4, SBW-5, SBW-5A, SBW-6, SBW-7, SBW-8, and BH-99-1	The overburden drilling was performed using 6-1\4-inch inside diameter (ID) hollow stem augers with continuous soil sampling. The sampling was performed through the augers using 2-foot long, 2-inch diameter split spoon samplers [Page 12]	Enclosed Headspace Plastic Bag	MiniRae ® PID	N/A	8260	8260
Golder	Supplemental Subsurf ace Investigation Risk Assessment, Natural Attenuation Evaluation and Soil Remediation	May 2000	September 15, 1999 to November 24, 1999	Direct Push Macro-Core ®	BH-99-2 through BH-99-46	Golder advanced shallow overburden soil borings at a total of 45 locations using a Geoprobe® direct push drilling method during two investigation events. Borings were advanced at 31 locations on September 15 and 16, 1999, during the initial phase of the investigation. Based on the preliminary laboratory results of the initial phase, soil borings were advanced at an additional 14 locations to further delineate the extent of VOCs in the overburden soil. The borings were located in the northeast corner of the facility near previous borings where elevated concentrations of VOCs were detected, in the vicinity of MW-2, SBW-3, and SB-8. [Page 13]	Enclosed Headspace Plastic Bag	MiniRae ® PID	N/A	8260	8260
O'Brien & Gere	Remedial investigation Report	October 2014	August 30, 2004 to September 3, 2004	Bucket Auger	TD-1	The sample was collected from 0-6 inches below the bottom of the concrete using a decontaminated hand auger and transferred to the appropriate sample container. [Page 18]	Enclosed Headspace Plastic Bag	MiniRae ® PID	11.7 eV	8260B	Not Performed
				Direct Push Macro-Core ®	OBG-SB-1 through OBG-SB-44	Soil boring locations were selected in the field with the NYSDEC between August 30, 2004 and September 2, 2004. Soil borings were installed by Nothnagle Drilling Inc. (Nothnagle) using direct push drilling methods [Page 18]					
				Split Spoon	ITT-SBW-9, ITT-SBW-10, ITT-SBW-11, ITT-SBW-12, ITT-SBW-13, ITT-SBW-14, ITT-SBW-15, ITT-SBW-16, AMSF-MW-11S, AMSF-MW-12S, and AMSF-MW-13S	The overburden was continuously sampled, using 2 inch split-spoon samplers, to the top of bedrock for soil description. Soil grain size descriptions were based on the modified Wentworth grain size classification scale. [Page 37]					

Notes:
eV - electron volts
FID - Flame ionization detector
N/A - not available
NYSDEC - New York State Department of Environmental Conservation
PID - photoionization detector
SIM - selective ion monitoring
USEPA - United State Environmental Protection Agency
VOC - volatile organic compound

Table 3-1
VOC Analytical Results for Soil Samples at the Former RFM Site
Former ITT Rochester Form Machine Facility
Site #8-28-112
Town of Gates, New York

													Removed	Removed			Removed	Removed	Removed	Removed	Removed	Removed	Removed
Location							**APC2-1**	**APC2-2**	**APC3-1**	**APC3-2**	**BH-99-1**	**BH-99-2**	**BH-99-3**	**BH-99-4**	**BH-99-5**	**BH-99-6**	**BH-99-7**	**BH-99-7**	**BH-99-8**	**BH-99-8**	**BH-99-9**	**BH-99-10**
Sample Date:							10/23/1991	10/23/1991	10/23/1991	10/23/1991	4/12/1999	9/15/1999	9/15/1999	9/15/1999	9/15/1999	9/15/1999	9/15/1999	9/15/1999	9/15/1999	9/15/1999	9/15/1999	9/15/1999
Sample ID:							APC2-1	APC2-2	APC3-1	APC3-2	BH-99-1(6-6.9)	BH-99-2 (6-7)	BH-99-3 (6-7)	BH-99-4 (6-8)	BH-99-5 (6-8)	BH-99-6 (6-8)	BH-99-7 (2-4)	BH-99-7 (6-8)	BH-99-8 (3-4)	BH-99-8 (8-10)	BH-99-9 (4-6)	BH-99-10 (6-8)
Start Depth (ft bgs):							6	6	6	6	6	6	6	6	6	6	2	6	3	8	4	6
End Depth (ft bgs):							8	8	8	8	6.9	7	7	8	8	8	4	8	4	10	6	8
Sample Type Code:							N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Analyte	**Part 375 Unrestricted Use SCOs[1]**	**NY CP-51 Residential Use SCOs[2]**	**Part 375 Protection of Groundwater SCOs[3]**	**NY CP-51 Protection of Groundwater SCOs[4]**	**Part 375 Commercial Use SCOs[5]**	**NY CP-51 Commercial Use SCOs[4]**																
1,1,1,2-Tetrachloroethane	NC	NC	NC	NC	NC	NC	---	---	---	---	0.005 U	---	---	---	---	---	---	---	---	---	---	---
1,1,1-Trichloroethane	0.68	NC	0.68	NC	500	NC	0.006 U	0.006 U	0.014	0.006 U	0.012 ^	**0.750**	0.019 U	0.047	0.006 U	**4.200 E**	**12.000 E**	**1.600 E**	0.340	**1.500**	0.250	**10.000**
1,1,2,2-Tetrachloroethane	NC	35	NC	0.6	NC	NC	---	---	---	---	0.005 U	0.600 U	0.019 U	0.006 U	0.006 U	0.005 U	0.006 U	0.005 U	0.009 U	0.740 U	0.010 U	0.720 U
1,1,2-Trichloroethane	NC	NC	NC	NC	NC	NC	0.006 U	0.006 U	0.006 U	0.006 U	---	0.600 U	0.019 U	0.006 U	0.006 U	0.005 U	0.006 U	0.005 U	0.009 U	0.740 U	0.010 U	0.720 U
1,1-Dichloroethane	0.27	NC	0.27	NC	240	NC	0.006 U	0.006 U	0.006 U	0.006 U	0.005 U	0.600 U	0.019 U	0.006 U	0.006 U	0.005 U	0.077	0.005 U	0.013	0.740 U	0.010 U	0.720 U
1,1-Dichloroethylene	0.33	NC	0.33	NC	500	NC	0.006 U	0.006 U	0.006 U	0.006 U	---	0.600 U	0.019 U	0.018	0.006 U	0.160	**0.360 E**	0.024	0.009 U	0.740 U	0.010 U	0.720 U
1,2,3-Trichloropropane	NC	80	NC	0.34	NC	NC	---	---	---	---	0.005 U	---	---	---	---	---	---	---	---	---	---	---
1,2-Dibromo-3-Chloropropane	NC	NC	NC	NC	NC	NC	---	---	---	---	0.005 U	---	---	---	---	---	---	---	---	---	---	---
1,2-Dibromoethane	NC	NC	NC	NC	NC	NC	---	---	---	---	0.005 U	---	---	---	---	---	---	---	---	---	---	---
1,2-Dichloroethane	0.02	NC	0.02	NC	30	NC	0.006 U	0.006 U	0.006 U	0.006 U	---	0.600 U	0.019 U	0.006 U	0.006 U	0.006	0.020	0.005 U	0.009 U	0.740 U	0.010 U	0.720 U
1,2-Dichloroethene	NC	NC	NC	NC	NC	NC	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
1,2-Dichloropropane	NC	NC	NC	NC	NC	NC	---	---	---	---	0.005 U	0.600 U	0.019 U	0.006 U	0.006 U	0.005 U	0.006 U	0.005 U	0.009 U	0.740 U	0.010 U	0.720 U
2-Butanone	0.12	100	0.12	0.3	500	NC	---	---	---	---	---	3.000 U	0.094 U	0.028 U	0.028 U	0.025 U	0.032 U	0.025 U	0.044 U	3.700 U	0.048 U	3.600 U
2-Chloroethyl vinyl ether	NC	NC	NC	NC	NC	NC	---	---	---	---	0.005 U	---	---	---	---	---	---	---	---	---	---	---
2-Chlorotoluene	NC	NC	NC	NC	NC	NC	---	---	---	---	0.005 U	---	---	---	---	---	---	---	---	---	---	---
2-Hexanone	NC	NC	NC	NC	NC	NC	---	---	---	---	0.010 U	1.200 U	0.037 U	0.011 U	0.011 U	0.010 U	0.013 U	0.010 U	0.018 U	1.500 U	0.019 U	1.400 U
4-Chlorotoluene	NC	NC	NC	NC	NC	NC	---	---	---	---	0.005 U	---	---	---	---	---	---	---	---	---	---	---
4-Methyl-2-Pentanone	NC	NC	NC	1	NC	NC	---	---	---	---	0.010 U	1.200 U	0.037 U	0.011 U	0.011 U	0.01 U	0.013 U	0.010 U	0.018 U	1.500 U	0.019 U	1.400 U
Acetone	0.05	NC	0.05	NC	500	NC	0.012 U	0.012	0.014 B	0.008	0.025 U	3.000 U	0.094 U	0.028 U	0.028 U	0.025 U	0.032 U	0.025 U	0.044 U	3.700 U	0.048 U	
Acrolein	NC	NC	NC	NC	NC	NC	---	---	---	---	0.020 U	---	---	---	---	---	---	---	---	---	---	---
Acrylonitrile	NC	NC	NC	NC	NC	NC	---	---	---	---	0.020 U	---	---	---	---	---	---	---	---	---	---	---
Benzene	0.06	NC	0.06	NC	44	NC	---	---	---	---	0.0007 U	0.084 U	0.003 U	0.0008 U	0.0008 U	0.0007 U	0.0009 U	0.0007 U	0.001 U	0.100 U	0.001 U	0.100 U
Bromobenzene	NC	NC	NC	NC	NC	NC	---	---	---	---	0.005 U	---	---	---	---	---	---	---	---	---	---	---
Bromodichloromethane	NC	NC	NC	NC	NC	NC	---	---	---	---	0.005 U	0.600 U	0.019 U	0.006 U	0.006 U	0.005 U	0.006 U	0.005 U	0.009 U	0.740 U	0.010 U	0.720 U
Bromoform	NC	NC	NC	NC	NC	NC	---	---	---	---	0.005 U	0.600 U	0.019 U	0.006 U	0.006 U	0.005 U	0.006 U	0.005 U	0.009 U	0.740 U	0.010 U	0.720 U
Bromomethane	NC	NC	NC	NC	NC	NC	---	---	---	---	0.005 U	0.600 U	0.019 U	0.006 U	0.006 U	0.005 U	0.006 U	0.005 U	0.009 U	0.740 U	0.010 U	0.720 U
Carbon Disulfide	NC	100	NC	2.7	NC	NC	---	---	---	---	0.005 U	0.600 U	0.019 U	0.006 U	0.006 U	0.005 U	0.006 U	0.005 U	0.009 U	0.740 U	0.010 U	0.720 U
Carbon Tetrachloride	0.76	NC	0.76	NC	22	NC	---	---	---	---	0.005 U	0.600 U	0.019 U	0.006 U	0.006 U	0.005 U	0.006 U	0.005 U	0.009 U	0.740 U	0.010 U	0.720 U
Chlorobenzene	1.1	NC	1.1	NC	500	NC	---	---	---	---	0.005 U	0.600 U	0.019 U	0.006 U	0.006 U	0.005 U	0.006 U	0.005 U	0.009 U	0.740 U	0.010 U	0.720 U
Chloroethane	NC	NC	NC	1.9	NC	NC	---	---	---	---	0.005 U	0.600 U	0.019 U	0.006 U	0.006 U	0.005 U	0.006 U	0.005 U	0.009 U	0.740 U	0.010 U	0.720 U
Chloroform	0.37	NC	0.37	NC	350	NC	---	---	---	---	0.005 U	0.600 U	0.019 U	0.006 U	0.006 U	0.005 U	0.006 U	0.005 U	0.009 U	0.740 U	0.010 U	0.720 U
Chloromethane	NC	NC	NC	NC	NC	NC	---	---	---	---	0.005 U	0.600 U	0.019 U	0.006 U	0.006 U	0.005 U	0.006 U	0.005 U	0.009 U	0.740 U	0.010 U	0.720 U
cis-1,2-Dichloroethylene	0.25	NC	0.25	NC	500	NC	---	---	---	---	0.005 U	0.600 U	0.019 U	0.006 U	0.006 U	0.005 U	0.022	0.005 U	0.009 U	0.740 U	0.010 U	0.720 U
cis-1,3-Dichloropropylene	NC	NC	NC	NC	NC	NC	---	---	---	---	0.005 U	0.600 U	0.019 U	0.006 U	0.006 U	0.005 U	0.006 U	0.005 U	0.009 U	0.740 U	0.010 U	0.720 U
Dibromochloromethane	NC	NC	NC	NC	NC	NC	---	---	---	---	0.005 U	0.600 U	0.019 U	0.006 U	0.006 U	0.005 U	0.006 U	0.005 U	0.009 U	0.740 U	0.010 U	0.720 U
Dichlorodifluoromethane	NC	NC	NC	NC	NC	NC	---	---	---	---	0.005 U	---	---	---	---	---	---	---	---	---	---	---
Ethylbenzene	1	NC	1	NC	390	NC	0.006 U	0.006 U	0.006 U	0.006 U	---	0.600 U	0.019 U	0.006 U	0.006 U	0.005 U	0.006 U	0.005 U	0.009 U	0.740 U	0.010 U	0.720 U
Methylene chloride	0.05	NC	0.05	NC	500	NC	0.004	0.004	0.003	0.004	0.005 U	0.600 U	0.019 U	0.006 U	0.006 U	0.005 U	0.006 U	0.005 U	0.009 U	0.740 U	0.010 U	0.720 U
o-Xylene	NC	NC	NC	NC	NC	NC	---	---	---	---	0.005 U	0.600 U	0.019 U	0.006 U	0.006 U	0.005 U	0.006 U	0.005 U	0.009 U	0.740 U	0.010 U	0.720 U
Styrene	NC	NC	NC	NC	NC	NC	---	---	---	---	0.005 U	0.600 U	0.019 U	0.006 U	0.006 U	0.005 U	0.006 U	0.005 U	0.009 U	0.740 U	0.010 U	0.720 U
Tetrachloroethene	1.3	NC	1.3	NC	150	NC	0.006 U	0.006 U	0.006 U	0.006 U	---	0.600 U	0.019 U	0.006 U	0.006 U	0.005 U	0.260	0.032	0.011	0.740 U	0.010 U	0.720 U
Toluene	0.7	NC	0.7	NC	500	NC	0.006 U	0.006 U	0.006 U	0.006 U	---	0.600 U	0.019 U	0.006 U	0.006 U	0.005 U	0.006 U	0.005 U	0.009 U	0.740 U	0.010 U	0.720 U
Total BTEX	NC	NC	NC	NC	NC	NC	0.006 U	0.006 U	0.006 U	0.006 U	0.005 U	0.600 U	0.019 U	0.006 U	0.006 U	0.005 U	0.006 U	0.005 U	0.009 U	0.740 U	0.010 U	0.720 U
trans-1,2-Dichloroethylene	0.19	NC	0.19	NC	500	NC	---	---	---	---	0.005 U	0.600 U	0.019 U	0.006 U	0.006 U	0.005 U	0.006 U	0.005 U	0.009 U	0.740 U	0.010 U	0.720 U
trans-1,3-Dichloropropylene	NC	NC	NC	NC	NC	NC	---	---	---	---	0.005 U	0.600 U	0.019 U	0.006 U	0.006 U	0.005 U	0.006 U	0.005 U	0.009 U	0.740 U	0.010 U	0.720 U
Trichloroethylene	0.47	NC	0.47	NC	200	NC	0.006 U	0.006 U	0.006 U	0.006 U	---	0.600 U	0.019 U	0.006 U	0.006 U	0.065	0.390	0.056	0.009 U	0.740 U	0.010 U	0.720 U
Trichlorofluoromethane	NC	NC	NC	NC	NC	NC	---	---	---	---	0.005 U	---	---	---	---	---	---	---	---	---	---	---
Vinyl Acetate	NC	NC	NC	NC	NC	NC	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Vinyl Chloride	0.02	NC	0.02	NC	13	NC	---	---	---	---	0.002 U	0.240 U	0.007 U	0.002 U	0.002 U	0.002 U	0.003 U	0.002 U	0.004 U	0.290 U	0.004 U	0.290 U
Xylene (m,p)	NC	NC	NC	NC	NC	NC	---	---	---	---	---	0.600 U	0.019 U	0.006 U	0.006 U	0.005 U	0.006 U	0.005 U	0.009 U	0.740 U	0.010 U	0.720 U
Xylene (total)	0.26	NC	1.6	NC	500	NC	0.006 U	0.006 U	0.006 U	0.006 U	0.005 U	0.600 U	0.019 U	0.006 U	0.006 U	0.005 U	0.006 U	0.005 U	0.009 U	0.740 U	0.010 U	0.720 U

Notes:

All units in micrograms per kilogram (µg/kg)

Bold - Exceeds 6 NYCRR Part 375 or CP-51 Protection of Groundwater Soil Cleanup Objectives

▨ - Exceeds 6 NYCRR Part 375 Unrestricted Soil Cleanup Objectives or CP-51 Residential Soil Cleanup Objectives

🟪 - Exceeds 6 NYCRR Part 375 or CP-51 Commercial Soil Cleanup Objectives

Exceeds 6 NYCRR Part 375 or CP-51 Commercial Soil Cleanup Objectives

ft bgs - feet below ground surface

NC - No criteria exists, NA - Not available

Sample Type Code: N - Normal, FD - Field Duplicate

U - Not Detected at the Detection Limit shown, J - Estimated value, UJ - Approximate Non-detect

B - Blank Contamination, BJ - Estimated Value Detected in Blank, ND - Not Detected

--- Not Analyzed

[1] 6 NYCRR Part 375, Table 375-6.8(b): Restricted Use Soil Cleanup Objectives, Protection of Public Health, Commercial, December 14, 2006.

[2] Final Commissioner Policy CP-51, Table 1: Supplimental Soil Cleanup Objectives, Residential, October 21, 2010.

[3] 6 NYCRR Part 375, Table 375-6.8(b): Restricted Use Soil Cleanup Objectives, Protection of Public Health, Protection of Groundwater, December 14, 2006.

[4] Final Commissioner Policy CP-51, Table 1: Supplimental Soil Cleanup Objectives, Protection of Groundwater, October 21, 2010.

[5] 6 NYCRR Part 375, Table 375-6.8(b): Unrestricted Use Soil Cleanup Objectives, Protection of Public Health, December 14, 2006.

[6] Final Commissioner Policy CP-51, Table 1: Supplimental Soil Cleanup Objectives, Commercial, October 21, 2010.

- Value qualified with a U per validation report dated March 6, 2006. Value reported in October 20, 2014 RIR did not reflect this qualifier.

$ - Value qualified with a J per validation report dated March 6, 2006. Value reported in October 20, 2014 RIR did not reflect this qualifier.

& - Value revised per laboratory data sheets presented in the Quantitative Environmental Survey dated April 1993. Value reported in October 20, 2014 RIR was incorrect.

^ - Value revised per laboratory data sheets presented in the Groundwater Investigation dated March 2000. Value reported in October 20, 2014 RIR was incorrect.

Table 3-1
VOC Analytical Results for Soil Samples at the Former RFM Site
Former ITT Rochester Form Machine Facility
Site #8-28-112
Town of Gates, New York

							Removed		Removed		Removed	Removed	Removed	Removed	Removed	Removed	Removed	Removed	Removed	Removed	Removed	Removed
						Location	**BH-99-10**	**BH-99-11B**	**BH-99-12**	**BH-99-13**	**BH-99-14A/B**	**BH-99-15**	**BH-99-16**	**BH-99-17**	**BH-99-18**	**BH-99-19**	**BH-99-19**	**BH-99-20**	**BH-99-21**	**BH-99-22**	**BH-99-23**	**BH-99-25**
						Sample Date:	9/15/1999	9/15/1999	9/15/1999	9/15/1999	9/15/1999	9/15/1999	9/15/1999	9/15/1999	9/15/1999	9/15/1999	9/15/1999	9/16/1999	9/16/1999	9/16/1999	9/16/1999	9/16/1999
						Sample ID:	BH-99-10 (8-10)	BH-99-11B (5-7)	BH-99-12 (6-8)	BH-99-13 (8-10)	BH-99-14A (4-6)	BH-99-15 (4-6)	BH-99-16 (4-6)	BH-99-17 (7-9)	BH-99-18 (6-8)	BH-99-19 (4-6)	BH-99-19 (6-8)	BH-99-20 (4-6)	BH-99-21 (2-4)	BH-99-22 (4-6)	BH-99-23 (8-10)	BH-99-25 (4-6)
						Start Depth (ft bgs):	8	5	6	8	4	4	4	7	6	4	6	4	2	4	8	4
						End Depth (ft bgs):	10	7	8	10	6	6	6	9	8	6	8	6	4	6	10	6
						Sample Type Code:	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Analyte	**Part 375 Unrestricted Use SCOs[1]**	**NY CP-51 Residential Use SCOs[2]**	**Part 375 Protection of Groundwater SCOs[3]**	**NY CP-51 Protection of Groundwater SCOs[4]**	**Part 375 Commercial Use SCOs[5]**	**NY CP-51 Commercial Use SCOs[4]**																
1,1,1,2-Tetrachloroethane	NC	NC	NC	NC	NC	NC	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
1,1,1-Trichloroethane	0.68	NC	0.68	NC	500	NC	**27.000**	0.019	0.170	0.130	**0.700**	**1.500**	0.025	**1.600**	0.025 U	**51.000**	**570.000 E**	0.380	**2.400**	**1.500**	0.370	0.200
1,1,2,2-Tetrachloroethane	NC	35	NC	0.6	NC	NC	0.680 U	0.007 U	0.008 U	0.027 U	0.680 U	0.700 U	0.025 U	0.700 U	0.025 U	6.900 U	14.000 U	0.010 U	0.520 U	0.480 U	0.010 U	0.010 U
1,1,2-Trichloroethane	NC	NC	NC	NC	NC	NC	0.680 U	0.007 U	0.008 U	0.027 U	0.680 U	0.700 U	0.025 U	0.700 U	0.025 U	6.900 U	14.000 U	0.010 U	0.520 U	0.480 U	0.010 U	0.010 U
1,1-Dichloroethane	0.27	NC	0.27	NC	240	NC	0.680 U	0.007 U	0.008 U	0.027 U	0.680 U	0.700 U	0.025 U	0.700 U	0.025 U	6.900 U	14.000 U	0.010 U	0.520 U	0.480 U	0.010 U	0.010 U
1,1-Dichloroethylene	0.33	NC	0.33	NC	500	NC	0.680 U	0.007 U	0.008 U	0.027 U	0.680 U	0.700 U	0.025 U	0.700 U	0.025 U	6.900 U	14.000 U	0.087	0.520 U	2.400 U	0.010 U	0.010 U
1,2,3-Trichloropropane	NC	80	NC	0.34	NC	NC	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
1,2-Dibromo-3-Chloropropane	NC	NC	NC	NC	NC	NC	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
1,2-Dibromoethane	NC	NC	NC	NC	NC	NC	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
1,2-Dichloroethane	0.02	NC	0.02	NC	30	NC	0.680 U	0.007 U	0.008 U	0.027 U	0.680 U	0.700 U	0.025 U	0.700 U	0.025 U	6.900 U	14.000 U	0.010 U	0.520 U	0.480 U	0.010 U	0.010 U
1,2-Dichloroethene	NC	NC	NC	NC	NC	NC	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
1,2-Dichloropropane	NC	NC	NC	NC	NC	NC	0.680 U	0.007 U	0.008 U	0.027 U	0.680 U	0.700 U	0.025 U	0.700 U	0.025 U	6.900 U	14.000 U	0.010 U	0.520 U	0.480 U	0.010 U	0.010 U
2-Butanone	0.12	100	0.12	0.3	500	NC	3.400 U	0.034 U	0.041 U	0.140 U	3.40 U	3.500 U	0.120 U	3.500 U	0.120 U	34.000 U	68.000 U	0.052 U	2.600 U	2.400 U	0.048 U	0.051 U
2-Chloroethyl vinyl ether	NC	NC	NC	NC	NC	NC	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
2-Chlorotoluene	NC	NC	NC	NC	NC	NC	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
2-Hexanone	NC	NC	NC	NC	NC	NC	1.400 U	0.007 U	0.016 U	0.054 U	1.40 U	1.400 U	0.050 U	1.400 U	0.049 U	14.000 U	27.000 U	0.021 U	1 .000U	0.970 U	0.019 U	0.020 U
4-Chlorotoluene	NC	NC	NC	NC	NC	NC	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
4-Methyl-2-Pentanone	NC	NC	NC	1	NC	NC	1.400 U	0.014 U	0.016 U	0.054 U	1.40 U	1.400 U	0.050 U	1.400 U	0.049 U	14.000 U	27.000 U	0.021 U	1.000 U	0.970 U	0.019 U	0.020 U
Acetone	0.05	NC	0.05	NC	500	NC	3.400 U	0.034 U	0.041 U	0.140 U	3.40 U	3.500 U	0.120 U	3.500 U	0.120 U	34.000 U	68.000 U	0.052 U	2.600 U	0.480 U	0.048 U	0.051 U
Acrolein	NC	NC	NC	NC	NC	NC	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Acrylonitrile	NC	NC	NC	NC	NC	NC	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Benzene	0.06	NC	0.06	NC	44	NC	0.095 U	0.001 U	0.001 U	0.004 U	0.095 U	0.098 U	0.003 U	0.099 U	0.003 U	0.96 U	1.900 U	0.001 U	0.073 U	0.068 U	0.001 U	0.001 U
Bromobenzene	NC	NC	NC	NC	NC	NC	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Bromodichloromethane	NC	NC	NC	NC	NC	NC	0.680 U	0.007 U	0.008 U	0.027 U	0.680 U	0.700 U	0.025 U	0.700 U	0.025 U	6.900 U	14.000 U	0.010 U	0.520 U	0.480 U	0.010 U	0.010 U
Bromoform	NC	NC	NC	NC	NC	NC	0.680 U	0.007 U	0.008 U	0.027 U	0.680 U	0.700 U	0.025 U	0.700 U	0.025 U	6.900 U	14.000 U	0.010 U	0.520 U	0.480 U	0.010 U	0.010 U
Bromomethane	NC	NC	NC	NC	NC	NC	0.680 U	0.007 U	0.008 U	0.027 U	0.680 U	0.700 U	0.025 U	0.700 U	0.025 U	6.900 U	14.000 U	0.010 U	0.520 U	0.480 U	0.010 U	0.010 U
Carbon Disulfide	NC	100	NC	2.7	NC	NC	0.680 U	0.007 U	0.008 U	0.027 U	0.680 U	0.700 U	0.025 U	0.700 U	0.025 U	6.900 U	14.000 U	0.010 U	0.520 U	0.480 U	0.010 U	0.010 U
Carbon Tetrachloride	0.76	NC	0.76	NC	22	NC	0.680 U	0.007 U	0.008 U	0.027 U	0.680 U	0.700 U	0.025 U	0.700 U	0.025 U	6.900 U	14.000 U	0.010 U	0.520 U	0.480 U	0.010 U	0.010 U
Chlorobenzene	1.1	NC	1.1	NC	500	NC	0.680 U	0.007 U	0.008 U	0.027 U	0.680 U	0.700 U	0.025 U	0.700 U	0.025 U	6.900 U	14.000 U	0.010 U	0.520 U	0.480 U	0.010 U	0.010 U
Chloroethane	NC	NC	NC	1.9	NC	NC	0.680 U	0.007 U	0.008 U	0.027 U	0.680 U	0.700 U	0.025 U	0.700 U	0.025 U	6.900 U	14.000 U	0.010 U	0.520 U	0.480 U	0.010 U	0.010 U
Chloroform	0.37	NC	0.37	NC	350	NC	0.680 U	0.007 U	0.008 U	0.027 U	0.680 U	0.700 U	0.025 U	0.700 U	0.025 U	6.900 U	14.000 U	0.010 U	0.520 U	0.480 U	0.010 U	0.010 U
Chloromethane	NC	NC	NC	NC	NC	NC	0.680 U	0.007 U	0.008 U	0.027 U	0.680 U	0.700 U	0.025 U	0.700 U	0.025 U	6.900 U	14.000 U	0.010 U	0.520 U	0.480 U	0.010 U	0.010 U
cis-1,2-Dichloroethylene	0.25	NC	0.25	NC	500	NC	0.680 U	0.007 U	0.008 U	0.027 U	0.680 U	0.700 U	0.025 U	0.700 U	0.025 U	6.900 U	14.000 U	0.010 U	0.520 U	0.480 U	0.010 U	0.010 U
cis-1,3-Dichloropropylene	NC	NC	NC	NC	NC	NC	0.680 U	0.007 U	0.008 U	0.027 U	0.680 U	0.700 U	0.025 U	0.700 U	0.025 U	6.900 U	14.000 U	0.010 U	0.520 U	0.480 U	0.010 U	0.010 U
Dibromochloromethane	NC	NC	NC	NC	NC	NC	0.680 U	0.007 U	0.008 U	0.027 U	0.680 U	0.700 U	0.025 U	0.700 U	0.025 U	6.900 U	14.000 U	0.010 U	0.520 U	0.480 U	0.010 U	0.010 U
Dichlorodifluoromethane	NC	NC	NC	NC	NC	NC	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Ethylbenzene	1	NC	1	NC	390	NC	0.680 U	0.007 U	0.008 U	0.027 U	0.680 U	0.700 U	0.025 U	0.700 U	0.025 U	6.900 U	14.000 U	0.010 U	0.520 U	0.480 U	0.010 U	0.010 U
Methylene chloride	0.05	NC	0.05	NC	500	NC	0.680 U	0.007 U	0.008 U	0.027 U	0.680 U	0.700 U	0.025 U	0.700 U	0.025 U	6.900 U	14.000 U	0.010 U	0.520 U	0.480 U	0.010 U	0.010 U
o-Xylene	NC	NC	NC	NC	NC	NC	0.680 U	0.007 U	0.008 U	0.027 U	0.680 U	0.089 U	0.025 U	0.700 U	0.025 U	6.900 U	14.000 U	0.010 U	0.520 U	0.480 U	0.010 U	0.010 U
Styrene	NC	NC	NC	NC	NC	NC	0.680 U	0.007 U	0.008 U	0.027 U	0.680 U	0.700 U	0.025 U	0.700 U	0.025 U	6.900 U	14.000 U	0.010 U	0.520 U	0.480 U	0.010 U	0.010 U
Tetrachloroethene	1.3	NC	1.3	NC	150	NC	0.680 U	0.007 U	0.008 U	0.027 U	0.680 U	0.700 U	0.025 U	0.700 U	0.025 U	6.900 U	14.000 U	0.010 U	0.520 U	0.480 U	0.010 U	0.010 U
Toluene	0.7	NC	0.7	NC	500	NC	0.680 U	0.007 U	0.008 U	0.027 U	0.680 U	0.700 U	0.025 U	0.700 U	0.025 U	6.900 U	14.000 U	0.010 U	0.520 U	0.480 U	0.010 U	0.010 U
Total BTEX	NC	NC	NC	NC	NC	NC	0.680 U	0.007 U	0.008 U	0.027 U	0.680 U	0.700 U	0.025 U	0.700 U	0.025 U	6.900 U	14.000 U	0.010 U	0.520 U	0.480 U	0.010 U	0.010 U
trans-1,2-Dichloroethylene	0.19	NC	0.19	NC	500	NC	0.680 U	0.007 U	0.008 U	0.027 U	0.680 U	0.700 U	0.025 U	0.700 U	0.025 U	6.900 U	14.000 U	0.010 U	0.520 U	0.480 U	0.010 U	0.010 U
trans-1,3-Dichloropropylene	NC	NC	NC	NC	NC	NC	0.680 U	0.007 U	0.008 U	0.027 U	0.680 U	0.700 U	0.025 U	0.700 U	0.025 U	6.900 U	14.000 U	0.010 U	0.520 U	0.480 U	0.010 U	0.010 U
Trichloroethylene	0.47	NC	0.47	NC	200	NC	0.680 U	0.007 U	0.008 U	0.027 U	0.680 U	**1.600**	0.025 U	0.700 U	0.025 U	6.900 U	14.000 U	0.015	0.520 U	0.480 U	0.016	0.016
Trichlorofluoromethane	NC	NC	NC	NC	NC	NC	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Vinyl Acetate	NC	NC	NC	NC	NC	NC	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Vinyl Chloride	0.02	NC	0.02	NC	13	NC	0.270 U	0.003 U	0.003 U	0.011 U	0.270 U	0.280 U	0.010 U	0.280 U	0.010 U	2.700 U	5.400 U	0.004 U	0.210 U	0.190 U	0.004 U	0.004 U
Xylene (m,p)	NC	NC	NC	NC	NC	NC	0.680 U	0.007 U	0.008 U	0.027 U	0.680 U	0.700 U	0.025 U	0.700 U	0.025 U	6.900 U	14.000 U	0.010 U	0.520 U	0.480 U	0.010 U	0.010 U
Xylene (total)	0.26	NC	1.6	NC	500	NC	0.680 U	0.007 U	0.008 U	0.027 U	0.680 U	0.089 U	0.025 U	0.700 U	0.025 U	6.900 U	14.000 U	0.010 U	0.520 U	0.480 U	0.010 U	0.010 U

Notes:

All units in micrograms per kilogram (µg/kg)

Bold - Exceeds 6 NYCRR Part 375 or CP-51 Protection of Groundwater Soil Cleanup Objectives

▨ - Exceeds 6 NYCRR Part 375 Unrestricted Soil Cleanup Objectives or CP-51 Residential Soil Cleanup Objectives

🟪 - Exceeds 6 NYCRR Part 375 or CP-51 Commercial Soil Cleanup Objectives

Exceeds 6 NYCRR Part 375 or CP-51 Commercial Soil Cleanup Objectives

ft bgs - feet below ground surface

NC - No criteria exists, NA - Not available

Sample Type Code: N - Normal, FD - Field Duplicate

U - Not Detected at the Detection Limit shown, J - Estimated value, UJ - Approximate Non-detect

B - Blank Contamination, BJ - Estimated Value Detected in Blank, ND - Not Detected

--- Not Analyzed

[1] 6 NYCRR Part 375, Table 375-6.8(b): Restricted Use Soil Cleanup Objectives, Protection of Public Health, Commercial, December 14, 2006.

[2] Final Commissioner Policy CP-51, Table 1: Supplimental Soil Cleanup Objectives, Residential, October 21, 2010.

[3] 6 NYCRR Part 375, Table 375-6.8(b): Restricted Use Soil Cleanup Objectives, Protection of Public Health, Protection of Groundwater, December 14, 2006.

[4] Final Commissioner Policy CP-51, Table 1: Supplimental Soil Cleanup Objectives, Protection of Groundwater, October 21, 2010.

[5] 6 NYCRR Part 375, Table 375-6.8(b): Unrestricted Use Soil Cleanup Objectives, Protection of Public Health, December 14, 2006.

[6] Final Commissioner Policy CP-51, Table 1: Supplimental Soil Cleanup Objectives, Commercial, October 21, 2010.

- Value qualified with a U per validation report dated March 6, 2006. Value reported in October 20, 2014 RIR did not reflect this qualifier.

$ - Value qualified with a J per validation report dated March 6, 2006. Value reported in October 20, 2014 RIR did not reflect this qualifier.

& - Value revised per laboratory data sheets presented in the Quantitative Environmental Survey dated April 1993. Value reported in October 20, 2014 RIR was incorrect.

^ - Value revised per laboratory data sheets presented in the Groundwater Investigation dated March 2000. Value reported in October 20, 2014 RIR was incorrect.

Table 3-1
VOC Analytical Results for Soil Samples at the Former RFM Site
Former ITT Rochester Form Machine Facility
Site #8-28-112
Town of Gates, New York

							Removed	Removed	Removed	Removed	Removed				Removed	Removed	Removed	Removed		Removed	Removed	Removed
Location							**BH-99-26**	**BH-99-27**	**BH-99-28**	**BH-99-29**	**BH-99-30**	**BH-99-31**	**BH-99-31**	**BH-99-32**	**BH-99-33**	**BH-99-34**	**BH-99-35**	**BH-99-36A**	**BH-99-37**	**BH-99-38**	**BH-99-39**	**BH-99-40B**
Sample Date:							9/16/1999	9/16/1999	9/16/1999	9/16/1999	9/16/1999	9/16/1999	9/16/1999	9/16/1999	10/1/1999	10/1/1999	10/1/1999	10/1/1999	10/1/1999	10/1/1999	10/1/1999	10/1/1999
Sample ID:							BH-99-26 (4-6)	BH-99-27 (4-6)	BH-99-28 (4-6)	BH-99-29 (6-7)	BH-99-30 (6-7)	BH-99-31 (1-4)	BH-99-31 (4-6)	BH-99-32 (1-4)	BH-99-33 (1-2)	BH-99-34 (2-4)	BH-99-35 (4-6)	BH-99-36 (4-6)	BH-99-37 (6-8)	BH-99-38 (6-8)	BH-99-39 (6-8)	BH-99-40B (8-10)
Start Depth (ft bgs):							4	4	4	6	6	1	4	1	1	2	4	4	6	6	6	8
End Depth (ft bgs):							6	6	6	7	7	4	6	4	2	4	6	6	8	8	8	10
Sample Type Code:							N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Analyte	**Part 375 Unrestricted Use SCOs[1]**	**NY CP-51 Residential Use SCOs[2]**	**Part 375 Protection of Groundwater SCOs[3]**	**NY CP-51 Protection of Groundwater SCOs[4]**	**Part 375 Commercial Use SCOs[5]**	**NY CP-51 Commercial Use SCOs[4]**																
1,1,1,2-Tetrachloroethane	NC	NC	NC	NC	NC	NC	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
1,1,1-Trichloroethane	0.68	NC	0.68	NC	500	NC	0.033	0.010	0.040	**2.300**	**2.200**	0.072	0.210	0.110	0.092	0.021	0.015	0.65	0.012	0.030	0.010 U	**11.000**
1,1,2,2-Tetrachloroethane	NC	35	NC	0.6	NC	NC	0.010 U	0.009 U	0.010 U	0.710 U	0.460 U	0.010 U	0.009 U	0.010 U	0.026 U	0.010 U	0.010 U	0.028 U	0.010 U	0.010 U	0.010 U	0.450 U
1,1,2-Trichloroethane	NC	NC	NC	NC	NC	NC	0.010 U	0.009 U	0.010 U	0.710 U	0.460 U	0.010 U	0.009 U	0.010 U	0.026 U	0.010 U	0.010 U	0.028 U	0.010 U	0.010 U	0.010 U	0.450 U
1,1-Dichloroethane	0.27	NC	0.27	NC	240	NC	0.010 U	0.009 U	0.010 U	0.710 U	0.460 U	0.010 U	0.009 U	0.010 U	0.026 U	0.010 U	0.010 U	0.028 U	0.010 U	0.010 U	0.010 U	0.450 U
1,1-Dichloroethylene	0.33	NC	0.33	NC	500	NC	0.010 U	0.009 U	0.010 U	0.710 U	0.460 U	0.010 U	0.009 U	0.010 U	0.026 U	0.010 U	0.010 U	0.028 U	0.010 U	0.010 U	0.010 U	0.450 U
1,2,3-Trichloropropane	NC	80	NC	0.34	NC	NC	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
1,2-Dibromo-3-Chloropropane	NC	NC	NC	NC	NC	NC	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
1,2-Dibromoethane	NC	NC	NC	NC	NC	NC	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
1,2-Dichloroethane	0.02	NC	0.02	NC	30	NC	0.010 U	0.009 U	0.010 U	0.710 U	0.460 U	0.010 U	0.009 U	0.010 U	0.026 U	0.010 U	0.010 U	0.028 U	0.010 U	0.010 U	0.010 U	0.450 U
1,2-Dichloroethene	NC	NC	NC	NC	NC	NC	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
1,2-Dichloropropane	NC	NC	NC	NC	NC	NC	0.010 U	0.009 U	0.010 U	0.710 U	0.460 U	0.010 U	0.009 U	0.010 U	0.026 U	0.010 U	0.010 U	0.028 U	0.010 U	0.010 U	0.010 U	0.450 U
2-Butanone	0.12	100	0.12	0.3	500	NC	0.050 U	0.047 U	0.048 U	3.600 U	2.300 U	0.048 U	0.045 U	0.048 U	0.130 U	0.049 U	0.048 U	0.140 U	0.051 U	0.050 U	0.048 U	2.300 U
2-Chloroethyl vinyl ether	NC	NC	NC	NC	NC	NC	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
2-Chlorotoluene	NC	NC	NC	NC	NC	NC	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
2-Hexanone	NC	NC	NC	NC	NC	NC	0.020 U	0.019 U	0.019 U	1.400 U	0.920 U	0.019 U	0.018 U	0.019 U	0.052 U	0.019 U	0.019 U	0.056 U	0.020 U	0.020 U	0.019 U	0.910 U
4-Chlorotoluene	NC	NC	NC	NC	NC	NC	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
4-Methyl-2-Pentanone	NC	NC	NC	1	NC	NC	0.020 U	0.019 U	0.019 U	1.400 U	0.920 U	0.019 U	0.018 U	0.019 U	0.052 U	0.019 U	0.019 U	0.056 U	0.020 U	0.020 U	0.019 U	0.910 U
Acetone	0.05	NC	0.05	NC	500	NC	0.050 U	0.047 U	0.048 U	3.600 U	2.300 U	0.048 U	0.045 U	0.048 U	0.130 U	0.010 U	0.048 U	0.140 U	0.051 U	0.050 U	0.048 U	2.300 U
Acrolein	NC	NC	NC	NC	NC	NC	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Acrylonitrile	NC	NC	NC	NC	NC	NC	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Benzene	0.06	NC	0.06	NC	44	NC	0.001 U	0.001 U	0.001 U	0.100 U	0.064 U	0.001 U	0.001 U	0.001 U	0.004 U	0.001 U	0.001 U	0.004 U	0.001 U	0.001 U	0.001 U	0.064 U
Bromobenzene	NC	NC	NC	NC	NC	NC	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Bromodichloromethane	NC	NC	NC	NC	NC	NC	0.010 U	0.009 U	0.010 U	0.710 U	0.460 U	0.010 U	0.009 U	0.010 U	0.026 U	0.010 U	0.010 U	0.028 U	0.010 U	0.010 U	0.010 U	0.450 U
Bromoform	NC	NC	NC	NC	NC	NC	0.010 U	0.009 U	0.010 U	0.710 U	0.460 U	0.010 U	0.009 U	0.010 U	0.026 U	0.010 U	0.010 U	0.028 U	0.010 U	0.010 U	0.010 U	0.450 U
Bromomethane	NC	NC	NC	NC	NC	NC	0.010 U	0.009 U	0.010 U	0.710 U	0.460 U	0.010 U	0.009 U	0.010 U	0.026 U	0.010 U	0.010 U	0.028 U	0.010 U	0.010 U	0.010 U	0.450 U
Carbon Disulfide	NC	100	NC	2.7	NC	NC	0.010 U	0.009 U	0.010 U	0.710 U	0.460 U	0.010 U	0.009 U	0.010 U	0.026 U	0.010 U	0.010 U	0.028 U	0.010 U	0.010 U	0.010 U	0.450 U
Carbon Tetrachloride	0.76	NC	0.76	NC	22	NC	0.010 U	0.009 U	0.010 U	0.710 U	0.460 U	0.010 U	0.009 U	0.010 U	0.026 U	0.010 U	0.010 U	0.028 U	0.010 U	0.010 U	0.010 U	0.450 U
Chlorobenzene	1.1	NC	1.1	NC	500	NC	0.010 U	0.009 U	0.010 U	0.710 U	0.460 U	0.010 U	0.009 U	0.010 U	0.026 U	0.010 U	0.010 U	0.028 U	0.010 U	0.010 U	0.010 U	0.450 U
Chloroethane	NC	NC	NC	1.9	NC	NC	0.010 U	0.009 U	0.010 U	0.710 U	0.460 U	0.010 U	0.009 U	0.010 U	0.026 U	0.010 U	0.010 U	0.028 U	0.010 U	0.010 U	0.010 U	0.450 U
Chloroform	0.37	NC	0.37	NC	350	NC	0.010 U	0.009 U	0.010 U	0.710 U	0.460 U	0.010 U	0.009 U	0.010 U	0.026 U	0.010 U	0.010 U	0.028 U	0.010 U	0.010 U	0.010 U	0.450 U
Chloromethane	NC	NC	NC	NC	NC	NC	0.010 U	0.009 U	0.010 U	0.710 U	0.460 U	0.010 U	0.009 U	0.010 U	0.026 U	0.010 U	0.010 U	0.028 U	0.010 U	0.010 U	0.010 U	0.450 U
cis-1,2-Dichloroethylene	0.25	NC	0.25	NC	500	NC	0.010 U	0.009 U	0.010 U	0.710 U	0.460 U	0.010 U	0.009 U	0.010 U	0.026 U	0.010 U	0.010 U	0.028 U	0.010 U	0.010 U	0.010 U	0.450 U
cis-1,3-Dichloropropylene	NC	NC	NC	NC	NC	NC	0.010 U	0.009 U	0.010 U	0.710 U	0.460 U	0.010 U	0.009 U	0.010 U	0.026 U	0.010 U	0.010 U	0.028 U	0.010 U	0.010 U	0.010 U	0.450 U
Dibromochloromethane	NC	NC	NC	NC	NC	NC	0.010 U	0.009 U	0.010 U	0.710 U	0.460 U	0.010 U	0.009 U	0.010 U	0.026 U	0.010 U	0.010 U	0.028 U	0.010 U	0.010 U	0.010 U	0.450 U
Dichlorodifluoromethane	NC	NC	NC	NC	NC	NC	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Ethylbenzene	1	NC	1	NC	390	NC	0.010 U	0.009 U	0.010 U	0.710 U	0.460 U	0.010 U	0.009 U	0.010 U	0.026 U	0.010 U	0.010 U	0.028 U	0.010 U	0.010 U	0.010 U	0.450 U
Methylene chloride	0.05	NC	0.05	NC	500	NC	0.010 U	0.009 U	0.010 U	0.710 U	0.460 U	0.010 U	0.009 U	0.010 U	0.026 U	0.010 U	0.010 U	0.028 U	0.010 U	0.010 U	0.010 U	0.450 U
o-Xylene	NC	NC	NC	NC	NC	NC	0.010 U	0.009 U	0.010 U	0.710 U	0.460 U	0.010 U	0.009 U	0.010 U	0.026 U	0.010 U	0.010 U	0.028 U	0.010 U	0.010 U	0.010 U	0.450 U
Styrene	NC	NC	NC	NC	NC	NC	0.010 U	0.009 U	0.010 U	0.710 U	0.460 U	0.010 U	0.009 U	0.010 U	0.026 U	0.010 U	0.010 U	0.028 U	0.010 U	0.010 U	0.010 U	0.450 U
Tetrachloroethene	1.3	NC	1.3	NC	150	NC	0.010 U	0.009 U	0.010 U	0.710 U	0.460 U	0.028	0.069	0.010 U	0.026 U	0.010 U	0.010 U	0.028 U	0.010 U	0.010 U	0.010 U	0.450 U
Toluene	0.7	NC	0.7	NC	500	NC	0.010 U	0.009 U	0.010 U	0.710 U	0.460 U	0.010 U	0.009 U	0.010 U	0.026 U	0.010 U	0.010 U	0.028 U	0.010 U	0.010 U	0.010 U	0.450 U
Total BTEX	NC	NC	NC	NC	NC	NC	0.010 U	0.009 U	0.010 U	0.710 U	0.460 U	0.010 U	0.009 U	0.010 U	0.026 U	0.010 U	0.010 U	0.028 U	0.010 U	0.010 U	0.010 U	0.450 U
trans-1,2-Dichloroethylene	0.19	NC	0.19	NC	500	NC	0.010 U	0.009 U	0.010 U	0.710 U	0.460 U	0.010 U	0.009 U	0.010 U	0.026 U	0.010 U	0.010 U	0.028 U	0.010 U	0.010 U	0.010 U	0.450 U
trans-1,3-Dichloropropylene	NC	NC	NC	NC	NC	NC	0.010 U	0.009 U	0.010 U	0.710 U	0.460 U	0.010 U	0.009 U	0.010 U	0.026 U	0.010 U	0.010 U	0.028 U	0.010 U	0.010 U	0.010 U	0.450 U
Trichloroethylene	0.47	NC	0.47	NC	200	NC	0.010 U	0.009 U	0.010 U	0.710 U	0.460 U	0.010 U	0.009 U	0.010 U	0.026 U	0.010 U	0.010 U	0.028 U	0.010 U	0.010 U	0.010 U	0.450 U
Trichlorofluoromethane	NC	NC	NC	NC	NC	NC	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Vinyl Acetate	NC	NC	NC	NC	NC	NC	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Vinyl Chloride	0.02	NC	0.02	NC	13	NC	0.004 U	0.004 U	0.004 U	0.280 U	0.180 U	0.004 U	0.004 U	0.004 U	0.010 U	0.004 U	0.004 U	0.011 U	0.004 U	0.004 U	0.004 U	0.180 U
Xylene (m,p)	NC	NC	NC	NC	NC	NC	0.010 U	0.009 U	0.010 U	0.710 U	0.460 U	0.010 U	0.009 U	0.010 U	0.026 U	0.010 U	0.010 U	0.028 U	0.010 U	0.010 U	0.010 U	0.450 U
Xylene (total)	0.26	NC	1.6	NC	500	NC	0.010 U	0.009 U	0.010 U	0.710 U	0.460 U	0.010 U	0.009 U	0.010 U	0.026 U	0.010 U	0.010 U	0.028 U	0.010 U	0.010 U	0.010 U	0.450 U

Notes:

All units in micrograms per kilogram (µg/kg)

Bold - Exceeds 6 NYCRR Part 375 or CP-51 Protection of Groundwater Soil Cleanup Objectives

▨ - Exceeds 6 NYCRR Part 375 Unrestricted Soil Cleanup Objectives or CP-51 Residential Soil Cleanup Objectives

🟪 - Exceeds 6 NYCRR Part 375 or CP-51 Commercial Soil Cleanup Objectives

Exceeds 6 NYCRR Part 375 or CP-51 Commercial Soil Cleanup Objectives

ft bgs - feet below ground surface

NC - No criteria exists, NA - Not available

Sample Type Code: N - Normal, FD - Field Duplicate

U - Not Detected at the Detection Limit shown, J - Estimated value, UJ - Approximate Non-detect

B - Blank Contamination, BJ - Estimated Value Detected in Blank, ND - Not Detected

--- Not Analyzed

[1] 6 NYCRR Part 375, Table 375-6.8(b): Restricted Use Soil Cleanup Objectives, Protection of Public Health, Commercial, December 14, 2006.

[2] Final Commissioner Policy CP-51, Table 1: Supplimental Soil Cleanup Objectives, Residential, October 21, 2010.

[3] 6 NYCRR Part 375, Table 375-6.8(b): Restricted Use Soil Cleanup Objectives, Protection of Public Health, Protection of Groundwater, December 14, 2006.

[4] Final Commissioner Policy CP-51, Table 1: Supplimental Soil Cleanup Objectives, Protection of Groundwater, October 21, 2010.

[5] 6 NYCRR Part 375, Table 375-6.8(b): Unrestricted Use Soil Cleanup Objectives, Protection of Public Health, December 14, 2006.

[6] Final Commissioner Policy CP-51, Table 1: Supplimental Soil Cleanup Objectives, Commercial, October 21, 2010.

- Value qualified with a U per validation report dated March 6, 2006. Value reported in October 20, 2014 RIR did not reflect this qualifier.

$ - Value qualified with a J per validation report dated March 6, 2006. Value reported in October 20, 2014 RIR did not reflect this qualifier.

& - Value revised per laboratory data sheets presented in the Quantitative Environmental Survey dated April 1993. Value reported in October 20, 2014 RIR was incorrect.

^ - Value revised per laboratory data sheets presented in the Groundwater Investigation dated March 2000. Value reported in October 20, 2014 RIR was incorrect.

Table 3-1
VOC Analytical Results for Soil Samples at the Former RFM Site
Former ITT Rochester Form Machine Facility
Site #8-28-112
Town of Gates, New York

							Removed		Removed			Removed										
						Location	**BH-99-41**	**BH-99-42**	**BH-99-43**	**BH-99-44**	**BH-99-45**	**BH-99-46**	**CS-01**	**CS-02**	**CS-03**	**CS-04**	**CS-05**	**ITT-MW-1**	**ITT-MW-2**	**ITT-MW-3**	**ITT-MW-4**	**ITT-MW-4**
						Sample Date:	10/1/1999	10/1/1999	10/1/1999	10/1/1999	10/1/1999	10/1/1999	11/23/1999	11/23/1999	11/23/1999	11/24/1999	11/24/1999	10/23/1991	10/23/1991	10/23/1991	10/24/1991	10/24/1991
						Sample ID:	BH-99-41 (8-10)	BH-99-42 (4-6)	BH-99-43 (8-10)	BH-99-44 (8-10)	BH-99-45 (6-8)	BH-99-46 (6-8)	CS-01	CS-02	CS-03	CS-04	CS-05	MW-1(SOIL)10-23-91	MW-2(SOIL)10-23-91	MW-3(SOIL)10-23-91	MW-4 (1-2)10-24-91	MW-4 (6-8)10-24-91
						Start Depth (ft bgs):	8	4	8	8	6	6	7	6.5	7.5	7	9	8	6	4	1	6
						End Depth (ft bgs):	10	6	10	10	8	8	7	6.5	7.5	7	9	10	8	6	2	8
						Sample Type Code:	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Analyte	**Part 375 Unrestricted Use SCOs^1**	**NY CP-51 Residential Use SCOs^2**	**Part 375 Protection of Groundwater SCOs^3**	**NY CP-51 Protection of Groundwater SCOs^4**	**Part 375 Commercial Use SCOs^5**	**NY CP-51 Commercial Use SCOs^4**																
1,1,1,2-Tetrachloroethane	NC	NC	NC	NC	NC	NC	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
1,1,1-Trichloroethane	0.68	NC	0.68	NC	500	NC	**0.800**	0.012	0.045	**0.920**	0.016	0.085	0.011	0.029	0.006 U	0.006 U	0.006 U	0.004 J	**0.790**	0.006 U	0.001 J	0.006 U
1,1,2,2-Tetrachloroethane	NC	35	NC	0.6	NC	NC	0.027 U	0.010 U	0.010 U	0.026 U	0.010 U	0.009 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.028 U	0.006 U	0.006 U	0.006 U
1,1,2-Trichloroethane	NC	NC	NC	NC	NC	NC	0.027 U	0.010 U	0.010 U	0.026 U	0.010 U	0.009 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.011 J	0.006 U	0.006 U	0.006 U
1,1-Dichloroethane	0.27	NC	0.27	NC	240	NC	0.027 U	0.010 U	0.010 U	0.026 U	0.010 U	0.009 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.028 U	0.006 U	0.005 J &	0.006 U
1,1-Dichloroethylene	0.33	NC	0.33	NC	500	NC	0.027 U	0.010 U	0.010 U	0.026 U	0.010 U	0.009 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.028 U	0.006 U	0.006 U	0.006 U
1,2,3-Trichloropropane	NC	80	NC	0.34	NC	NC	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
1,2-Dibromo-3-Chloropropane	NC	NC	NC	NC	NC	NC	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
1,2-Dibromoethane	NC	NC	NC	NC	NC	NC	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
1,2-Dichloroethane	0.02	NC	0.02	NC	30	NC	0.027 U	0.010 U	0.010 U	0.026 U	0.010 U	0.009 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.012 J	0.006 U	0.006 U	0.006 U
1,2-Dichloroethene	NC	NC	NC	NC	NC	NC	---	---	---	---	---	---	---	---	---	---	---	0.006 U	0.028 U	0.006 U	0.006 U	0.006 U
1,2-Dichloropropane	NC	NC	NC	NC	NC	NC	0.027 U	0.010 U	0.010 U	0.026 U	0.010 U	0.009 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.028 U	0.006 U	0.006 U	0.006 U
2-Butanone	0.12	100	0.12	0.3	500	NC	0.130 U	0.049 U	0.048 U	0.130 U	0.048 U	0.046 U	0.031 U	0.032 U	0.030 U	0.031 U	0.029 U	0.011 U	0.057 U	0.012 U	0.012 U	0.013 U
2-Chloroethyl vinyl ether	NC	NC	NC	NC	NC	NC	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
2-Chlorotoluene	NC	NC	NC	NC	NC	NC	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
2-Hexanone	NC	NC	NC	NC	NC	NC	0.053 U	0.020 U	0.019 U	0.052 U	0.019 U	0.018 U	0.012 U	0.013 U	0.012 U	0.012 U	0.011 U	0.011 U	0.057 U	0.012 U	0.012 U	0.013 U
4-Chlorotoluene	NC	NC	NC	NC	NC	NC	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
4-Methyl-2-Pentanone	NC	NC	NC	1	NC	NC	0.053 U	0.020 U	0.019 U	0.052 U	0.019 U	0.018 U	0.012 U	0.013 U	0.012 U	0.012 U	0.011 U	0.011 U	0.057 U	0.012 U	0.012 U	0.013 U
Acetone	0.05	NC	0.05	NC	500	NC	0.130 U	0.049 U	0.048 U	0.130 U	0.048 U	0.046 U	0.031 U	0.032 U	0.030 U	0.031 U	0.029 U	0.003 BJ	0.014 BJ	0.007 BJ	0.003 BJ	0.006 BJ
Acrolein	NC	NC	NC	NC	NC	NC	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Acrylonitrile	NC	NC	NC	NC	NC	NC	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Benzene	0.06	NC	0.06	NC	44	NC	0.004 U	0.001 U	0.001 U	0.004 U	0.001 U	0.001 U	0.0009 U	0.0009 U	0.0009 U	0.0009 U	0.0008 U	0.006 U	0.028 U	0.006 U	0.006 U	0.006 U
Bromobenzene	NC	NC	NC	NC	NC	NC	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Bromodichloromethane	NC	NC	NC	NC	NC	NC	0.027 U	0.010 U	0.010 U	0.026 U	0.010 U	0.009 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.028 U	0.006 U	0.006 U	0.006 U
Bromoform	NC	NC	NC	NC	NC	NC	0.027 U	0.010 U	0.010 U	0.026 U	0.010 U	0.009 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.028 U	0.006 U	0.006 U	0.006 U
Bromomethane	NC	NC	NC	NC	NC	NC	0.027 U	0.010 U	0.010 U	0.026 U	0.010 U	0.009 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.011 U	0.057 U	0.012 U	0.012 U	0.013 U
Carbon Disulfide	NC	100	NC	2.7	NC	NC	0.027 U	0.010 U	0.010 U	0.026 U	0.010 U	0.009 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.028 U	0.006 U	0.006 U	0.006 U
Carbon Tetrachloride	0.76	NC	0.76	NC	22	NC	0.027 U	0.010 U	0.010 U	0.026 U	0.010 U	0.009 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.028 U	0.006 U	0.006 U	0.006 U
Chlorobenzene	1.1	NC	1.1	NC	500	NC	0.027 U	0.010 U	0.010 U	0.026 U	0.010 U	0.009 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.028 U	0.006 U	0.006 U	0.006 U
Chloroethane	NC	NC	NC	1.9	NC	NC	0.027 U	0.010 U	0.010 U	0.026 U	0.010 U	0.009 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.011 U	0.057 U	0.012 U	0.012 U	0.013 U
Chloroform	0.37	NC	0.37	NC	350	NC	0.027 U	0.010 U	0.010 U	0.026 U	0.010 U	0.009 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.028 U	0.006 U	0.006 U	0.006 U
Chloromethane	NC	NC	NC	NC	NC	NC	0.027 U	0.010 U	0.010 U	0.026 U	0.010 U	0.009 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.011 U	0.057 U	0.012 U	0.012 U	0.013 U
cis-1,2-Dichloroethylene	0.25	NC	0.25	NC	500	NC	0.027 U	0.010 U	0.010 U	0.026 U	0.010 U	0.009 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	---	---	---	---	---
cis-1,3-Dichloropropylene	NC	NC	NC	NC	NC	NC	0.027 U	0.010 U	0.010 U	0.026 U	0.010 U	0.009 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.028 U	0.006 U	0.006 U	0.006 U
Dibromochloromethane	NC	NC	NC	NC	NC	NC	0.027 U	0.010 U	0.010 U	0.026 U	0.010 U	0.009 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.028 U	0.006 U	0.006 U	0.006 U
Dichlorodifluoromethane	NC	NC	NC	NC	NC	NC	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Ethylbenzene	1	NC	1	NC	390	NC	0.027 U	0.010 U	0.010 U	0.026 U	0.010 U	0.009 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.028 U	0.006 U	0.006 U	0.006 U
Methylene chloride	0.05	NC	0.05	NC	500	NC	0.027 U	0.010 U	0.010 U	0.026 U	0.010 U	0.009 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.003 BJ	0.011 BJ	0.003 BJ	0.002 BJ	0.003 BJ
o-Xylene	NC	NC	NC	NC	NC	NC	0.027 U	0.010 U	0.010 U	0.026 U	0.010 U	0.009 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	---	---	---	---	---
Styrene	NC	NC	NC	NC	NC	NC	0.027 U	0.010 U	0.010 U	0.026 U	0.010 U	0.009 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.028 U	0.006 U	0.006 U	0.006 U
Tetrachloroethene	1.3	NC	1.3	NC	150	NC	0.027 U	0.010 U	0.010 U	0.026 U	0.010 U	0.009 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.017 J	0.006 U	0.006 U	0.002 J
Toluene	0.7	NC	0.7	NC	500	NC	0.027 U	0.010 U	0.010 U	0.026 U	0.010 U	0.009 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.028 U	0.006 U	0.003 BJ	0.003 BJ
Total BTEX	NC	NC	NC	NC	NC	NC	0.027 U	0.010 U	0.010 U	0.026 U	0.010 U	0.009 U	0.006 U	0.006 U	0.006 U	0.006 U	0.8 U	0.006 U	0.028 U	0.006 U	0.003	0.003
trans-1,2-Dichloroethylene	0.19	NC	0.19	NC	500	NC	0.027 U	0.010 U	0.010 U	0.026 U	0.010 U	0.009 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	---	---	---	---	---
trans-1,3-Dichloropropylene	NC	NC	NC	NC	NC	NC	0.027 U	0.010 U	0.010 U	0.026 U	0.010 U	0.009 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.028 U	0.006 U	0.006 U	0.006 U
Trichloroethylene	0.47	NC	0.47	NC	200	NC	0.027 U	0.010 U	0.010 U	0.026 U	0.010 U	0.009 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.058	0.006 U	0.006 U	0.006 U
Trichlorofluoromethane	NC	NC	NC	NC	NC	NC	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Vinyl Acetate	NC	NC	NC	NC	NC	NC	---	---	---	---	---	---	---	---	---	---	---	0.011 U	0.057 U	0.012 U	0.012 U	0.013 U
Vinyl Chloride	0.02	NC	0.02	NC	13	NC	0.011 U	0.004 U	0.004 U	0.010 U	0.004 U	0.004 U	0.002 U	0.003 U	0.002 U	0.002 U	0.002 U	0.011 U	0.057 U	0.012 U	0.012 U	0.013 U
Xylene (m,p)	NC	NC	NC	NC	NC	NC	0.027 U	0.010 U	0.010 U	0.026 U	0.010 U	0.009 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	---	---	---	---	---
Xylene (total)	0.26	NC	1.6	NC	500	NC	0.027 U	0.010 U	0.010 U	0.026 U	0.010 U	0.009 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.028 U	0.006 U	0.006 U	0.006 U

Notes:

All units in micrograms per kilogram (µg/kg)

Bold - Exceeds 6 NYCRR Part 375 or CP-51 Protection of Groundwater Soil Cleanup Objectives

▨ - Exceeds 6 NYCRR Part 375 Unrestricted Soil Cleanup Objectives or CP-51 Residential Soil Cleanup Objectives

🟪 - Exceeds 6 NYCRR Part 375 or CP-51 Commercial Soil Cleanup Objectives

Exceeds 6 NYCRR Part 375 or CP-51 Commercial Soil Cleanup Objectives

ft bgs - feet below ground surface

NC - No criteria exists, NA - Not available

Sample Type Code: N - Normal, FD - Field Duplicate

U - Not Detected at the Detection Limit shown, J - Estimated value, UJ - Approximate Non-detect

B - Blank Contamination, BJ - Estimated Value Detected in Blank, ND - Not Detected

--- Not Analyzed

[1] 6 NYCRR Part 375, Table 375-6.8(b): Restricted Use Soil Cleanup Objectives, Protection of Public Health, Commercial, December 14, 2006.

[2] Final Commissioner Policy CP-51, Table 1: Supplimental Soil Cleanup Objectives, Residential, October 21, 2010.

[3] 6 NYCRR Part 375, Table 375-6.8(b): Restricted Use Soil Cleanup Objectives, Protection of Public Health, Protection of Groundwater, December 14, 2006.

[4] Final Commissioner Policy CP-51, Table 1: Supplimental Soil Cleanup Objectives, Protection of Groundwater, October 21, 2010.

[5] 6 NYCRR Part 375, Table 375-6.8(b): Unrestricted Use Soil Cleanup Objectives, Protection of Public Health, December 14, 2006.

[6] Final Commissioner Policy CP-51, Table 1: Supplimental Soil Cleanup Objectives, Commercial, October 21, 2010.

- Value qualified with a U per validation report dated March 6, 2006. Value reported in October 20, 2014 RIR did not reflect this qualifier.

$ - Value qualified with a J per validation report dated March 6, 2006. Value reported in October 20, 2014 RIR did not reflect this qualifier.

& - Value revised per laboratory data sheets presented in the Quantitative Environmental Survey dated April 1993. Value reported in October 20, 2014 RIR was incorrect.

^ - Value revised per laboratory data sheets presented in the Groundwater Investigation dated March 2000. Value reported in October 20, 2014 RIR was incorrect.

Table 3-1
VOC Analytical Results for Soil Samples at the Former RFM Site
Former ITT Rochester Form Machine Facility
Site #8-28-112
Town of Gates, New York

Location							ITT-SBW-1A	ITT-SBW-2	ITT-SBW-2	ITT-SBW-2	ITT-SBW-3	ITT-SBW-3	ITT-SBW-3	ITT-SBW-3	ITT-SBW-3	ITT-SBW-3	ITT-SBW-3	ITT-SBW-3	ITT-SBW-4	ITT-SBW-5A	ITT-SBW-6	ITT-SBW-7
Sample Date:							8/17/1998	8/17/1998	8/17/1998	8/17/1998	8/17/1998	8/17/1998	8/17/1998	8/17/1998	8/17/1998	8/17/1998	8/17/1998	8/17/1998	3/1/1999	3/2/1999	3/3/1999	3/3/1999
Sample ID:							N04601	SBW-2 (4-6)	N04602	N04603	SBW-3 (2-4)	N04604	SBW-3 (4-6)	N04605	SBW-3 (6-8)	N04606	SBW-3 (8-10)	N04607	SBW-4(7-8.7)	SBW-5A(8-9.8)	SBW-6(8-9)	SBW-7(8-9.8)
Start Depth (ft bgs):							10	4	4	6	2	2	4	4	6	6	8	8	7	8	8	8
End Depth (ft bgs):							12	6	6	8	4	4	6	6	8	8	10	10	8.7	9.8	9	9.8
Sample Type Code:							N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Analyte	Part 375 Unrestricted Use SCOs¹	NY CP-51 Residential Use SCOs²	Part 375 Protection of Groundwater SCOs³	NY CP-51 Protection of Groundwater SCOs⁴	Part 375 Commercial Use SCOs⁵	NY CP-51 Commercial Use SCOs⁴	NYSDEC Sample		NYSDEC Sample	NYSDEC Sample		NYSDEC Sample		NYSDEC Sample		NYSDEC Sample		NYSDEC Sample				
1,1,1,2-Tetrachloroethane	NC	NC	NC	NC	NC	NC	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
1,1,1-Trichloroethane	0.68	NC	0.68	NC	500	NC	0.063	ND	0.011 U	0.070	0.11	**0.740**	**2.1 E**	0.093	0.068	0.028	0.420 E	0.340 D	0.006 U	0.015	0.005 U	0.039
1,1,2,2-Tetrachloroethane	NC	35	NC	0.6	NC	NC	0.011 U	---	0.011 U	0.011 U	---	0.063 U	---	0.011 U	---	0.011 U	---	0.012 U	0.006 U	0.005 U	0.005 U	0.006 U
1,1,2-Trichloroethane	NC	NC	NC	NC	NC	NC	0.011 U	ND	0.011 U	0.011 U	0.007 J	0.018 J	ND	0.009 J	ND	0.011 U	ND	0.011 J	0.006 U	0.005 U	0.005 U	0.006 U
1,1-Dichloroethane	0.27	NC	0.27	NC	240	NC	0.011 U	---	0.011 U	0.011 U	---	0.031 J	---	0.011 U	---	0.011 U	---	0.012 U	0.006 U	0.005 U	0.005 U	0.006 U
1,1-Dichloroethylene	0.33	NC	0.33	NC	500	NC	0.011 U	ND	0.011 U	0.002 J	ND	0.043 J	0.006 J	0.011 U	ND	0.011 U	ND	0.012 U	0.006 U	0.005 U	0.005 U	0.006 U
1,2,3-Trichloropropane	NC	80	NC	0.34	NC	NC	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
1,2-Dibromo-3-Chloropropane	NC	NC	NC	NC	NC	NC	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
1,2-Dibromoethane	NC	NC	NC	NC	NC	NC	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
1,2-Dichloroethane	0.02	NC	0.02	NC	30	NC	0.011 U	---	0.011 U	0.011 U	---	0.063 U	---	0.006 J	---	0.011 U	---	0.012 U	0.006 U	0.005 U	0.005 U	0.006 U
1,2-Dichloroethene	NC	NC	NC	NC	NC	NC	0.011 U	---	0.011 U	0.011 U	---	0.063 U	---	0.011 U	---	0.011 U	---	0.012 U	---	---	---	---
1,2-Dichloropropane	NC	NC	NC	NC	NC	NC	0.011 U	---	0.011 U	0.011 U	---	0.063 U	---	0.011 U	---	0.011 U	---	0.012 U	0.006 U	0.005 U	0.005 U	0.006 U
2-Butanone	0.12	100	0.12	0.3	500	NC	0.011 U	0.007 J	0.011 U	0.011 U	0.004 J	0.063 U	ND	0.011 U	ND	0.011 U	ND	0.012 U	0.028 U	0.026 U	0.026 U	0.028 U
2-Chloroethyl vinyl ether	NC	NC	NC	NC	NC	NC	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
2-Chlorotoluene	NC	NC	NC	NC	NC	NC	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
2-Hexanone	NC	NC	NC	NC	NC	NC	0.011 U	---	0.011 U	0.011 U	---	0.063 U	---	0.011 U	---	0.011 U	---	0.012 U	0.011 U	0.010 U	0.011 U	0.011 U
4-Chlorotoluene	NC	NC	NC	NC	NC	NC	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
4-Methyl-2-Pentanone	NC	NC	NC	1	NC	NC	---	---	---	---	---	---	---	---	---	---	---	---	0.011 U	0.010 U	0.011 U	0.011 U
Acetone	0.05	NC	0.05	NC	500	NC	0.009 J	0.008 J	0.011 U	0.011 U	ND	0.059 J	ND	0.010 J	ND	0.009 J	ND	0.012 U	0.028 U	0.026 U	0.026 U	0.028 U
Acrolein	NC	NC	NC	NC	NC	NC	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Acrylonitrile	NC	NC	NC	NC	NC	NC	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Benzene	0.06	NC	0.06	NC	44	NC	0.001 J	ND	0.011 U	0.011 U	ND	0.063 U	ND	0.011 U	ND	0.011 U	0.002 J	0.012 U	0.0008 U	0.0007 U	0.0007 U	0.0007 U
Bromobenzene	NC	NC	NC	NC	NC	NC	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Bromodichloromethane	NC	NC	NC	NC	NC	NC	0.011 U	---	0.011 U	0.011 U	---	0.063 U	---	0.011 U	---	0.011 U	---	0.012 U	0.006 U	0.005 U	0.005 U	0.006 U
Bromoform	NC	NC	NC	NC	NC	NC	0.011 U	---	0.011 U	0.011 U	---	0.063 U	---	0.011 U	---	0.011 U	---	0.012 U	0.006 U	0.005 U	0.005 U	0.006 U
Bromomethane	NC	NC	NC	NC	NC	NC	0.011 U	---	0.011 U	0.011 U	---	0.063 U	---	0.011 U	---	0.011 U	---	0.012 U	0.006 U	0.005 U	0.005 U	0.006 U
Carbon Disulfide	NC	100	NC	2.7	NC	NC	0.011 U	---	0.011 U	0.011 U	---	0.063 U	---	0.011 U	---	0.011 U	---	0.012 U	0.006 U	0.005 U	0.005 U	0.006 U
Carbon Tetrachloride	0.76	NC	0.76	NC	22	NC	0.011 U	---	0.011 U	0.011 U	---	0.063 U	---	0.011 U	---	0.011 U	---	0.012 U	0.006 U	0.005 U	0.005 U	0.006 U
Chlorobenzene	1.1	NC	1.1	NC	500	NC	0.011 U	---	0.011 U	0.011 U	---	0.063 U	---	0.011 U	---	0.011 U	---	0.012 U	0.006 U	0.005 U	0.005 U	0.006 U
Chloroethane	NC	NC	NC	1.9	NC	NC	0.011 U	---	0.011 U	0.011 U	---	0.063 U	---	0.011 U	---	0.011 U	---	0.012 U	0.006 U	0.005 U	0.005 U	0.006 U
Chloroform	0.37	NC	0.37	NC	350	NC	0.011 U	---	0.011 U	0.011 U	---	0.063 U	---	0.011 U	---	0.011 U	---	0.012 U	0.006 U	0.005 U	0.005 U	0.006 U
Chloromethane	NC	NC	NC	NC	NC	NC	0.011 U	---	0.011 U	0.011 U	---	0.063 U	---	0.011 U	---	0.011 U	---	0.012 U	0.006 U	0.005 U	0.005 U	0.006 U
cis-1,2-Dichloroethylene	0.25	NC	0.25	NC	500	NC	---	---	---	---	---	---	---	---	---	---	---	---	0.006 U	0.005 U	0.005 U	0.006 U
cis-1,3-Dichloropropylene	NC	NC	NC	NC	NC	NC	0.011 U	---	0.011 U	0.011 U	---	0.063 U	---	0.011 U	---	0.011 U	---	0.012 U	0.006 U	0.005 U	0.005 U	0.006 U
Dibromochloromethane	NC	NC	NC	NC	NC	NC	0.011 U	---	0.011 U	0.011 U	---	0.063 U	---	0.011 U	---	0.011 U	---	0.012 U	0.006 U	0.005 U	0.005 U	0.006 U
Dichlorodifluoromethane	NC	NC	NC	NC	NC	NC	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Ethylbenzene	1	NC	1	NC	390	NC	0.011 U	ND	0.011 U	0.011 U	ND	0.063 U	0.005 J	0.011 U	ND	0.011 U	ND	0.001 J	0.006 U	0.005 U	0.005 U	0.006 U
Methylene chloride	0.05	NC	0.05	NC	500	NC	0.011 U	---	0.011 U	0.011 U	---	0.063 U	---	0.011 U	---	0.011 U	---	0.012 U	0.006 U	0.005 U	0.005 U	0.006 U
o-Xylene	NC	NC	NC	NC	NC	NC	---	---	---	---	---	---	---	---	---	---	---	---	0.006 U	0.005 U	0.005 U	0.006 U
Styrene	NC	NC	NC	NC	NC	NC	0.011 U	---	0.011 U	0.011 U	---	0.063 U	---	0.011 U	---	0.011 U	---	0.012 U	0.006 U	0.005 U	0.005 U	0.006 U
Tetrachloroethene	1.3	NC	1.3	NC	150	NC	0.004 J	ND	0.011 U	0.011 U	ND	0.007 J	0.05	0.002 J	ND	0.011 U	0.003 J	0.005 J	0.006 U	0.005 U	0.005 U	0.01
Toluene	0.7	NC	0.7	NC	500	NC	0.006 J	ND	0.011 U	0.001 J	ND	0.063 U	ND	0.011 U	ND	0.011 U	0.002 J	0.003 J	0.006 U	0.005 U	0.005 U	0.006 U
Total BTEX	NC	NC	NC	NC	NC	NC	0.013		0.011 U	0.001		0.063 U		0.006		0.011 U		0.013				
trans-1,2-Dichloroethylene	0.19	NC	0.19	NC	500	NC	---	---	---	---	---	---	---	---	---	---	---	---	0.006 U	0.005 U	0.005 U	0.006 U
trans-1,3-Dichloropropylene	NC	NC	NC	NC	NC	NC	0.011 U	---	0.011 U	0.011 U	---	0.063 U	---	0.011 U	---	0.011 U	---	0.012 U	0.006 U	0.005 U	0.005 U	0.006 U
Trichloroethylene	0.47	NC	0.47	NC	200	NC	0.008 J	ND	0.011 U	0.002 J	0.017	**0.710**	0.1	0.036	0.006 J	0.004 J	0.023	0.092	0.006 U	0.005 U	0.005 U	0.006 U
Trichlorofluoromethane	NC	NC	NC	NC	NC	NC	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Vinyl Acetate	NC	NC	NC	NC	NC	NC	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Vinyl Chloride	0.02	NC	0.02	NC	13	NC	0.011 U	---	0.011 U	0.011 U	---	0.063 U	---	0.011 U	---	0.011 U	---	0.012 U	0.002 U	0.002 U	0.002 U	0.002 U
Xylene (m,p)	NC	NC	NC	NC	NC	NC	---	ND	---	---	ND	---	0.004 J	---	ND	---	ND	---	0.006 U	---	---	0.006 U
Xylene (total)	0.26	NC	1.6	NC	500	NC	0.006 J	ND	0.011 U	0.011 U	ND	0.063 U	0.004 J	0.006 J	ND	0.011 U	ND	0.009 J	0.006 U	0.005 U	0.005 U	0.006 U

Notes:
All units in micrograms per kilogram (µg/kg)
Bold - Exceeds 6 NYCRR Part 375 or CP-51 Protection of Groundwater Soil Cleanup Objectives
▨ - Exceeds 6 NYCRR Part 375 Unrestricted Soil Cleanup Objectives or CP-51 Residential Soil Cleanup Objectives
🟪 - Exceeds 6 NYCRR Part 375 or CP-51 Commercial Soil Cleanup Objectives
Exceeds 6 NYCRR Part 375 or CP-51 Commercial Soil Cleanup Objectives
ft bgs - feet below ground surface
NC - No criteria exists, NA - Not available
Sample Type Code: N - Normal, FD - Field Duplicate
U - Not Detected at the Detection Limit shown, J - Estimated value, UJ - Approximate Non-detect
B - Blank Contamination, BJ - Estimated Value Detected in Blank, ND - Not Detected
--- Not Analyzed

[1] 6 NYCRR Part 375, Table 375-6.8(b): Restricted Use Soil Cleanup Objectives, Protection of Public Health, Commercial, December 14, 2006.

[2] Final Commissioner Policy CP-51, Table 1: Supplimental Soil Cleanup Objectives, Residential, October 21, 2010.

[3] 6 NYCRR Part 375, Table 375-6.8(b): Restricted Use Soil Cleanup Objectives, Protection of Public Health, Protection of Groundwater, December 14, 2006.

[4] Final Commissioner Policy CP-51, Table 1: Supplimental Soil Cleanup Objectives, Protection of Groundwater, October 21, 2010.

[5] 6 NYCRR Part 375, Table 375-6.8(b): Unrestricted Use Soil Cleanup Objectives, Protection of Public Health, December 14, 2006.

[6] Final Commissioner Policy CP-51, Table 1: Supplimental Soil Cleanup Objectives, Commercial, October 21, 2010.

- Value qualified with a U per validation report dated March 6, 2006. Value reported in October 20, 2014 RIR did not reflect this qualifier.
$ - Value qualified with a J per validation report dated March 6, 2006. Value reported in October 20, 2014 RIR did not reflect this qualifier.
& - Value revised per laboratory data sheets presented in the Quantitative Environmental Survey dated April 1993. Value reported in October 20, 2014 RIR was incorrect.
^ - Value revised per laboratory data sheets presented in the Groundwater Investigation dated March 2000. Value reported in October 20, 2014 RIR was incorrect.

Table 3-1
VOC Analytical Results for Soil Samples at the Former RFM Site
Former ITT Rochester Form Machine Facility
Site #8-28-112
Town of Gates, New York

Location							ITT-SBW-8	OBG-SB-1	OBG-SB-1	OBG-SB-2	OBG-SB-2	OBG-SB-3	OBG-SB-3	OBG-SB-4	OBG-SB-4	OBG-SB-5	OBG-SB-5	OBG-SB-6	OBG-SB-6	OBG-SB-7	OBG-SB-7	OBG-SB-8
Sample Date:							4/12/1999	8/30/2004	8/30/2004	8/30/2004	8/30/2004	8/30/2004	8/30/2004	8/30/2004	8/30/2004	8/30/2004	8/30/2004	8/31/2004	8/31/2004	8/31/2004	8/31/2004	8/31/2004
Sample ID:							SBW-8(8-9.1)	OBG-SB-1 (0-2)	OBG-SB-1 (9-10)	OBG-SB-2 (2-4)	OBG-SB-2 (9-10)	OBG-SB-3 (2-4)	OBG-SB-3 (7-9'	OBG-SB-4 (4-6')	OBG-SB-4 (9.5-10.5'	OBG-SB-5 (7.5-9)	OBG-SB-5 (9-10.5)	OBG-SB-6 (0-2)	OBG-SB-6 (8.5-10.5)	OBG-SB-7 (4-6)	OBG-SB-7 (8.5-10.5)	OBG-SB-8 (1.5-3)
Start Depth (ft bgs):							8	0	9	2	9	2	7	4	9.5	7.5	9	0	8.5	4	8.5	1.5
End Depth (ft bgs):							9.1	2	10	4	10	4	9	6	10.5	9	10.5	2	10.5	6	10.5	3
Sample Type Code:							N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Analyte	Part 375 Unrestricted Use SCOs^1	NY CP-51 Residential Use SCOs^2	Part 375 Protection of Groundwater SCOs^3	NY CP-51 Protection of Groundwater SCOs^4	Part 375 Commercial Use SCOs^5	NY CP-51 Commercial Use SCOs^4																
1,1,1,2-Tetrachloroethane	NC	NC	NC	NC	NC	NC	0.005 U	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
1,1,1-Trichloroethane	0.68	NC	0.68	NC	500	NC	0.005 U	0.001 J	0.17	0.003 U	0.021	0.003 U	0.022	0.001 J	0.006	0.003 U	0.013	0.003 U	0.005	0.002 J	0.01	0.004
1,1,2,2-Tetrachloroethane	NC	35	NC	0.6	NC	NC	0.005 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U
1,1,2-Trichloroethane	NC	NC	NC	NC	NC	NC	0.005 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.0008 J	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U
1,1-Dichloroethane	0.27	NC	0.27	NC	240	NC	0.005 U	0.003 U	0.007	0.003 U	0.003 U	0.003 U	0.0009 J	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.001 J	0.003	0.004
1,1-Dichloroethylene	0.33	NC	0.33	NC	500	NC	0.005 U	0.003 U	**0.43**	0.003 U	0.028	0.003 U	0.069	0.001 J	0.011	0.003 U	0.021	0.003 U	0.004	0.003 U	0.013	0.001 J
1,2,3-Trichloropropane	NC	80	NC	0.34	NC	NC	0.005 U	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
1,2-Dibromo-3-Chloropropane	NC	NC	NC	NC	NC	NC	0.005 U	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
1,2-Dibromoethane	NC	NC	NC	NC	NC	NC	0.005 U	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
1,2-Dichloroethane	0.02	NC	0.02	NC	30	NC	0.005 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U
1,2-Dichloroethene	NC	NC	NC	NC	NC	NC	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
1,2-Dichloropropane	NC	NC	NC	NC	NC	NC	0.005 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U
2-Butanone	0.12	100	0.12	0.3	500	NC	0.026 U	0.01 U	0.011 U	0.011 U	0.011 U	0.011 U	0.013 U	0.012 U	0.011 U	0.012 U	0.011 U	0.012 U	0.011 U	0.012 U	0.011 U	0.037
2-Chloroethyl vinyl ether	NC	NC	NC	NC	NC	NC	0.005 U	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
2-Chlorotoluene	NC	NC	NC	NC	NC	NC	0.005 U	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
2-Hexanone	NC	NC	NC	NC	NC	NC	0.011 U	0.005 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U
4-Chlorotoluene	NC	NC	NC	NC	NC	NC	0.005 U	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
4-Methyl-2-Pentanone	NC	NC	NC	1	NC	NC	0.011 U	0.005 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U
Acetone	0.05	NC	0.05	NC	500	NC	0.026 U	0.01 U	0.011 U	0.011 U #	0.011 U#	0.011 U	0.006 U #	0.012 U	0.011 U	0.012 U	0.011 U	0.012 U	0.011 U	0.012 U	0.011 U #	**0.14**
Acrolein	NC	NC	NC	NC	NC	NC	0.021 U	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Acrylonitrile	NC	NC	NC	NC	NC	NC	0.021 U	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Benzene	0.06	NC	0.06	NC	44	NC	0.0007 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U
Bromobenzene	NC	NC	NC	NC	NC	NC	0.005 U	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Bromodichloromethane	NC	NC	NC	NC	NC	NC	0.005 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U
Bromoform	NC	NC	NC	NC	NC	NC	0.005 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U
Bromomethane	NC	NC	NC	NC	NC	NC	0.005 U	0.005 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U
Carbon Disulfide	NC	100	NC	2.7	NC	NC	0.005 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003
Carbon Tetrachloride	0.76	NC	0.76	NC	22	NC	0.005 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U
Chlorobenzene	1.1	NC	1.1	NC	500	NC	0.005 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U
Chloroethane	NC	NC	NC	1.9	NC	NC	0.005 U	0.005 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U
Chloroform	0.37	NC	0.37	NC	350	NC	0.005 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U
Chloromethane	NC	NC	NC	NC	NC	NC	0.005 U	0.005 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U
cis-1,2-Dichloroethylene	0.25	NC	0.25	NC	500	NC	0.005 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U
cis-1,3-Dichloropropylene	NC	NC	NC	NC	NC	NC	0.005 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U
Dibromochloromethane	NC	NC	NC	NC	NC	NC	0.005 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U
Dichlorodifluoromethane	NC	NC	NC	NC	NC	NC	0.005 U	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Ethylbenzene	1	NC	1	NC	390	NC	0.005 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U
Methylene chloride	0.05	NC	0.05	NC	500	NC	0.005 U	0.005 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U #	0.006 U
o-Xylene	NC	NC	NC	NC	NC	NC	0.005 U	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Styrene	NC	NC	NC	NC	NC	NC	0.005 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U
Tetrachloroethene	1.3	NC	1.3	NC	150	NC	0.005 U	0.003 U	0.025	0.003 U	0.001 J	0.001 J	0.015	0.015	0.008	0.003 U	0.003 U	0.003 U	0.003 U	0.0007 J	0.003 U	0.001 J
Toluene	0.7	NC	0.7	NC	500	NC	---	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U
Total BTEX	NC	NC	NC	NC	NC	NC		0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U
trans-1,2-Dichloroethylene	0.19	NC	0.19	NC	500	NC	0.005 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U
trans-1,3-Dichloropropylene	NC	NC	NC	NC	NC	NC	0.005 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U
Trichloroethylene	0.47	NC	0.47	NC	200	NC	0.005 U	0.003 U	0.015	0.003 U	0.003	0.003 U	0.005	0.0009 J	0.001 J	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.0008 J	0.001 J
Trichlorofluoromethane	NC	NC	NC	NC	NC	NC	0.005 U	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Vinyl Acetate	NC	NC	NC	NC	NC	NC	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Vinyl Chloride	0.02	NC	0.02	NC	13	NC	0.002 U	0.005 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 UJ	0.006 U	0.006 UJ
Xylene (m,p)	NC	NC	NC	NC	NC	NC	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Xylene (total)	0.26	NC	1.6	NC	500	NC	0.005 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U

Notes:
All units in micrograms per kilogram (µg/kg)
Bold - Exceeds 6 NYCRR Part 375 or CP-51 Protection of Groundwater Soil Cleanup Objectives
▨ - Exceeds 6 NYCRR Part 375 Unrestricted Soil Cleanup Objectives or CP-51 Residential Soil Cleanup Objectives
🟪 - Exceeds 6 NYCRR Part 375 or CP-51 Commercial Soil Cleanup Objectives
Exceeds 6 NYCRR Part 375 or CP-51 Commercial Soil Cleanup Objectives
ft bgs - feet below ground surface
NC - No criteria exists, NA - Not available
Sample Type Code: N - Normal, FD - Field Duplicate
U - Not Detected at the Detection Limit shown, J - Estimated value, UJ - Approximate Non-detect
B - Blank Contamination, BJ - Estimated Value Detected in Blank, ND - Not Detected
--- Not Analyzed

[1] 6 NYCRR Part 375, Table 375-6.8(b): Restricted Use Soil Cleanup Objectives, Protection of Public Health, Commercial, December 14, 2006.

[2] Final Commissioner Policy CP-51, Table 1: Supplimental Soil Cleanup Objectives, Residential, October 21, 2010.

[3] 6 NYCRR Part 375, Table 375-6.8(b): Restricted Use Soil Cleanup Objectives, Protection of Public Health, Protection of Groundwater, December 14, 2006.

[4] Final Commissioner Policy CP-51, Table 1: Supplimental Soil Cleanup Objectives, Protection of Groundwater, October 21, 2010.

[5] 6 NYCRR Part 375, Table 375-6.8(b): Unrestricted Use Soil Cleanup Objectives, Protection of Public Health, December 14, 2006.

[6] Final Commissioner Policy CP-51, Table 1: Supplimental Soil Cleanup Objectives, Commercial, October 21, 2010.

- Value qualified with a U per validation report dated March 6, 2006. Value reported in October 20, 2014 RIR did not reflect this qualifier.
$ - Value qualified with a J per validation report dated March 6, 2006. Value reported in October 20, 2014 RIR did not reflect this qualifier.
& - Value revised per laboratory data sheets presented in the Quantitative Environmental Survey dated April 1993. Value reported in October 20, 2014 RIR was incorrect.
^ - Value revised per laboratory data sheets presented in the Groundwater Investigation dated March 2000. Value reported in October 20, 2014 RIR was incorrect.

Table 3-1
VOC Analytical Results for Soil Samples at the Former RFM Site
Former ITT Rochester Form Machine Facility
Site #8-28-112
Town of Gates, New York

						Location	**OBG-SB-8**	**OBG-SB-9**	**OBG-SB-9**	**OBG-SB-10**	**OBG-SB-10**	**OBG-SB-11**	**OBG-SB-11**	**OBG-SB-12**	**OBG-SB-12**	**OBG-SB-13**	**OBG-SB-13**	**OBG-SB-14**	**OBG-SB-14**	**OBG-SB-15**	**OBG-SB-15**	**OBG-SB-16**
						Sample Date:	8/31/2004	8/31/2004	8/31/2004	8/31/2004	8/31/2004	8/31/2004	8/31/2004	8/31/2004	8/31/2004	8/31/2004	8/31/2004	8/31/2004	8/31/2004	8/31/2004	8/31/2004	9/1/2004
						Sample ID:	OBG-SB-8 (7-9)	OBG-SB-9 (2-4)	OBG-SB-9 (8-10)	OBG-SB-10 (4-6)	OBG-SB-10 (7-9)	OBG-SB-11 (9-10)	OBG-SB-11 (10-11)	OBG-SB-12 (4-5)	OBG-SB-12 (5-7)	OBG-SB-13 (7-8)	OBG-SB-13 (9.5-10.5	OBG-SB-14 (2-3)	OBG-SB-14 (9-10.5)	OBG-SB-15 (0-2)	OBG-SB-15 (8-9)	DUP-1_09012004
						Start Depth (ft bgs):	7	2	8	4	7	9	10	4	5	7	9.5	2	9	0	8	5
						End Depth (ft bgs):	9	4	10	6	9	10	11	5	7	8	10.5	3	10.5	2	9	7.5
						Sample Type Code:	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	FD
Analyte	**Part 375 Unrestricted Use SCOs[1]**	**NY CP-51 Residential Use SCOs[2]**	**Part 375 Protection of Groundwater SCOs[3]**	**NY CP-51 Protection of Groundwater SCOs[4]**	**Part 375 Commercial Use SCOs[5]**	**NY CP-51 Commercial Use SCOs[4]**																
1,1,1,2-Tetrachloroethane	NC	NC	NC	NC	NC	NC	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
1,1,1-Trichloroethane	0.68	NC	0.68	NC	500	NC	0.002 J	0.003	0.007	0.098	0.059	0.22	0.23	0.29	0.4	0.1	**0.71**	0.007	0.004	0.001 J	0.004	0.079
1,1,2,2-Tetrachloroethane	NC	35	NC	0.6	NC	NC	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.006 U	0.007 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U
1,1,2-Trichloroethane	NC	NC	NC	NC	NC	NC	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.001 J	0.006 U	0.007 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U
1,1-Dichloroethane	0.27	NC	0.27	NC	240	NC	0.007	0.001 J	0.008	0.003 U	0.003 U	0.003 U	0.003 U	0.006 U	0.007 U	0.001 J	0.004	0.007	0.004	0.003 U	0.005	0.074
1,1-Dichloroethylene	0.33	NC	0.33	NC	500	NC	0.003 U	0.003 U	0.002 J	0.023	0.003	0.028	0.026	0.006 J	0.008	0.011	0.082	0.002 J	0.003 U	0.003 U	0.002 J	0.001 J
1,2,3-Trichloropropane	NC	80	NC	0.34	NC	NC	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
1,2-Dibromo-3-Chloropropane	NC	NC	NC	NC	NC	NC	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
1,2-Dibromoethane	NC	NC	NC	NC	NC	NC	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
1,2-Dichloroethane	0.02	NC	0.02	NC	30	NC	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.006 U	0.007 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U
1,2-Dichloroethene	NC	NC	NC	NC	NC	NC	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
1,2-Dichloropropane	NC	NC	NC	NC	NC	NC	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.006 U	0.007 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U
2-Butanone	0.12	100	0.12	0.3	500	NC	0.012 U	0.012 U	0.011 U	0.011 U	0.011 U	0.011 U	0.001 J	0.024 U	0.027 U	0.012 U	0.012 U	0.047	0.012 U	0.011 U	0.012 U	0.004 J
2-Chloroethyl vinyl ether	NC	NC	NC	NC	NC	NC	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
2-Chlorotoluene	NC	NC	NC	NC	NC	NC	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
2-Hexanone	NC	NC	NC	NC	NC	NC	0.006 U	0.006 U	0.006 U	0.006 U	0.005 U	0.006 U	0.006 U	0.012 U	0.014 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U
4-Chlorotoluene	NC	NC	NC	NC	NC	NC	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
4-Methyl-2-Pentanone	NC	NC	NC	1	NC	NC	0.006 U	0.006 U	0.006 U	0.006 U	0.005 U	0.006 U	0.006 U	0.012 U	0.014 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U
Acetone	0.05	NC	0.05	NC	500	NC	0.012 U	0.012 U	0.011 U	0.011 U	0.011 U	0.011 U	0.011 U #	0.024 U #	0.027 U #	0.012 U #	0.012 U #	**0.15**	0.012 U #	0.011 U	0.012 U	0.023 U #
Acrolein	NC	NC	NC	NC	NC	NC	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Acrylonitrile	NC	NC	NC	NC	NC	NC	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Benzene	0.06	NC	0.06	NC	44	NC	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.006 U	0.007 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U
Bromobenzene	NC	NC	NC	NC	NC	NC	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Bromodichloromethane	NC	NC	NC	NC	NC	NC	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.006 U	0.007 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U
Bromoform	NC	NC	NC	NC	NC	NC	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.006 U	0.007 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U
Bromomethane	NC	NC	NC	NC	NC	NC	0.006 U	0.006 U	0.006 U	0.006 U	0.005 U	0.006 U	0.006 U	0.012 U	0.014 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U
Carbon Disulfide	NC	100	NC	2.7	NC	NC	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.006 U	0.007 U	0.003 U	0.003 U	0.011	0.003 U	0.003 U	0.003 U	0.003 U
Carbon Tetrachloride	0.76	NC	0.76	NC	22	NC	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.006 U	0.007 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U
Chlorobenzene	1.1	NC	1.1	NC	500	NC	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.006 U	0.007 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U
Chloroethane	NC	NC	NC	1.9	NC	NC	0.006 U	0.006 U	0.006 U	0.006 U	0.005 U	0.006 U	0.006 U	0.012 U	0.014 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U
Chloroform	0.37	NC	0.37	NC	350	NC	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.006 U	0.007 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U
Chloromethane	NC	NC	NC	NC	NC	NC	0.006 U	0.006 U	0.006 U	0.006 U	0.005 U	0.006 U	0.006 U	0.012 U	0.014 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U
cis-1,2-Dichloroethylene	0.25	NC	0.25	NC	500	NC	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.006 U	0.007 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U
cis-1,3-Dichloropropylene	NC	NC	NC	NC	NC	NC	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.006 U	0.007 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U
Dibromochloromethane	NC	NC	NC	NC	NC	NC	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.006 U	0.007 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U
Dichlorodifluoromethane	NC	NC	NC	NC	NC	NC	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Ethylbenzene	1	NC	1	NC	390	NC	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.006 U	0.007 U	0.003 U	0.0006 J	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U
Methylene chloride	0.05	NC	0.05	NC	500	NC	0.006 U	0.006 U	0.006 U	0.006 U	0.005 U	0.006 U	0.006 U #	0.012 U #	0.014 U #	0.006 U #	0.006 U #	0.006 U	0.006 U	0.006 U	0.006 U	0.002 U #
o-Xylene	NC	NC	NC	NC	NC	NC	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Styrene	NC	NC	NC	NC	NC	NC	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.006 U	0.007 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U
Tetrachloroethene	1.3	NC	1.3	NC	150	NC	0.005	0.003 U	0.003 U	0.007	0.005	0.003 U	0.003 U	0.006 U	0.007 U	0.003 J	0.007	0.003 U	0.009	0.003 U	0.002 J	0.046
Toluene	0.7	NC	0.7	NC	500	NC	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.006 U	0.007 U	0.003 U	0.003	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U
Total BTEX	NC	NC	NC	NC	NC	NC	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.006 U	0.007 U	0.003 U	0.0096	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U
trans-1,2-Dichloroethylene	0.19	NC	0.19	NC	500	NC	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.006 U	0.007 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U
trans-1,3-Dichloropropylene	NC	NC	NC	NC	NC	NC	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.006 U	0.007 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U
Trichloroethylene	0.47	NC	0.47	NC	200	NC	0.0006 J	0.003 U	0.003 U	0.002 J	0.0007 J	0.006	0.003	0.002 J	0.002 J	0.004	0.011	0.002 J	0.001 J	0.003 U	0.003 U	0.001 J
Trichlorofluoromethane	NC	NC	NC	NC	NC	NC	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Vinyl Acetate	NC	NC	NC	NC	NC	NC	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Vinyl Chloride	0.02	NC	0.02	NC	13	NC	0.006 UJ	0.006 UJ	0.006 UJ	0.006 UJ	0.005 UJ	0.006 UJ	0.006 U	0.012 U	0.014 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U
Xylene (m,p)	NC	NC	NC	NC	NC	NC	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Xylene (total)	0.26	NC	1.6	NC	500	NC	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.006 U	0.007 U	0.003 U	0.006	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U

Notes:
All units in micrograms per kilogram (µg/kg)
Bold - Exceeds 6 NYCRR Part 375 or CP-51 Protection of Groundwater Soil Cleanup Objectives
▨ - Exceeds 6 NYCRR Part 375 Unrestricted Soil Cleanup Objectives or CP-51 Residential Soil Cleanup Objectives
🟪 - Exceeds 6 NYCRR Part 375 or CP-51 Commercial Soil Cleanup Objectives
Exceeds 6 NYCRR Part 375 or CP-51 Commercial Soil Cleanup Objectives
ft bgs - feet below ground surface
NC - No criteria exists, NA - Not available
Sample Type Code: N - Normal, FD - Field Duplicate
U - Not Detected at the Detection Limit shown, J - Estimated value, UJ - Approximate Non-detect
B - Blank Contamination, BJ - Estimated Value Detected in Blank, ND - Not Detected
--- Not Analyzed

[1] 6 NYCRR Part 375, Table 375-6.8(b): Restricted Use Soil Cleanup Objectives, Protection of Public Health, Commercial, December 14, 2006.

[2] Final Commissioner Policy CP-51, Table 1: Supplimental Soil Cleanup Objectives, Residential, October 21, 2010.

[3] 6 NYCRR Part 375, Table 375-6.8(b): Restricted Use Soil Cleanup Objectives, Protection of Public Health, Protection of Groundwater, December 14, 2006.

[4] Final Commissioner Policy CP-51, Table 1: Supplimental Soil Cleanup Objectives, Protection of Groundwater, October 21, 2010.

[5] 6 NYCRR Part 375, Table 375-6.8(b): Unrestricted Use Soil Cleanup Objectives, Protection of Public Health, December 14, 2006.

[6] Final Commissioner Policy CP-51, Table 1: Supplimental Soil Cleanup Objectives, Commercial, October 21, 2010.

\# - Value qualified with a U per validation report dated March 6, 2006. Value reported in October 20, 2014 RIR did not reflect this qualifier.
$ - Value qualified with a J per validation report dated March 6, 2006. Value reported in October 20, 2014 RIR did not reflect this qualifier.
& - Value revised per laboratory data sheets presented in the Quantitative Environmental Survey dated April 1993. Value reported in October 20, 2014 RIR was incorrect.
^ - Value revised per laboratory data sheets presented in the Groundwater Investigation dated March 2000. Value reported in October 20, 2014 RIR was incorrect.

Table 3-1
VOC Analytical Results for Soil Samples at the Former RFM Site
Former ITT Rochester Form Machine Facility
Site #8-28-112
Town of Gates, New York

Location							OBG-SB-16	OBG-SB-16	OBG-SB-17	OBG-SB-17	OBG-SB-18	OBG-SB-18	OBG-SB-19	OBG-SB-19	OBG-SB-20	OBG-SB-20	OBG-SB-20	OBG-SB-21	OBG-SB-21	OBG-SB-22	OBG-SB-22	OBG-SB-23
Sample Date:							9/1/2004	9/1/2004	9/1/2004	9/1/2004	9/1/2004	9/1/2004	9/1/2004	9/1/2004	9/1/2004	9/1/2004	9/1/2004	9/1/2004	9/1/2004	9/1/2004	9/1/2004	9/1/2004
Sample ID:							OBG-SB-16 (5-7.5)	OBG-SB-16 (7.5-9)	OBG-SB-17 (4-7)	OBG-SB-17 (8-9)	OBG-SB-18 (6-7)	OBG-SB-18 (7-9.5)	OBG-SB-19 (4-7)	OBG-SB-19 (8.5-10)	DUP-2_09012004	OBG-SB-20 (2-4)	OBG-SB-20 (6-7)	OBG-SB-21 (4-6)	OBG-SB-21 (9-10)	OBG-SB-22 (1-2)	OBG-SB-22 (6-7)	OBG-SB-23 (1-2)
Start Depth (ft bgs):							5	7.5	4	8	6	7	4	8.5	2	2	6	4	9	1	6	1
End Depth (ft bgs):							7.5	9	7	9	7	9.5	7	10	4	4	7	6	10	2	7	2
Sample Type Code:							N	N	N	N	N	N	N	N	FD	N	N	N	N	N	N	N
Analyte	**Part 375 Unrestricted Use SCOs[1]**	**NY CP-51 Residential Use SCOs[2]**	**Part 375 Protection of Groundwater SCOs[3]**	**NY CP-51 Protection of Groundwater SCOs[4]**	**Part 375 Commercial Use SCOs[5]**	**NY CP-51 Commercial Use SCOs[4]**																
1,1,1,2-Tetrachloroethane	NC	NC	NC	NC	NC	NC	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
1,1,1-Trichloroethane	0.68	NC	0.68	NC	500	NC	0.13	0.012	0.009	0.46	0.039	0.12	0.09 J $	0.62	0.002 J	0.02 J $	0.44	0.22	0.41	0.003	0.003	0.001 J
1,1,2,2-Tetrachloroethane	NC	35	NC	0.6	NC	NC	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 UJ $	0.003 U	0.003 U	0.003 U	0.003 U	0.003 UJ	0.003 U	0.003 U	0.003 U
1,1,2-Trichloroethane	NC	NC	NC	NC	NC	NC	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.001 J	0.002 J	0.003 U	0.001 J	0.005	0.003 U	0.003 J $	0.003 U	0.003 U	0.003 U
1,1-Dichloroethane	0.27	NC	0.27	NC	240	NC	0.11	0.002 J	0.003 U	0.11	0.039	0.041	0.0006 J	0.001 J	0.003 U	0.003 U	0.002 J	0.002 J	0.001 J	0.004	0.0008 J	0.009
1,1-Dichloroethylene	0.33	NC	0.33	NC	500	NC	0.001 J	0.003 U	0.003 U	0.039	0.002 J	0.024	0.001 J	0.005	0.003 U	0.003 U	0.028	0.003 J	0.002 J	0.003 U	0.003 U	0.004
1,2,3-Trichloropropane	NC	80	NC	0.34	NC	NC	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
1,2-Dibromo-3-Chloropropane	NC	NC	NC	NC	NC	NC	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
1,2-Dibromoethane	NC	NC	NC	NC	NC	NC	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
1,2-Dichloroethane	0.02	NC	0.02	NC	30	NC	0.003 U	0.003 U	0.003 U	0.001 J	0.005	0.004	0.003 U	0.0007 J	0.003 U	0.003 U	0.001 J	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U
1,2-Dichloroethene	NC	NC	NC	NC	NC	NC	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
1,2-Dichloropropane	NC	NC	NC	NC	NC	NC	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U
2-Butanone	0.12	100	0.12	0.3	500	NC	0.002 J	0.011 U	0.012 U	0.011 U	0.012 U	0.011 U	0.011 U	0.011 U	0.012 U	0.012 U	0.011 U	0.011 U	0.013 U	0.025	0.011 U	0.076
2-Chloroethyl vinyl ether	NC	NC	NC	NC	NC	NC	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
2-Chlorotoluene	NC	NC	NC	NC	NC	NC	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
2-Hexanone	NC	NC	NC	NC	NC	NC	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.005 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U
4-Chlorotoluene	NC	NC	NC	NC	NC	NC	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
4-Methyl-2-Pentanone	NC	NC	NC	1	NC	NC	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.005 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U
Acetone	0.05	NC	0.05	NC	500	NC	0.013 U #	0.011 U #	0.012 U	0.011 U	0.012 U	0.011 U	0.011 U #	0.011 U	0.012 U	0.012 U	0.011 U	0.011 U	0.013 U	**0.093**	0.011 U	**0.2**
Acrolein	NC	NC	NC	NC	NC	NC	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Acrylonitrile	NC	NC	NC	NC	NC	NC	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Benzene	0.06	NC	0.06	NC	44	NC	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.001 J	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U
Bromobenzene	NC	NC	NC	NC	NC	NC	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Bromodichloromethane	NC	NC	NC	NC	NC	NC	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U
Bromoform	NC	NC	NC	NC	NC	NC	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U
Bromomethane	NC	NC	NC	NC	NC	NC	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.005 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U
Carbon Disulfide	NC	100	NC	2.7	NC	NC	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.005
Carbon Tetrachloride	0.76	NC	0.76	NC	22	NC	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U
Chlorobenzene	1.1	NC	1.1	NC	500	NC	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U
Chloroethane	NC	NC	NC	1.9	NC	NC	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.005 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.002 J
Chloroform	0.37	NC	0.37	NC	350	NC	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U
Chloromethane	NC	NC	NC	NC	NC	NC	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.005 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U
cis-1,2-Dichloroethylene	0.25	NC	0.25	NC	500	NC	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U
cis-1,3-Dichloropropylene	NC	NC	NC	NC	NC	NC	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U
Dibromochloromethane	NC	NC	NC	NC	NC	NC	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U
Dichlorodifluoromethane	NC	NC	NC	NC	NC	NC	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Ethylbenzene	1	NC	1	NC	390	NC	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.001 J	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U
Methylene chloride	0.05	NC	0.05	NC	500	NC	0.006 U #	0.006 U	0.006 U	0.006 U #	0.006 U #	0.005 U #	0.006 U #	0.006 U #	0.006 U	0.006 U #	0.006 U #	0.006 U #	0.006 U #	0.006 U #	0.006 U #	0.006 U #
o-Xylene	NC	NC	NC	NC	NC	NC	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Styrene	NC	NC	NC	NC	NC	NC	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U
Tetrachloroethene	1.3	NC	1.3	NC	150	NC	0.075	0.009	0.013	0.02	0.008	0.01	0.029 J $	0.1	0.003 J	0.021 J $	0.2	0.085	0.45	0.001 J	0.002 J	0.001 J
Toluene	0.7	NC	0.7	NC	500	NC	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.005	0.003 U	0.003 U	0.003 U	0.002 J	0.003 J	0.003 U	0.003 U	0.003 U
Total BTEX	NC	NC	NC	NC	NC	NC	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.016	0.003 U	0.003 U	0.003 U	0.007	0.008	0.003 U	0.003 U	0.003 U
trans-1,2-Dichloroethylene	0.19	NC	0.19	NC	500	NC	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U
trans-1,3-Dichloropropylene	NC	NC	NC	NC	NC	NC	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U
Trichloroethylene	0.47	NC	0.47	NC	200	NC	0.002 J	0.003 U	0.003 U	0.005	0.003 J	0.008	0.003	0.015	0.003 U	0.002 J	0.016	0.006	0.02	0.003 U	0.003 U	0.002 J
Trichlorofluoromethane	NC	NC	NC	NC	NC	NC	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Vinyl Acetate	NC	NC	NC	NC	NC	NC	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Vinyl Chloride	0.02	NC	0.02	NC	13	NC	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.005 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U
Xylene (m,p)	NC	NC	NC	NC	NC	NC	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Xylene (total)	0.26	NC	1.6	NC	500	NC	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.009	0.003 U	0.003 U	0.003 U	0.005	0.005	0.003 U	0.003 U	0.003 U

Notes:

All units in micrograms per kilogram (µg/kg)

Bold - Exceeds 6 NYCRR Part 375 or CP-51 Protection of Groundwater Soil Cleanup Objectives

▨ - Exceeds 6 NYCRR Part 375 Unrestricted Soil Cleanup Objectives or CP-51 Residential Soil Cleanup Objectives

▨ - Exceeds 6 NYCRR Part 375 or CP-51 Commercial Soil Cleanup Objectives

Exceeds 6 NYCRR Part 375 or CP-51 Commercial Soil Cleanup Objectives

ft bgs - feet below ground surface

NC - No criteria exists, NA - Not available

Sample Type Code: N - Normal, FD - Field Duplicate

U - Not Detected at the Detection Limit shown, J - Estimated value, UJ - Approximate Non-detect

B - Blank Contamination, BJ - Estimated Value Detected in Blank, ND - Not Detected

--- Not Analyzed

[1] 6 NYCRR Part 375, Table 375-6.8(b): Restricted Use Soil Cleanup Objectives, Protection of Public Health, Commercial, December 14, 2006.

[2] Final Commissioner Policy CP-51, Table 1: Supplimental Soil Cleanup Objectives, Residential, October 21, 2010.

[3] 6 NYCRR Part 375, Table 375-6.8(b): Restricted Use Soil Cleanup Objectives, Protection of Public Health, Protection of Groundwater, December 14, 2006.

[4] Final Commissioner Policy CP-51, Table 1: Supplimental Soil Cleanup Objectives, Protection of Groundwater, October 21, 2010.

[5] 6 NYCRR Part 375, Table 375-6.8(b): Unrestricted Use Soil Cleanup Objectives, Protection of Public Health, December 14, 2006.

[6] Final Commissioner Policy CP-51, Table 1: Supplimental Soil Cleanup Objectives, Commercial, October 21, 2010.

- Value qualified with a U per validation report dated March 6, 2006. Value reported in October 20, 2014 RIR did not reflect this qualifier.

$ - Value qualified with a J per validation report dated March 6, 2006. Value reported in October 20, 2014 RIR did not reflect this qualifier.

& - Value revised per laboratory data sheets presented in the Quantitative Environmental Survey dated April 1993. Value reported in October 20, 2014 RIR was incorrect.

^ - Value revised per laboratory data sheets presented in the Groundwater Investigation dated March 2000. Value reported in October 20, 2014 RIR was incorrect.

Table 3-1
VOC Analytical Results for Soil Samples at the Former RFM Site
Former ITT Rochester Form Machine Facility
Site #8-28-112
Town of Gates, New York

Location							OBG-SB-23	OBG-SB-24	OBG-SB-24	OBG-SB-25	OBG-SB-25	OBG-SB-26	OBG-SB-26	OBG-SB-27	OBG-SB-27	OBG-SB-28	OBG-SB-28	OBG-SB-28	OBG-SB-29	SB-1	SB-2	SB-3
Sample Date:							9/1/2004	9/1/2004	9/1/2004	9/1/2004	9/1/2004	9/1/2004	9/1/2004	9/1/2004	9/1/2004	9/1/2004	9/2/2004	9/1/2004	9/2/2004	10/22/1991	10/22/1991	10/24/1991
Sample ID:							OBG-SB-23 (6-7)	OBG-SB-24 (1-2)	OBG-SB-24 (8-9)	OBG-SB-25 (4-6)	OBG-SB-25 (6-8)	OBG-SB-26 (0.5-1.5)	OBG-SB-26 (4-5)	OBG-SB-27 (1-2)	OBG-SB-27 (6.5-7.5)	OBG-SB-28 (1-2)	OBG-SB-29 (2-4)	OBG-SB-28 (10-11)	OBG-SB-29 (5-6.5)	SB-1_10-23-04	SB-2_10-23-04	SB-3 (1-2)10-24-91
Start Depth (ft bgs):							6	1	8	4	6	0.5	4	1	6.5	1	2	10	5	0.5	0.5	1
End Depth (ft bgs):							7	2	9	6	8	1.5	5	2	7.5	2	4	11	6.5	1	1	2
Sample Type Code:							N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Analyte	**Part 375 Unrestricted Use SCOs[1]**	**NY CP-51 Residential Use SCOs[2]**	**Part 375 Protection of Groundwater SCOs[3]**	**NY CP-51 Protection of Groundwater SCOs[4]**	**Part 375 Commercial Use SCOs[5]**	**NY CP-51 Commercial Use SCOs[4]**																
1,1,1,2-Tetrachloroethane	NC	NC	NC	NC	NC	NC	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
1,1,1-Trichloroethane	0.68	NC	0.68	NC	500	NC	0.023	0.0008 J	0.12	0.001 J	0.003 J	0.001 J	0.002 J	0.003 U	0.004	0.003 U	0.032	0.016	0.021	0.006 U	0.006 U	0.053
1,1,2,2-Tetrachloroethane	NC	35	NC	0.6	NC	NC	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 UJ	0.003 U	0.003 U	0.006 U	0.006 U	0.006 U
1,1,2-Trichloroethane	NC	NC	NC	NC	NC	NC	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.006 U	0.006 U	0.006 U
1,1-Dichloroethane	0.27	NC	0.27	NC	240	NC	0.002 J	0.01	0.005 J $	0.001 J	0.002 J	0.001 J	0.001 J	0.004	0.001 J	0.003	0.0008 J	0.003	0.003 U	0.006 U	0.006 U	0.006 U
1,1-Dichloroethylene	0.33	NC	0.33	NC	500	NC	0.001 J	0.006	0.002 J	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.002 J	0.0008 J	0.002 J	0.006 U	0.006 U	0.006 U
1,2,3-Trichloropropane	NC	80	NC	0.34	NC	NC	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
1,2-Dibromo-3-Chloropropane	NC	NC	NC	NC	NC	NC	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
1,2-Dibromoethane	NC	NC	NC	NC	NC	NC	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
1,2-Dichloroethane	0.02	NC	0.02	NC	30	NC	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.006 U	0.006 U	0.006 U
1,2-Dichloroethene	NC	NC	NC	NC	NC	NC	---	---	---	---	---	---	---	---	---	---	---	---	---	0.006 U	0.006 U	0.006 U
1,2-Dichloropropane	NC	NC	NC	NC	NC	NC	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.006 U	0.006 U	0.006 U
2-Butanone	0.12	100	0.12	0.3	500	NC	0.011 U	0.041	0.013 U	0.012 U	0.012 U	0.012 U	0.012 U	0.005 J	0.012 U	0.009 J	0.012 U	0.011 U	0.011 U	0.013 U	0.013 U	0.003 J
2-Chloroethyl vinyl ether	NC	NC	NC	NC	NC	NC	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
2-Chlorotoluene	NC	NC	NC	NC	NC	NC	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
2-Hexanone	NC	NC	NC	NC	NC	NC	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.013 U	0.013 U	0.012 U
4-Chlorotoluene	NC	NC	NC	NC	NC	NC	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
4-Methyl-2-Pentanone	NC	NC	NC	1	NC	NC	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.013 U	0.013 U	0.012 U
Acetone	0.05	NC	0.05	NC	500	NC	0.011 U	**0.12**	0.013 U	0.012 U	0.012 U	0.012 U	0.012 U	0.012 U #	0.012 U	0.012 U #	0.012 U #	0.011 U #	0.011 U #	0.004 BJ	0.004 BJ	0.002 B
Acrolein	NC	NC	NC	NC	NC	NC	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Acrylonitrile	NC	NC	NC	NC	NC	NC	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Benzene	0.06	NC	0.06	NC	44	NC	0.003 U	0.003 U	0.0008 J	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.006 U	0.006 U	0.006 U
Bromobenzene	NC	NC	NC	NC	NC	NC	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Bromodichloromethane	NC	NC	NC	NC	NC	NC	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.006 U	0.006 U	0.006 U
Bromoform	NC	NC	NC	NC	NC	NC	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.006 U	0.006 U	0.006 U
Bromomethane	NC	NC	NC	NC	NC	NC	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.013 U	0.013 U	0.012 U
Carbon Disulfide	NC	100	NC	2.7	NC	NC	0.003 U	0.002 J	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.001 J	0.003 U	0.003 U	0.003 U	0.006 U	0.006 U	0.006 U
Carbon Tetrachloride	0.76	NC	0.76	NC	22	NC	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.006 U	0.006 U	0.006 U
Chlorobenzene	1.1	NC	1.1	NC	500	NC	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.006 U	0.006 U	0.006 U
Chloroethane	NC	NC	NC	1.9	NC	NC	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.013 U	0.013 U	0.012 U
Chloroform	0.37	NC	0.37	NC	350	NC	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.006 U	0.006 U	0.006 U
Chloromethane	NC	NC	NC	NC	NC	NC	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.013 U	0.013 U	0.012 U
cis-1,2-Dichloroethylene	0.25	NC	0.25	NC	500	NC	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	---	---	---
cis-1,3-Dichloropropylene	NC	NC	NC	NC	NC	NC	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.006 U	0.006 U	0.006 U
Dibromochloromethane	NC	NC	NC	NC	NC	NC	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.006 U	0.006 U	0.006 U
Dichlorodifluoromethane	NC	NC	NC	NC	NC	NC	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Ethylbenzene	1	NC	1	NC	390	NC	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.006 U	0.006 U	0.002 J
Methylene chloride	0.05	NC	0.05	NC	500	NC	0.006 U #	0.006 U #	0.006 U	0.006 U #	0.006 U #	0.006 U #	0.006 U #	0.006 U #	0.006 U #	0.006 U #	0.006 U #	0.006 U #	0.006 U	0.003 BJ	0.002 BJ	0.002 BJ
o-Xylene	NC	NC	NC	NC	NC	NC	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Styrene	NC	NC	NC	NC	NC	NC	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.006 U	0.006 U	0.006 U
Tetrachloroethene	1.3	NC	1.3	NC	150	NC	0.004	0.0006 J	0.076	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.002 J	0.003 U	0.003 U	0.008	0.003 U	0.006 U	0.006 U	0.004 J
Toluene	0.7	NC	0.7	NC	500	NC	0.003 U	0.003 U	0.002 J	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.006 U	0.006 U	0.004 J
Total BTEX	NC	NC	NC	NC	NC	NC	0.003 U	0.003 U	0.0028	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.006 U	0.006 U	0.020
trans-1,2-Dichloroethylene	0.19	NC	0.19	NC	500	NC	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	---	---	---
trans-1,3-Dichloropropylene	NC	NC	NC	NC	NC	NC	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.006 U	0.006 U	0.006 U
Trichloroethylene	0.47	NC	0.47	NC	200	NC	0.001 J	0.001 J	0.01	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.002 J	0.0007 J	0.003 U	0.006 U	0.006 U	0.006 U
Trichlorofluoromethane	NC	NC	NC	NC	NC	NC	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Vinyl Acetate	NC	NC	NC	NC	NC	NC	---	---	---	---	---	---	---	---	---	---	---	---	---	0.013 U	0.013 U	0.012 U
Vinyl Chloride	0.02	NC	0.02	NC	13	NC	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.013 U	0.013 U	0.012 U
Xylene (m,p)	NC	NC	NC	NC	NC	NC	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Xylene (total)	0.26	NC	1.6	NC	500	NC	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.006 U	0.006 U	0.014

Notes:

All units in micrograms per kilogram (µg/kg)

Bold - Exceeds 6 NYCRR Part 375 or CP-51 Protection of Groundwater Soil Cleanup Objectives

▨ - Exceeds 6 NYCRR Part 375 Unrestricted Soil Cleanup Objectives or CP-51 Residential Soil Cleanup Objectives

🟪 - Exceeds 6 NYCRR Part 375 or CP-51 Commercial Soil Cleanup Objectives

Exceeds 6 NYCRR Part 375 or CP-51 Commercial Soil Cleanup Objectives

ft bgs - feet below ground surface

NC - No criteria exists, NA - Not available

Sample Type Code: N - Normal, FD - Field Duplicate

U - Not Detected at the Detection Limit shown, J - Estimated value, UJ - Approximate Non-detect

B - Blank Contamination, BJ - Estimated Value Detected in Blank, ND - Not Detected

--- Not Analyzed

[1] 6 NYCRR Part 375, Table 375-6.8(b): Restricted Use Soil Cleanup Objectives, Protection of Public Health, Commercial, December 14, 2006.

[2] Final Commissioner Policy CP-51, Table 1: Supplimental Soil Cleanup Objectives, Residential, October 21, 2010.

[3] 6 NYCRR Part 375, Table 375-6.8(b): Restricted Use Soil Cleanup Objectives, Protection of Public Health, Protection of Groundwater, December 14, 2006.

[4] Final Commissioner Policy CP-51, Table 1: Supplimental Soil Cleanup Objectives, Protection of Groundwater, October 21, 2010.

[5] 6 NYCRR Part 375, Table 375-6.8(b): Unrestricted Use Soil Cleanup Objectives, Protection of Public Health, December 14, 2006.

[6] Final Commissioner Policy CP-51, Table 1: Supplimental Soil Cleanup Objectives, Commercial, October 21, 2010.

- Value qualified with a U per validation report dated March 6, 2006. Value reported in October 20, 2014 RIR did not reflect this qualifier.

$ - Value qualified with a J per validation report dated March 6, 2006. Value reported in October 20, 2014 RIR did not reflect this qualifier.

& - Value revised per laboratory data sheets presented in the Quantitative Environmental Survey dated April 1993. Value reported in October 20, 2014 RIR was incorrect.

^ - Value revised per laboratory data sheets presented in the Groundwater Investigation dated March 2000. Value reported in October 20, 2014 RIR was incorrect.

Table 3-1
VOC Analytical Results for Soil Samples at the Former RFM Site
Former ITT Rochester Form Machine Facility
Site #8-28-112
Town of Gates, New York

Location							SB-3	SB-4	SB-5	SB-6	SB-7	SB-8	SB-9	SB-10	SS-1	SS-2	TD-1
Sample Date:							10/24/1991	10/24/1991	10/24/1991	10/24/1991	10/23/1991	10/23/1991	11/13/1991	10/23/1991	7/28/1998	7/28/1998	9/3/2004
Sample ID:							SB-3 (5-7)10-24-91	SB-4 (1-2)10-24-91	SB-5 (1-2)10-24-91	SB-6 (1-2)10-24-91	SB-7_10-23-91	SB-8_10-23-91	SB-9_11-13-91	SB-10_10-23-91	SS-1 7/28/98	SS-2 7/28/98	TD-1
Start Depth (ft bgs):							5	1	1	1	0.5	1	2	2	0	0	0
End Depth (ft bgs):							7	2	2	2	1	2	3	3	0.17	0.17	0.5
Sample Type Code:							N	N	N	N	N	N	N	N	N	N	N
Analyte	Part 375 Unrestricted Use SCOs[1]	NY CP-51 Residential Use SCOs[2]	Part 375 Protection of Groundwater SCOs[3]	NY CP-51 Protection of Groundwater SCOs[4]	Part 375 Commercial Use SCOs[5]	NY CP-51 Commercial Use SCOs[4]											
1,1,1,2-Tetrachloroethane	NC	NC	NC	NC	NC	NC	---	---	---	---	---	---	---	---	---	---	---
1,1,1-Trichloroethane	0.68	NC	0.68	NC	500	NC	0.006 U	0.230	0.006 U	0.006 U	0.006 U	0.003 J	0.006 U	**1.000 &**	0.010 U	0.011 U	0.003 J
1,1,2,2-Tetrachloroethane	NC	35	NC	0.6	NC	NC	0.006 U	0.008 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.032 U	0.010 U	0.011 U	0.003 U
1,1,2-Trichloroethane	NC	NC	NC	NC	NC	NC	0.006 U	0.008 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.032 U	0.010 U	0.011 U	0.003 U
1,1-Dichloroethane	0.27	NC	0.27	NC	240	NC	0.006 U	0.021	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.066	0.010 U	0.011 U	0.003 U
1,1-Dichloroethylene	0.33	NC	0.33	NC	500	NC	0.006 U	0.008 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.017 J	0.010 U	0.011 U	0.009
1,2,3-Trichloropropane	NC	80	NC	0.34	NC	NC	---	---	---	---	---	---	---	---	---	---	---
1,2-Dibromo-3-Chloropropane	NC	NC	NC	NC	NC	NC	---	---	---	---	---	---	---	---	---	---	---
1,2-Dibromoethane	NC	NC	NC	NC	NC	NC	---	---	---	---	---	---	---	---	---	---	---
1,2-Dichloroethane	0.02	NC	0.02	NC	30	NC	0.006 U	0.008 U	0.006 U	0.006 U	0.006 U	0.003 J	0.006 U	0.032 U	0.010 U	0.011 U	0.003 U
1,2-Dichloroethene	NC	NC	NC	NC	NC	NC	0.006 U	0.008 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.032 U	0.010 U	0.011 U	---
1,2-Dichloropropane	NC	NC	NC	NC	NC	NC	0.006 U	0.008 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.032 U	0.010 U	0.011 U	0.003 U
2-Butanone	0.12	100	0.12	0.3	500	NC	0.012 U	0.015 U	0.012 U	0.012 U	0.012 U	0.012 U	0.012 U	0.065 U	0.010 U	0.011 U	0.011 U
2-Chloroethyl vinyl ether	NC	NC	NC	NC	NC	NC	---	---	---	---	---	---	---	---	---	---	---
2-Chlorotoluene	NC	NC	NC	NC	NC	NC	---	---	---	---	---	---	---	---	---	---	---
2-Hexanone	NC	NC	NC	NC	NC	NC	0.012 U	0.015 U	0.012 U	0.012 U	0.012 U	0.012 U	0.012 U	0.065 U	0.010 U	0.011 U	0.005 U
4-Chlorotoluene	NC	NC	NC	NC	NC	NC	---	---	---	---	---	---	---	---	---	---	---
4-Methyl-2-Pentanone	NC	NC	NC	1	NC	NC	0.012 U	0.015 U	0.012 U	0.012 U	0.012 U	0.012 U	0.012 U	0.065 U	---	---	0.005 U
Acetone	0.05	NC	0.05	NC	500	NC	0.002 BJ	0.004 BJ	0.012 U	0.012 U	0.005 BJ	0.006 BJ	0.012 U	0.021 BJ	0.010 U	0.011 U	0.011 U #
Acrolein	NC	NC	NC	NC	NC	NC	---	---	---	---	---	---	---	---	---	---	---
Acrylonitrile	NC	NC	NC	NC	NC	NC	---	---	---	---	---	---	---	---	---	---	---
Benzene	0.06	NC	0.06	NC	44	NC	0.006 U	0.008 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.032 U	0.010 U	0.011 U	0.003 U
Bromobenzene	NC	NC	NC	NC	NC	NC	---	---	---	---	---	---	---	---	---	---	---
Bromodichloromethane	NC	NC	NC	NC	NC	NC	0.006 U	0.008 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.032 U	0.010 U	0.011 U	0.003 U
Bromoform	NC	NC	NC	NC	NC	NC	0.006 U	0.008 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.032 U	0.010 U	0.011 U	0.003 U
Bromomethane	NC	NC	NC	NC	NC	NC	0.012 U	0.015 U	0.012 U	0.012 U	0.012 U	0.012 U	0.012 U	0.065 U	0.010 U	0.011 U	0.005 U
Carbon Disulfide	NC	100	NC	2.7	NC	NC	0.006 U	0.008 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.032 U	0.010 U	0.011 U	0.003 U
Carbon Tetrachloride	0.76	NC	0.76	NC	22	NC	0.006 U	0.008 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.032 U	0.010 U	0.011 U	0.003 U
Chlorobenzene	1.1	NC	1.1	NC	500	NC	0.006 U	0.008 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.032 U	0.010 U	0.011 U	0.003 U
Chloroethane	NC	NC	NC	1.9	NC	NC	0.012 U	0.015 U	0.012 U	0.012 U	0.012 U	0.012 U	0.012 U	0.065 U	0.010 U	0.011 U	0.005 U
Chloroform	0.37	NC	0.37	NC	350	NC	0.006 U	0.008 U	0.006 U	0.006 U	0.006 U	0.006 U	0.002 J	0.032 U	0.010 U	0.011 U	0.003 U
Chloromethane	NC	NC	NC	NC	NC	NC	0.012 U	0.015 U	0.012 U	0.012 U	0.012 U	0.012 U	0.012 U	0.065 U	0.010 U	0.011 U	0.005 U
cis-1,2-Dichloroethylene	0.25	NC	0.25	NC	500	NC	---	---	---	---	---	---	---	---	---	---	0.003 U
cis-1,3-Dichloropropylene	NC	NC	NC	NC	NC	NC	0.006 U	0.008 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.032 U	0.010 U	0.011 U	0.003 U
Dibromochloromethane	NC	NC	NC	NC	NC	NC	0.006 U	0.008 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.032 U	0.010 U	0.011 U	0.003 U
Dichlorodifluoromethane	NC	NC	NC	NC	NC	NC	---	---	---	---	---	---	---	---	---	---	---
Ethylbenzene	1	NC	1	NC	390	NC	0.006 U	0.008 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.032 U	0.010 U	0.011 U	0.057
Methylene chloride	0.05	NC	0.05	NC	500	NC	0.002 BJ	0.002 BJ	0.002 BJ	0.002 BJ	0.002 BJ	0.002 BJ	0.002 BJ	0.010 BJ	0.031	0.019	0.005 U
o-Xylene	NC	NC	NC	NC	NC	NC	---	---	---	---	---	---	---	---	---	---	---
Styrene	NC	NC	NC	NC	NC	NC	0.006 U	0.008 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.032 U	0.010 U	0.011 U	0.003 U
Tetrachloroethene	1.3	NC	1.3	NC	150	NC	0.006 U	0.110	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.007 J	0.010 U	0.011 U	0.003
Toluene	0.7	NC	0.7	NC	500	NC	0.006 U	0.008 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.032 U	0.010 U	0.011 U	0.003 U
Total BTEX	NC	NC	NC	NC	NC	NC	0.006 U	0.008 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.032 U	0.010 U	0.011 U	0.257
trans-1,2-Dichloroethylene	0.19	NC	0.19	NC	500	NC	---	---	---	---	---	---	---	---	---	---	0.003 U
trans-1,3-Dichloropropylene	NC	NC	NC	NC	NC	NC	0.006 U	0.008 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.032 U	0.010 U	0.011 U	0.003 U
Trichloroethylene	0.47	NC	0.47	NC	200	NC	0.006 U	0.007 J	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.032 U	0.010 U	0.011 U	0.004
Trichlorofluoromethane	NC	NC	NC	NC	NC	NC	---	---	---	---	---	---	---	---	---	---	---
Vinyl Acetate	NC	NC	NC	NC	NC	NC	0.012 U	0.015 U	0.012 U	0.012 U	0.012 U	0.012 U	0.012 U	0.065 U	---	---	---
Vinyl Chloride	0.02	NC	0.02	NC	13	NC	0.012 U	0.015 U	0.012 U	0.012 U	0.012 U	0.012 U	0.012 U	0.065 U	0.010 U	0.011 U	0.005 U
Xylene (m,p)	NC	NC	NC	NC	NC	NC	---	---	---	---	---	---	---	---	---	---	---
Xylene (total)	0.26	NC	1.6	NC	500	NC	0.006 U	0.008 U	0.006 U	0.006 U	0.006 U	0.006 U	0.006 U	0.032 U	0.010 U	0.011 U	0.2

Notes:
All units in micrograms per kilogram (µg/kg)
Bold - Exceeds 6 NYCRR Part 375 or CP-51 Protection of Groundwater Soil Cleanup Objectives
▨ - Exceeds 6 NYCRR Part 375 Unrestricted Soil Cleanup Objectives or CP-51 Residential Soil Cleanup Objectives
🟪 - Exceeds 6 NYCRR Part 375 or CP-51 Commercial Soil Cleanup Objectives
Exceeds 6 NYCRR Part 375 or CP-51 Commercial Soil Cleanup Objectives
ft bgs - feet below ground surface
NC - No criteria exists, NA - Not available
Sample Type Code: N - Normal, FD - Field Duplicate
U - Not Detected at the Detection Limit shown, J - Estimated value, UJ - Approximate Non-detect
B - Blank Contamination, BJ - Estimated Value Detected in Blank, ND - Not Detected
--- Not Analyzed
[1] 6 NYCRR Part 375, Table 375-6.8(b): Restricted Use Soil Cleanup Objectives, Protection of Public Health, Commercial, December 14, 2006.
[2] Final Commissioner Policy CP-51, Table 1: Supplimental Soil Cleanup Objectives, Residential, October 21, 2010.
[3] 6 NYCRR Part 375, Table 375-6.8(b): Restricted Use Soil Cleanup Objectives, Protection of Public Health, Protection of Groundwater, December 14, 2006.
[4] Final Commissioner Policy CP-51, Table 1: Supplimental Soil Cleanup Objectives, Protection of Groundwater, October 21, 2010.
[5] 6 NYCRR Part 375, Table 375-6.8(b): Unrestricted Use Soil Cleanup Objectives, Protection of Public Health, December 14, 2006.
[6] Final Commissioner Policy CP-51, Table 1: Supplimental Soil Cleanup Objectives, Commercial, October 21, 2010.
- Value qualified with a U per validation report dated March 6, 2006. Value reported in October 20, 2014 RIR did not reflect this qualifier.
$ - Value qualified with a J per validation report dated March 6, 2006. Value reported in October 20, 2014 RIR did not reflect this qualifier.
& - Value revised per laboratory data sheets presented in the Quantitative Environmental Survey dated April 1993. Value reported in October 20, 2014 RIR was incorrect.
^ - Value revised per laboratory data sheets presented in the Groundwater Investigation dated March 2000. Value reported in October 20, 2014 RIR was incorrect.

Table 3-2
1,4-Dioxane Analytical Results for Soil Samples at the Former RFM Site
Former ITT Rochester Form Machine Facility
Site #8-28-112
Town of Gates, New York

Location:								**APC2-1**	**APC2-2**	**APC3-1**	**APC3-2**	**BH-99-1**	**BH-99-2**	**BH-99-3**	**BH-99-4**	**BH-99-5**	**BH-99-6**
Sample Date:								10/23/1991	10/23/1991	10/23/1991	10/23/1991	4/12/1999	9/15/1999	9/15/1999	9/15/1999	9/15/1999	9/15/1999
Sample ID:								APC2-1	APC2-2	APC3-1	APC3-2	BH-99-1(6-6.9)	BH-99-2 (6-7)	BH-99-3 (6-7)	BH-99-4 (6-8)	BH-99-5 (6-8)	BH-99-6 (6-8)
Start Depth (ft bgs):								6	6	6	6	6	6	6	6	6	6
End Depth (ft bgs):								8	8	8	8	6.9	7	7	8	8	8
Sample Type Code:								N	N	N	N	N	N	N	N	N	N
USEPA Method	**Analyte**	**Part 375 Unrestricted Use SCOs^1**	**NY CP-51 Residential Use SCOs^2**	**Part 375 Protection of Groundwater SCOs^3**	**NY CP-51 Protection of Groundwater SCOs^4**	**Part 375 Commercial Use SCOs^5**	**NY CP-51 Commercial Use SCOs^6**										
8240	1,4-Dioxane	0.1	NC	0.1	NC	130	NC	**4.100**	0.027	**0.110**	0.068	---	---	---	---	---	---
8260	1,4-Dioxane							---	---	---	---	NA	**7.2 E**	**0.6**	**0.13**	0.74 E	**1.6 E**
8270	1,4-Dioxane							---	---	---	---	---	---	---	---	---	---

Location:								**BH-99-7**	**BH-99-7**	**BH-99-8**	**BH-99-8**	**BH-99-9**	**BH-99-10**	**BH-99-10**	**BH-99-11B**	**BH-99-12**	**BH-99-13**
Sample Date:								9/15/1999	9/15/1999	9/15/1999	9/15/1999	9/15/1999	9/15/1999	9/15/1999	9/15/1999	9/15/1999	9/15/1999
Sample ID:								BH-99-7 (2-4)	BH-99-7 (6-8)	BH-99-8 (3-4)	BH-99-8 (8-10)	BH-99-9 (4-6)	BH-99-10 (6-8)	BH-99-10 (8-10)	BH-99-11B (5-7)	BH-99-12 (6-8)	BH-99-13 (8-10)
Start Depth (ft bgs):								2	6	3	8	4	6	8	5	6	8
End Depth (ft bgs):								4	8	4	10	6	8	10	7	8	10
Sample Type Code:								N	N	N	N	N	N	N	N	N	N
USEPA Method	**Analyte**	**Part 375 Unrestricted Use SCOs^1**	**NY CP-51 Residential Use SCOs^2**	**Part 375 Protection of Groundwater SCOs^3**	**NY CP-51 Protection of Groundwater SCOs^4**	**Part 375 Commercial Use SCOs^5**	**NY CP-51 Commercial Use SCOs^6**										
8240	1,4-Dioxane	0.1	NC	0.1	NC	130	NC	---	---	---	---	---	---	---	---	---	---
8260	1,4-Dioxane							**19.000 E**	**2.700 E**	**0.760**	0.230 U	**22.000 E**	**0.440**	**0.260**	**0.700 E**	**1.500 E**	**1.500**
8270	1,4-Dioxane							---	---	---	---	---	---	---	---	---	---

Location:								**BH-99-14A/B**	**BH-99-15**	**BH-99-16**	**BH-99-17**	**BH-99-18**	**BH-99-19**	**BH-99-19**	**BH-99-20**	**BH-99-21**	**BH-99-22**
Sample Date:								9/15/1999	9/15/1999	9/15/1999	9/15/1999	9/15/1999	9/15/1999	9/15/1999	9/16/1999	9/16/1999	9/16/1999
Sample ID:								BH-99-14A (4-6)	BH-99-15 (4-6)	BH-99-16 (4-6)	BH-99-17 (7-9)	BH-99-18 (6-8)	BH-99-19 (4-6)	BH-99-19 (6-8)	BH-99-20 (4-6)	BH-99-21 (2-4)	BH-99-22 (4-6)
Start Depth (ft bgs):								4	4	4	7	6	4	6	4	2	4
End Depth (ft bgs):								6	6	6	9	8	6	8	6	4	6
Sample Type Code:								N	N	N	N	N	N	N	N	N	N
USEPA Method	**Analyte**	**Part 375 Unrestricted Use SCOs^1**	**NY CP-51 Residential Use SCOs^2**	**Part 375 Protection of Groundwater SCOs^3**	**NY CP-51 Protection of Groundwater SCOs^4**	**Part 375 Commercial Use SCOs^5**	**NY CP-51 Commercial Use SCOs^6**										
8240	1,4-Dioxane	0.1	NC	0.1	NC	130	NC	---	---	---	---	---	---	---	---	---	---
8260	1,4-Dioxane							**0.540**	0.700 U	0.250 U	**9.300 E**	**13.000 E**	**17.000 E**	14.000 U	0.100	**0.500**	**6.900 E**
8270	1,4-Dioxane							---	---	---	---	---	---	---	---	---	---

Notes:

All units in milligrams per kilogram (mg/kg)

Bold - Exceeds 6 NYCRR Part 375 or CP-51 Protection of Groundwater Soil Cleanup Objectives

▨ - Exceeds 6 NYCRR Part 375 Unrestricted Soil Cleanup Objectives or CP-51 Residential Soil Cleanup Objectives

6 NYCRR Part 375 and CP-51 Commercial Soil Cleanup Objectives were not exceeded.

NC - No criteria exists, NA - Not Available

Sample Type Code: N - Normal, FD - Field Duplicate

ft bgs - feet below ground surface

U - Not Detected at the Detection Limit shown

J - Esimated Value

E - Exceeds calibration range and is estimated in value.

--- Not Analyzed

[1] 6 NYCRR Part 375, Table 375-6.8(b): Unrestricted Use Soil Cleanup Objectives, Protection of Public Health, December 14, 2006.

[2] Final Commissioner Policy CP-51, Table 1: Supplimental Soil Cleanup Objectives, Residential, October 21, 2010.

[3] 6 NYCRR Part 375, Table 375-6.8(b): Restricted Use Soil Cleanup Objectives, Protection of Public Health, Protection of Grounwater, December 14, 2006.

[4] Final Commissioner Policy CP-51, Table 1: Supplimental Soil Cleanup Objectives, Protection of Groundwater, October 21, 2010.

[5] 6 NYCRR Part 375, Table 375-6.8(b): Restricted Use Soil Cleanup Objectives, Protection of Public Health, Commercial, December 14, 2006.

[6] Final Commissioner Policy CP-51, Table 1: Supplimental Soil Cleanup Objectives, Commercial, October 21, 2010.

Table 3-2
1,4-Dioxane Analytical Results for Soil Samples at the Former RFM Site
Former ITT Rochester Form Machine Facility
Site #8-28-112
Town of Gates, New York

							Location:	**BH-99-23**	**BH-99-25**	**BH-99-26**	**BH-99-27**	**BH-99-28**	**BH-99-29**	**BH-99-30**	**BH-99-31**	**BH-99-31**	**BH-99-32**
							Sample Date:	9/16/1999	9/16/1999	9/16/1999	9/16/1999	9/16/1999	9/16/1999	9/16/1999	9/16/1999	9/16/1999	9/16/1999
							Sample ID:	BH-99-23 (8-10)	BH-99-25 (4-6)	BH-99-26 (4-6)	BH-99-27 (4-6)	BH-99-28 (4-6)	BH-99-29 (6-7)	BH-99-30 (6-7)	BH-99-31 (1-4)	BH-99-31 (4-6)	BH-99-32 (1-4)
							Start Depth (ft bgs):	8	4	4	4	4	6	6	1	4	1
							End Depth (ft bgs):	10	6	6	6	6	7	7	4	6	4
							Sample Type Code:	N	N	N	N	N	N	N	N	N	N
USEPA Method	**Analyte**	**Part 375 Unrestricted Use SCOs[1]**	**NY CP-51 Residential Use SCOs[2]**	**Part 375 Protection of Groundwater SCOs[3]**	**NY CP-51 Protection of Groundwater SCOs[4]**	**Part 375 Commercial Use SCOs[5]**	**NY CP-51 Commercial Use SCOs[6]**										
8240	1,4-Dioxane	0.1	NC	0.1	NC	130	NC	---	---	---	---	---	---	---	---	---	---
8260	1,4-Dioxane							**7.9 E**	**49 E**	**130 E**	**84 E**	**4.1 E**	**0.15**	**0.69**	**17 E**	**11 E**	0.095 U
8270	1,4-Dioxane							---	---	---	---	---	---	---	---	---	---

							Location:	**BH-99-33**	**BH-99-34**	**BH-99-35**	**BH-99-36A**	**BH-99-37**	**BH-99-38**	**BH-99-39**	**BH-99-40B**	**BH-99-41**	**BH-99-42**
							Sample Date:	10/1/1999	10/1/1999	10/1/1999	10/1/1999	10/1/1999	10/1/1999	10/1/1999	10/1/1999	10/1/1999	10/1/1999
							Sample ID:	BH-99-33 (1-2)	BH-99-34 (2-4)	BH-99-35 (4-6)	BH-99-36 (4-6)	BH-99-37 (6-8)	BH-99-38 (6-8)	BH-99-39 (6-8)	BH-99-40B (8-10)	BH-99-41 (8-10)	BH-99-42 (4-6)
							Start Depth (ft bgs):	1	2	4	4	6	6	6	8	8	4
							End Depth (ft bgs):	2	4	6	6	8	8	8	10	10	6
							Sample Type Code:	N	N	N	N	N	N	N	N	N	N
USEPA Method	**Analyte**	**Part 375 Unrestricted Use SCOs[1]**	**NY CP-51 Residential Use SCOs[2]**	**Part 375 Protection of Groundwater SCOs[3]**	**NY CP-51 Protection of Groundwater SCOs[4]**	**Part 375 Commercial Use SCOs[5]**	**NY CP-51 Commercial Use SCOs[6]**										
8240	1,4-Dioxane	0.1	NC	0.1	NC	130	NC	---	---	---	---	---	---	---	---	---	---
8260	1,4-Dioxane							**54.000 E**	**0.340**	**0.550**	**0.600**	**0.220**	**1.700**	0.096 U	**2.200**	**3.200**	0.098 U
8270	1,4-Dioxane							---	---	---	---	---	---	---	---	---	---

							Location:	**BH-99-43**	**BH-99-44**	**BH-99-45**	**BH-99-46**	**CS-1**	**CS-2**	**CS-3**	**CS-4**	**CS-5**	**ITT-MW-1**
							Sample Date:	10/1/1999	10/1/1999	10/1/1999	10/1/1999	11/23/1999	11/23/1999	11/23/1999	11/24/1999	11/24/1999	10/23/1991
							Sample ID:	BH-99-43 (8-10)	BH-99-44 (8-10)	BH-99-45 (6-8)	BH-99-46 (6-8)						MW-1(SOIL)10-23-91
							Start Depth (ft bgs):	8	8	6	6	7	6.5	7.5	7	9	8
							End Depth (ft bgs):	10	10	8	8	7	6.5	7.5	7	9	10
							Sample Type Code:	N	N	N	N	N	N	N	N	N	N
USEPA Method	**Analyte**	**Part 375 Unrestricted Use SCOs[1]**	**NY CP-51 Residential Use SCOs[2]**	**Part 375 Protection of Groundwater SCOs[3]**	**NY CP-51 Protection of Groundwater SCOs[4]**	**Part 375 Commercial Use SCOs[5]**	**NY CP-51 Commercial Use SCOs[6]**										
8240	1,4-Dioxane	0.1	NC	0.1	NC	130	NC	---	---	---	---	---	---	---	---	---	0.005 U
8260	1,4-Dioxane							**0.450**	0.260 U	**2.200**	**1.500**	**0.380**	0.10	**2.100**	0.062 U	**0.130**	---
8270	1,4-Dioxane							---	---	---	---	---	---	---	---	---	---

Notes:

All units in milligrams per kilogram (mg/kg)

Bold - Exceeds 6 NYCRR Part 375 or CP-51 Protection of Groundwater Soil Cleanup Objectives

▨ - Exceeds 6 NYCRR Part 375 Unrestricted Soil Cleanup Objectives or CP-51 Residential Soil Cleanup Objectives

6 NYCRR Part 375 and CP-51 Commercial Soil Cleanup Objectives were not exceeded.

NC - No criteria exists, NA - Not Available

Sample Type Code: N - Normal, FD - Field Duplicate

ft bgs - feet below ground surface

U - Not Detected at the Detection Limit shown

J - Esimated Value

E - Exceeds calibration range and is estimated in value.

--- Not Analyzed

[1] 6 NYCRR Part 375, Table 375-6.8(b): Unrestricted Use Soil Cleanup Objectives, Protection of Public Health, December 14, 2006.

[2] Final Commissioner Policy CP-51, Table 1: Supplimental Soil Cleanup Objectives, Residential, October 21, 2010.

[3] 6 NYCRR Part 375, Table 375-6.8(b): Restricted Use Soil Cleanup Objectives, Protection of Public Health, Protection of Grounwater, December 14, 2006.

[4] Final Commissioner Policy CP-51, Table 1: Supplimental Soil Cleanup Objectives, Protection of Groundwater, October 21, 2010.

[5] 6 NYCRR Part 375, Table 375-6.8(b): Restricted Use Soil Cleanup Objectives, Protection of Public Health, Commercial, December 14, 2006.

[6] Final Commissioner Policy CP-51, Table 1: Supplimental Soil Cleanup Objectives, Commercial, October 21, 2010.

Table 3-2
1,4-Dioxane Analytical Results for Soil Samples at the Former RFM Site
Former ITT Rochester Form Machine Facility
Site #8-28-112
Town of Gates, New York

							Location:	ITT-MW-2	ITT-MW-3	ITT-MW-4	ITT-MW-4	ITT-SBW-8	OBG-SB-1	OBG-SB-2	OBG-SB-2	OBG-SB-3	OBG-SB-3
							Sample Date:	10/23/1991	10/23/1991	10/24/1991	10/24/1991	4/12/1999	8/30/2004	8/30/2004	8/30/2004	8/30/2004	8/30/2004
							Sample ID:	MW-2(SOIL)10-23-91	MW-3(SOIL)10-23-91	MW-4 (1-2)10-24-91	MW-4 (6-8)10-24-91	SBW-8(8-9.1)	OBG-SB-1 (9-10)	OBG-SB-2 (2-4)	OBG-SB-2 (9-10)	OBG-SB-3 (2-4)	OBG-SB-3 (7-9'
							Start Depth (ft bgs):	6	4	1	6	8	9	2	9	2	7
							End Depth (ft bgs):	8	6	2	8	9.1	10	4	10	4	9
							Sample Type Code:	N	N	N	N	N	N	N	N	N	N
USEPA Method	Analyte	Part 375 Unrestricted Use SCOs[1]	NY CP-51 Residential Use SCOs[2]	Part 375 Protection of Groundwater SCOs[3]	NY CP-51 Protection of Groundwater SCOs[4]	Part 375 Commercial Use SCOs[5]	NY CP-51 Commercial Use SCOs[6]										
8240	1,4-Dioxane	0.1	NC	0.1	NC	130	NC	**170.000**	0.071	0.054	**0.850**	---	---	---	---	---	---
8260	1,4-Dioxane							**---**	---	---	**---**	---	---	---	---	---	---
8270	1,4-Dioxane							**---**	---	---	**---**	---	0.380 U	0.370 U	0.380 U	0.380 U	0.420 U

							Location:	OBG-SB-4	OBG-SB-4	OBG-SB-5	OBG-SB-5	OBG-SB-6	OBG-SB-6	OBG-SB-7	OBG-SB-7	OBG-SB-8	OBG-SB-8
							Sample Date:	8/30/2004	8/30/2004	8/30/2004	8/30/2004	8/31/2004	8/31/2004	8/31/2004	8/31/2004	8/31/2004	8/31/2004
							Sample ID:	OBG-SB-4 (4-6')	OBG-SB-4 (9.5-10.5')	OBG-SB-5 (7.5-9)	OBG-SB-5 (9-10.5)	OBG-SB-6 (0-2)	OBG-SB-6 (8.5-10.5)	OBG-SB-7 (4-6)	OBG-SB-7 (8.5-10.5)	OBG-SB-8 (1.5-3)	OBG-SB-8 (7-9)
							Start Depth (ft bgs):	4	9.5	7.5	9	0	8.5	4	8.5	1.5	7
							End Depth (ft bgs):	6	10.5	9	10.5	2	10.5	6	10.5	3	9
							Sample Type Code:	N	N	N	N	N	N	N	N	N	N
USEPA Method	Analyte	Part 375 Unrestricted Use SCOs[1]	NY CP-51 Residential Use SCOs[2]	Part 375 Protection of Groundwater SCOs[3]	NY CP-51 Protection of Groundwater SCOs[4]	Part 375 Commercial Use SCOs[5]	NY CP-51 Commercial Use SCOs[6]										
8240	1,4-Dioxane	0.1	NC	0.1	NC	130	NC	---	---	---	---	---	---	---	---	---	**---**
8260	1,4-Dioxane							---	---	---	---	---	---	---	---	---	**---**
8270	1,4-Dioxane							0.380 U	0.380 U	0.410 U	0.370 U	0.390 U	0.360 U	0.400 U	0.380 U	0.380 U	**0.110 J**

							Location:	OBG-SB-9	OBG-SB-9	OBG-SB-10	OBG-SB-10	OBG-SB-11	OBG-SB-11	OBG-SB-12	OBG-SB-12	OBG-SB-13	OBG-SB-13
							Sample Date:	8/31/2004	8/31/2004	8/31/2004	8/31/2004	8/31/2004	8/31/2004	8/31/2004	8/31/2004	8/31/2004	8/31/2004
							Sample ID:	OBG-SB-9 (2-4)	OBG-SB-9 (8-10)	OBG-SB-10 (4-6)	OBG-SB-10 (7-9)	OBG-SB-11 (10-11)	OBG-SB-11 (9-10)	OBG-SB-12 (4-5)	OBG-SB-12 (5-7)	OBG-SB-13 (7-8)	OBG-SB-13 (9.5-10.5)
							Start Depth (ft bgs):	2	8	4	7	10	9	4	5	7	9.5
							End Depth (ft bgs):	4	10	6	9	11	10	5	7	8	10.5
							Sample Type Code:	N	N	N	N	N	N	N	N	N	N
USEPA Method	Analyte	Part 375 Unrestricted Use SCOs[1]	NY CP-51 Residential Use SCOs[2]	Part 375 Protection of Groundwater SCOs[3]	NY CP-51 Protection of Groundwater SCOs[4]	Part 375 Commercial Use SCOs[5]	NY CP-51 Commercial Use SCOs[6]										
8240	1,4-Dioxane	0.1	NC	0.1	NC	130	NC	---	---	---	---	---	---	---	---	---	---
8260	1,4-Dioxane							---	---	---	---	---	---	---	---	---	---
8270	1,4-Dioxane							0.390 U	0.380 U	0.380 U	0.370 U	0.380 U	0.370 U	0.400 U	0.370 U	0.390 U	0.390 U

Notes:

All units in milligrams per kilogram (mg/kg)

Bold - Exceeds 6 NYCRR Part 375 or CP-51 Protection of Groundwater Soil Cleanup Objectives

▨ - Exceeds 6 NYCRR Part 375 Unrestricted Soil Cleanup Objectives or CP-51 Residential Soil Cleanup Objectives

6 NYCRR Part 375 and CP-51 Commercial Soil Cleanup Objectives were not exceeded.

NC - No criteria exists, NA - Not Available

Sample Type Code: N - Normal, FD - Field Duplicate

ft bgs - feet below ground surface

U - Not Detected at the Detection Limit shown

J - Esimated Value

E - Exceeds calibration range and is estimated in value.

--- Not Analyzed

[1] 6 NYCRR Part 375, Table 375-6.8(b): Unrestricted Use Soil Cleanup Objectives, Protection of Public Health, December 14, 2006.

[2] Final Commissioner Policy CP-51, Table 1: Supplimental Soil Cleanup Objectives, Residential, October 21, 2010.

[3] 6 NYCRR Part 375, Table 375-6.8(b): Restricted Use Soil Cleanup Objectives, Protection of Public Health, Protection of Grounwater, December 14, 2006.

[4] Final Commissioner Policy CP-51, Table 1: Supplimental Soil Cleanup Objectives, Protection of Groundwater, October 21, 2010.

[5] 6 NYCRR Part 375, Table 375-6.8(b): Restricted Use Soil Cleanup Objectives, Protection of Public Health, Commercial, December 14, 2006.

[6] Final Commissioner Policy CP-51, Table 1: Supplimental Soil Cleanup Objectives, Commercial, October 21, 2010.

Table 3-2
1,4-Dioxane Analytical Results for Soil Samples at the Former RFM Site
Former ITT Rochester Form Machine Facility
Site #8-28-112
Town of Gates, New York

							Location:	**OBG-SB-14**	**OBG-SB-14**	**OBG-SB-15**	**OBG-SB-15**	**OBG-SB-16**	**OBG-SB-16**	**OBG-SB-16**	**OBG-SB-17**	**OBG-SB-17**	**OBG-SB-18**
							Sample Date:	8/31/2004	8/31/2004	8/31/2004	8/31/2004	9/1/2004	9/1/2004	9/1/2004	9/1/2004	9/1/2004	9/1/2004
							Sample ID:	OBG-SB-14 (2-3)	OBG-SB-14 (9-10.5)	OBG-SB-15 (0-2)	OBG-SB-15 (8-9)	DUP-1_09012004	OBG-SB-16 (5-7.5)	OBG-SB-16 (7.5-9)	OBG-SB-17 (4-7)	OBG-SB-17 (8-9)	OBG-SB-18 (6-7)
							Start Depth (ft bgs):	2	9	0	8	5	5	7.5	4	8	6
							End Depth (ft bgs):	3	10.5	2	9	7.5	7.5	9	7	9	7
							Sample Type Code:	N	N	N	N	N	N	N	N	N	N
USEPA Method	**Analyte**	**Part 375 Unrestricted Use SCOs^1**	**NY CP-51 Residential Use SCOs^2**	**Part 375 Protection of Groundwater SCOs^3**	**NY CP-51 Protection of Groundwater SCOs^4**	**Part 375 Commercial Use SCOs^5**	**NY CP-51 Commercial Use SCOs^6**										
8240	1,4-Dioxane	0.1	NC	0.1	NC	130	NC	---	---	---	---	---	---	---	---	---	**---**
8260	1,4-Dioxane							---	---	---	---	---	---	---	---	---	**---**
8270	1,4-Dioxane							0.390 U	0.390 U	0.360 U	0.390 U	0.400 U	0.410 U	0.370 U	0.390 U	0.370 U	**0.69**

							Location:	**OBG-SB-18**	**OBG-SB-19**	**OBG-SB-19**	**OBG-SB-20**	**OBG-SB-20**	**OBG-SB-20**	**OBG-SB-21**	**OBG-SB-21**	**OBG-SB-22**	**OBG-SB-22**
							Sample Date:	9/1/2004	9/1/2004	9/1/2004	9/1/2004	9/1/2004	9/1/2004	9/1/2004	9/1/2004	9/1/2004	9/1/2004
							Sample ID:	OBG-SB-18 (7-9.5)	OBG-SB-19 (4-7)	OBG-SB-19 (8.5-10)	DUP-2_09012004	OBG-SB-20 (2-4)	OBG-SB-20 (6-7)	OBG-SB-21 (4-6)	OBG-SB-21 (9-10)	OBG-SB-22 (1-2)	OBG-SB-22 (6-7)
							Start Depth (ft bgs):	7	4	8.5	2	2	6	4	9	1	6
							End Depth (ft bgs):	9.5	7	10	4	4	7	6	10	2	7
							Sample Type Code:	N	N	N	N	N	N	N	N	N	N
USEPA Method	**Analyte**	**Part 375 Unrestricted Use SCOs^1**	**NY CP-51 Residential Use SCOs^2**	**Part 375 Protection of Groundwater SCOs^3**	**NY CP-51 Protection of Groundwater SCOs^4**	**Part 375 Commercial Use SCOs^5**	**NY CP-51 Commercial Use SCOs^6**										
8240	1,4-Dioxane	0.1	NC	0.1	NC	130	NC	---	---	---	**---**	**---**	**---**	---	---	---	---
8260	1,4-Dioxane							---	---	---	**---**	**---**	**---**	---	---	---	---
8270	1,4-Dioxane							0.360 U	0.370 U	0.380 U	**0.930 J**	**0.170 J**	**0.600**	0.039 J	0.430 U	0.380 U	0.380 U

							Location:	**OBG-SB-23**	**OBG-SB-23**	**OBG-SB-24**	**OBG-SB-24**	**OBG-SB-25**	**OBG-SB-25**	**OBG-SB-26**	**OBG-SB-26**	**OBG-SB-27**	**OBG-SB-27**
							Sample Date:	9/1/2004	9/1/2004	9/1/2004	9/1/2004	9/1/2004	9/1/2004	9/1/2004	9/1/2004	9/1/2004	9/1/2004
							Sample ID:	OBG-SB-23 (1-2)	OBG-SB-23 (6-7)	OBG-SB-24 (1-2)	OBG-SB-24 (8-9)	OBG-SB-25 (4-6)	OBG-SB-25 (6-8)	OBG-SB-26 (0.5-1.5)	OBG-SB-26 (4-5)	OBG-SB-27 (1-2)	OBG-SB-27 (6.5-7.5)
							Start Depth (ft bgs):	1	6	1	8	4	6	0.5	4	1	6.5
							End Depth (ft bgs):	2	7	2	9	6	8	1.5	5	2	7.5
							Sample Type Code:	N	N	N	N	N	N	N	N	N	N
USEPA Method	**Analyte**	**Part 375 Unrestricted Use SCOs^1**	**NY CP-51 Residential Use SCOs^2**	**Part 375 Protection of Groundwater SCOs^3**	**NY CP-51 Protection of Groundwater SCOs^4**	**Part 375 Commercial Use SCOs^5**	**NY CP-51 Commercial Use SCOs^6**										
8240	1,4-Dioxane	0.1	NC	0.1	NC	130	NC	---	---	---	---	---	---	---	---	---	---
8260	1,4-Dioxane							---	---	---	---	---	---	---	---	---	---
8270	1,4-Dioxane							0.380 U	0.380 U	0.380 U	0.420 U	0.380 U	0.380 U	0.390 U	0.390 U	0.380 U	0.380 U

Notes:

All units in milligrams per kilogram (mg/kg)

Bold - Exceeds 6 NYCRR Part 375 or CP-51 Protection of Groundwater Soil Cleanup Objectives

▨ - Exceeds 6 NYCRR Part 375 Unrestricted Soil Cleanup Objectives or CP-51 Residential Soil Cleanup Objectives

6 NYCRR Part 375 and CP-51 Commercial Soil Cleanup Objectives were not exceeded.

NC - No criteria exists, NA - Not Available

Sample Type Code: N - Normal, FD - Field Duplicate

ft bgs - feet below ground surface

U - Not Detected at the Detection Limit shown

J - Esimated Value

E - Exceeds calibration range and is estimated in value.

--- Not Analyzed

[1] 6 NYCRR Part 375, Table 375-6.8(b): Unrestricted Use Soil Cleanup Objectives, Protection of Public Health, December 14, 2006.

[2] Final Commissioner Policy CP-51, Table 1: Supplimental Soil Cleanup Objectives, Residential, October 21, 2010.

[3] 6 NYCRR Part 375, Table 375-6.8(b): Restricted Use Soil Cleanup Objectives, Protection of Public Health, Protection of Grounwater, December 14, 2006.

[4] Final Commissioner Policy CP-51, Table 1: Supplimental Soil Cleanup Objectives, Protection of Groundwater, October 21, 2010.

[5] 6 NYCRR Part 375, Table 375-6.8(b): Restricted Use Soil Cleanup Objectives, Protection of Public Health, Commercial, December 14, 2006.

[6] Final Commissioner Policy CP-51, Table 1: Supplimental Soil Cleanup Objectives, Commercial, October 21, 2010.

Table 3-2
1,4-Dioxane Analytical Results for Soil Samples at the Former RFM Site
Former ITT Rochester Form Machine Facility
Site #8-28-112
Town of Gates, New York

							Location:	**OBG-SB-28**	**OBG-SB-28**	**SB-1**	**SB-2**	**SB-3**
							Sample Date:	9/1/2004	9/1/2004	10/22/1991	10/22/1991	10/24/1991
							Sample ID:	OBG-SB-28 (1-2)	OBG-SB-28 (10-11)	SB-1_10-22-91	SB-2_10-22-91	SB-3 (1-2)10-24-91
							Start Depth (ft bgs):	1	10	0.5	0.5	1
							End Depth (ft bgs):	2	11	1	1	2
							Sample Type Code:	N	N	N	N	N
USEPA Method	**Analyte**	**Part 375 Unrestricted Use SCOs[1]**	**NY CP-51 Residential Use SCOs[2]**	**Part 375 Protection of Groundwater SCOs[3]**	**NY CP-51 Protection of Groundwater SCOs[4]**	**Part 375 Commercial Use SCOs[5]**	**NY CP-51 Commercial Use SCOs[6]**					
8240	1,4-Dioxane	0.1	NC	0.1	NC	130	NC	---	---	0.005 U	0.005 U	**0.2800**
8260	1,4-Dioxane							---	---	---	---	**---**
8270	1,4-Dioxane							0.390 U	0.370 U	---	---	**---**

							Location:	**SB-3**	**SB-4**	**SB-5**	**SB-6**	**SB-7**
							Sample Date:	10/24/1991	10/24/1991	10/24/1991	10/24/1991	10/23/1991
							Sample ID:	SB-3 (5-7)10-24-91	SB-4 (1-2)10-24-91	SB-5 (1-2)10-24-91	SB-6 (1-2)10-24-91	SB-7_10-23-91
							Start Depth (ft bgs):	5	1	1	1	0.5
							End Depth (ft bgs):	7	2	2	2	1
							Sample Type Code:	N	N	N	N	N
USEPA Method	**Analyte**	**Part 375 Unrestricted Use SCOs[1]**	**NY CP-51 Residential Use SCOs[2]**	**Part 375 Protection of Groundwater SCOs[3]**	**NY CP-51 Protection of Groundwater SCOs[4]**	**Part 375 Commercial Use SCOs[5]**	**NY CP-51 Commercial Use SCOs[6]**					
8240	1,4-Dioxane	0.1	NC	0.1	NC	130	NC	**2.300**	**3.900**	0.005 U	**0.690**	0.005 U
8260	1,4-Dioxane							**---**	**---**	---	**---**	---
8270	1,4-Dioxane							**---**	**---**	---	**---**	---

							Location:	**SB-8**	**SB-9**	**SB-10**	**TD-1**
							Sample Date:	10/23/1991	11/13/1991	10/23/1991	9/3/2004
							Sample ID:	SB-8_10-23-91	SB-9_11-13-91	SB-10_10-23-91	TD-1
							Start Depth (ft bgs):	1	2	2	0
							End Depth (ft bgs):	2	3	3	0.5
							Sample Type Code:	N	N	N	N
USEPA Method	**Analyte**	**Part 375 Unrestricted Use SCOs[1]**	**NY CP-51 Residential Use SCOs[2]**	**Part 375 Protection of Groundwater SCOs[3]**	**NY CP-51 Protection of Groundwater SCOs[4]**	**Part 375 Commercial Use SCOs[5]**	**NY CP-51 Commercial Use SCOs[6]**				
8240	1,4-Dioxane	0.1	NC	0.1	NC	130	NC	**39.000**	0.014	**0.380**	---
8260	1,4-Dioxane							**---**	---	**---**	---
8270	1,4-Dioxane							**---**	---	**---**	0.350 U

Notes:

All units in milligrams per kilogram (mg/kg)

Bold - Exceeds 6 NYCRR Part 375 or CP-51 Protection of Groundwater Soil Cleanup Objectives

▨ - Exceeds 6 NYCRR Part 375 Unrestricted Soil Cleanup Objectives or CP-51 Residential Soil Cleanup Objectives

6 NYCRR Part 375 and CP-51 Commercial Soil Cleanup Objectives were not exceeded.

NC - No criteria exists, NA - Not Available

Sample Type Code: N - Normal, FD - Field Duplicate

ft bgs - feet below ground surface

U - Not Detected at the Detection Limit shown

J - Esimated Value

E - Exceeds calibration range and is estimated in value.

--- Not Analyzed

[1] 6 NYCRR Part 375, Table 375-6.8(b): Unrestricted Use Soil Cleanup Objectives, Protection of Public Health, December 14, 2006.

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[5] 6 NYCRR Part 375, Table 375-6.8(b): Restricted Use Soil Cleanup Objectives, Protection of Public Health, Commercial, December 14, 2006.

[6] Final Commissioner Policy CP-51, Table 1: Supplimental Soil Cleanup Objectives, Commercial, October 21, 2010.

FIGURES

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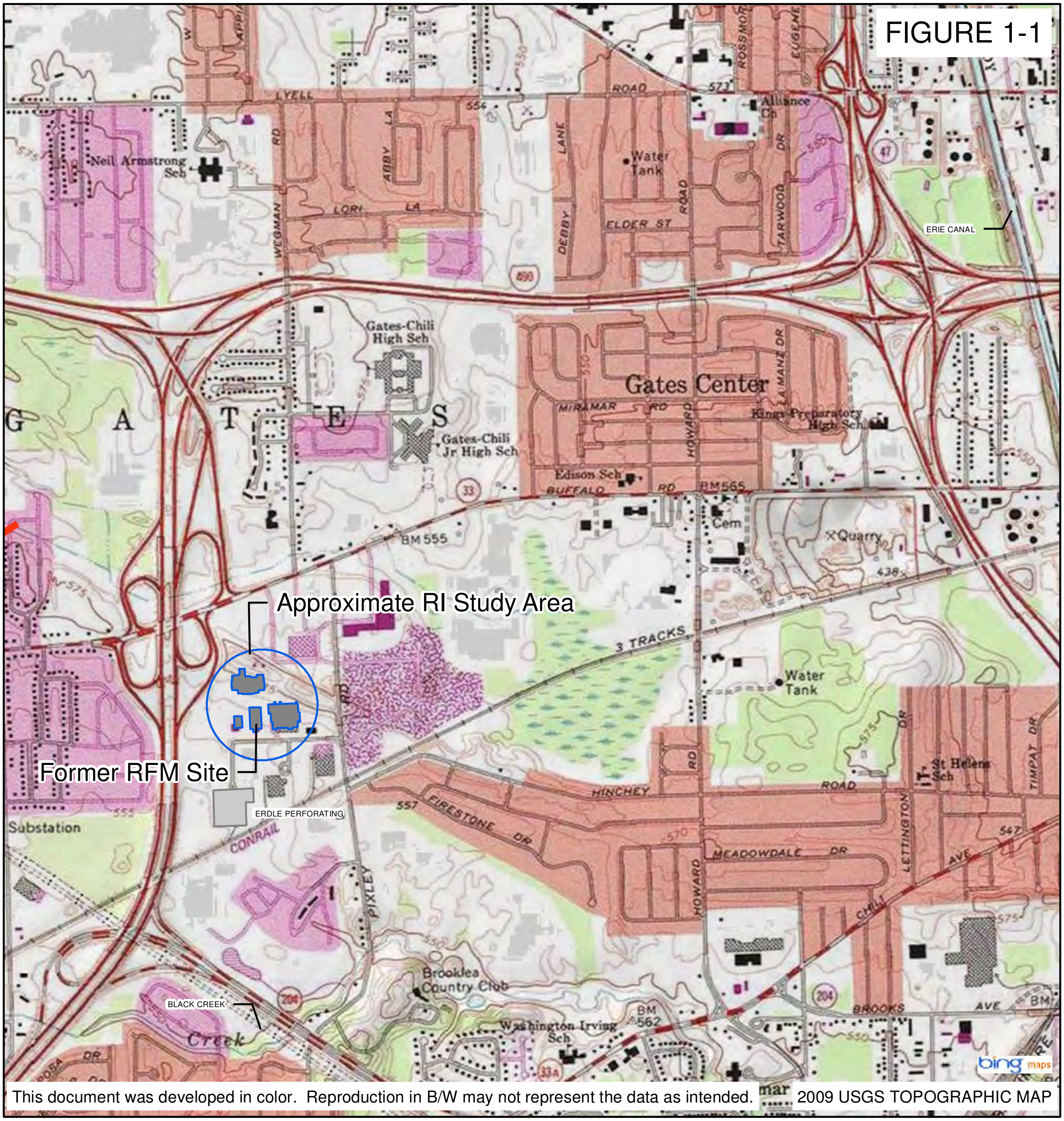
PLOTDATE: 05/31/12 2:10:23 PM NewtonJM

FIGURE 1-1



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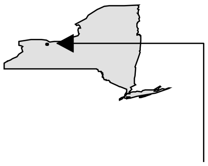
2009 USGS TOPOGRAPHIC MAP

ADAPTED FROM: (BING) USGS ROCHESTER WEST QUADRANGLE

FORMER ITT ROCHESTER FORM MACHINE FACILITY
TOWN OF GATES, NEW YORK
SITE #8-28-112



MAP LOCATION

SITE LOCATION

N

0 1,000 2,000 4,000 6,000 8,000

Feet

1:24,000

MAY 2012
3356.35273

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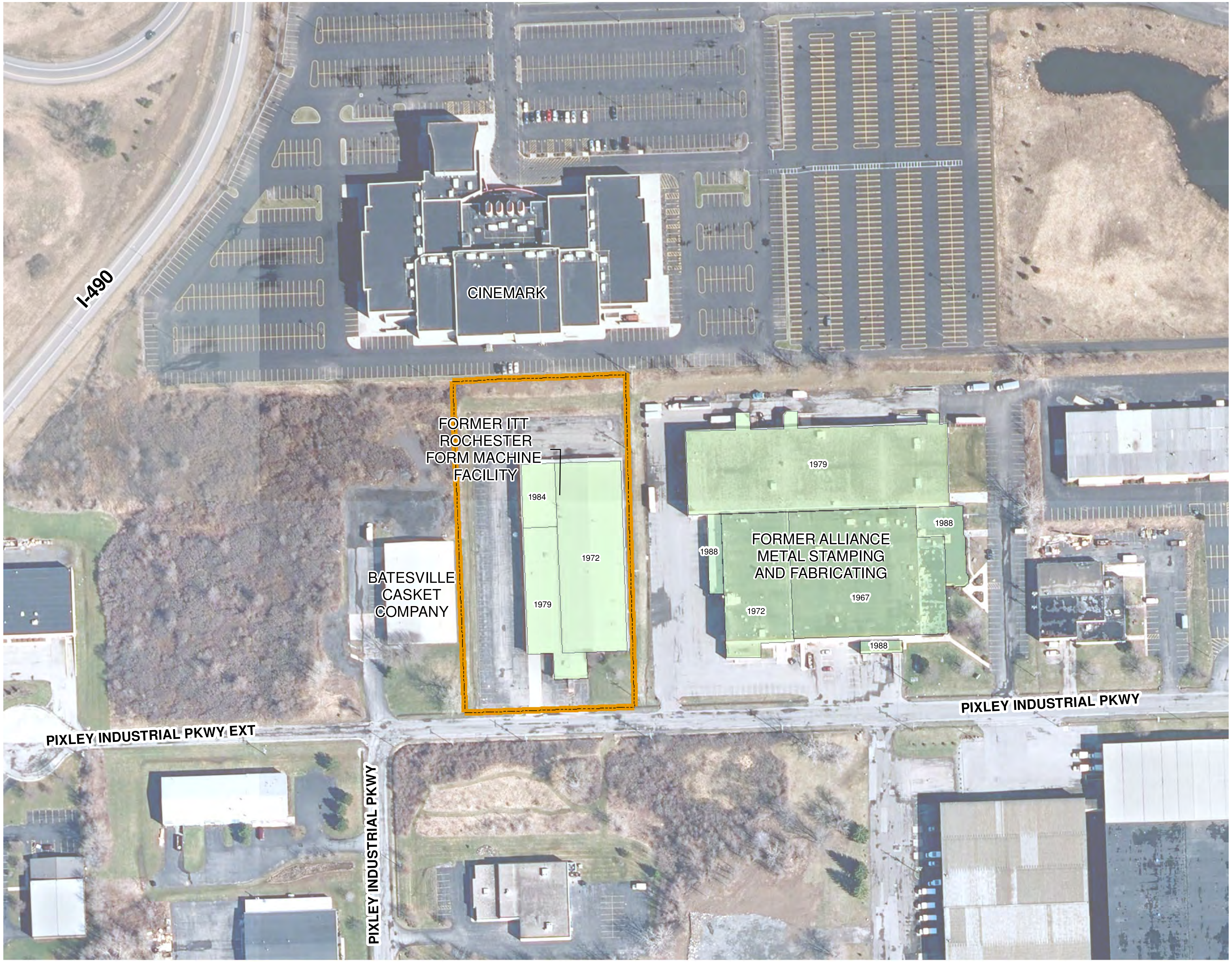

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AERIAL IMAGERY PROVIDED BY NYS GIS CLEARINGHOUSE, DATE APRIL 2009

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FIGURE 1-2

N

LEGEND

🟩 FACILITY ADDITIONS
YEAR OF ADDITION
---- PROPERTY LINE

NOTE:

ADDITIONS TO THE ORIGINAL AMSF FACILITY FOOTPRINT WERE APPROXIMATELY DEFINED USING BUILDING PLANS OBTAINED IN THE GEOSERVICES 1992 BASELINE ENVIRONMENTAL CHARACTERIZATION OF THE AMSF PROPERTY, FIGURE 2.

ADDITIONS TO THE ORIGINAL RFM FACILITY FOOTPRINT WERE APPROXIMATELY DEFINED USING BUILDING PLANS OBTAINED FROM HISTORIC SITE DRAWINGS.

FORMER ITT ROCHESTER FORM
MACHINE FACILITY
TOWN OF GATES, NEW YORK
SITE #8-28-112

SITE PLAN

0 75 150 300
Feet

SEPTEMBER 2014
3356.35273

O'BRIEN & GERE

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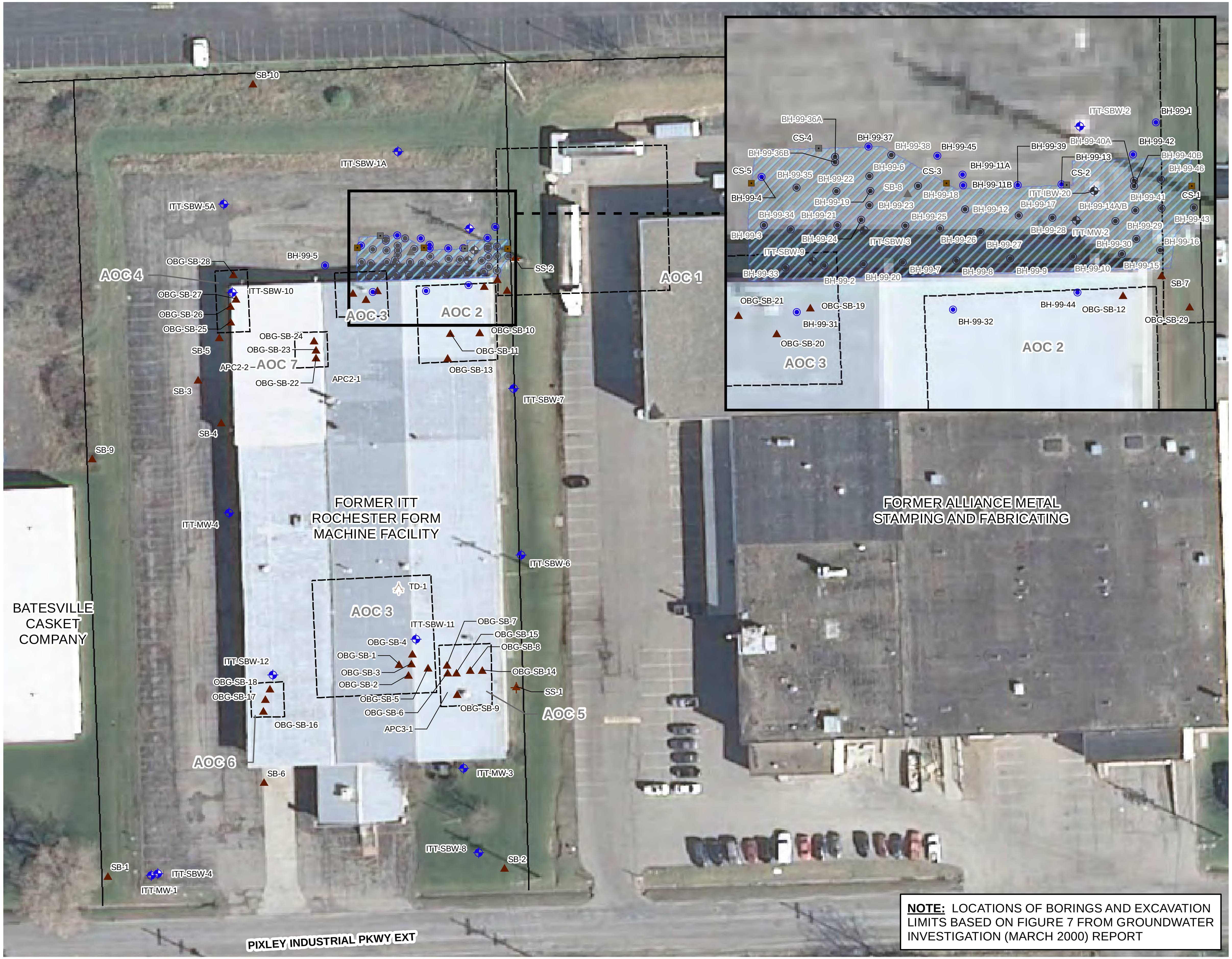

NOTE: LOCATIONS OF BORINGS AND EXCAVATION LIMITS BASED ON FIGURE 7 FROM GROUNDWATER INVESTIGATION (MARCH 2000) REPORT

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FIGURE 2-1

N

LEGEND

LOCATION TYPE

- ■ CONFIRMATION SAMPLE
- ◉ GEOPROBE
- ⊕ MONITORING WELL
- ▲ SOIL BORING
- ✦ SS
- ✧ TRENCH DRAIN SAMPLE
- ■ EXCAVATED CONFIRMATION SAMPLE
- ◉ EXCAVATED GEOPROBE
- ⊕ EXCAVATED MONITORING WELL
- ▲ EXCAVATED SOIL BORING
- ⬚ AREA OF CONCERN (AOC)
- ▨ 1999 FORMER RFM SOIL REMEDIATION AREA
- — PROPERTY LINE

FORMER ITT ROCHESTER FORM
MACHINE FACILITY
TOWN OF GATES, NEW YORK
SITE #8-28-112

SOIL SAMPLING LOCATIONS ON THE FORMER RFM SITE

0 30 60 120
Feet

NOVEMBER 2014
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NOTE: LOCATIONS OF BORINGS AND EXCAVATION LIMITS BASED ON FIGURE 7 FROM GROUNDWATER INVESTIGATION (MARCH 2000) REPORT

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FIGURE 2-2

N

LEGEND

LOCATION TYPE

- ■ CONFIRMATION SAMPLE
- ◉ GEOPROBE
- ⊕ MONITORING WELL
- ▲ SOIL BORING
- ✦ SURFACE SOIL
- ■ EXCAVATED HISTORIC CONFIRMATION SAMPLE
- ◉ EXCAVATED HISTORIC GEOPROBE
- ⊕ EXCAVATED HISTORIC MONITORING WELL
- ▲ EXCAVATED HISTORIC SOIL BORING
- ▨ 1999 FORMER RFM SOIL REMEDIATION AREA
- ⬚ AREA OF CONCERN (AOC)
- — PROPERTY LINE

FORMER ITT ROCHESTER FORM
MACHINE FACILITY
TOWN OF GATES, NEW YORK
SITE #8-28-112

SUBSURFACE SOIL SAMPLING LOCATIONS AT THE 1999 EXCAVATION AREA AT THE FORMER RFM SITE

0 5 10 20
Feet

NOVEMBER 2014
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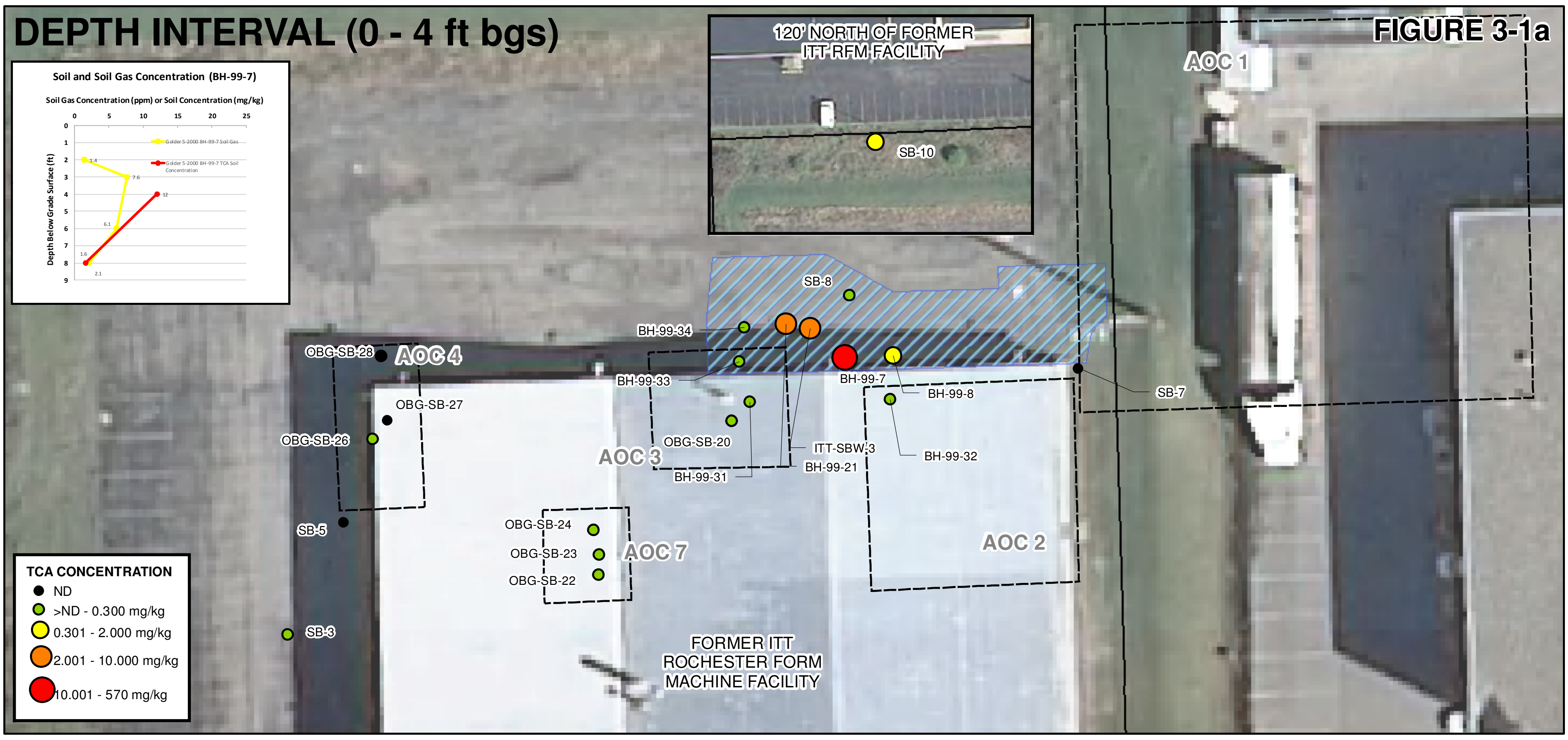

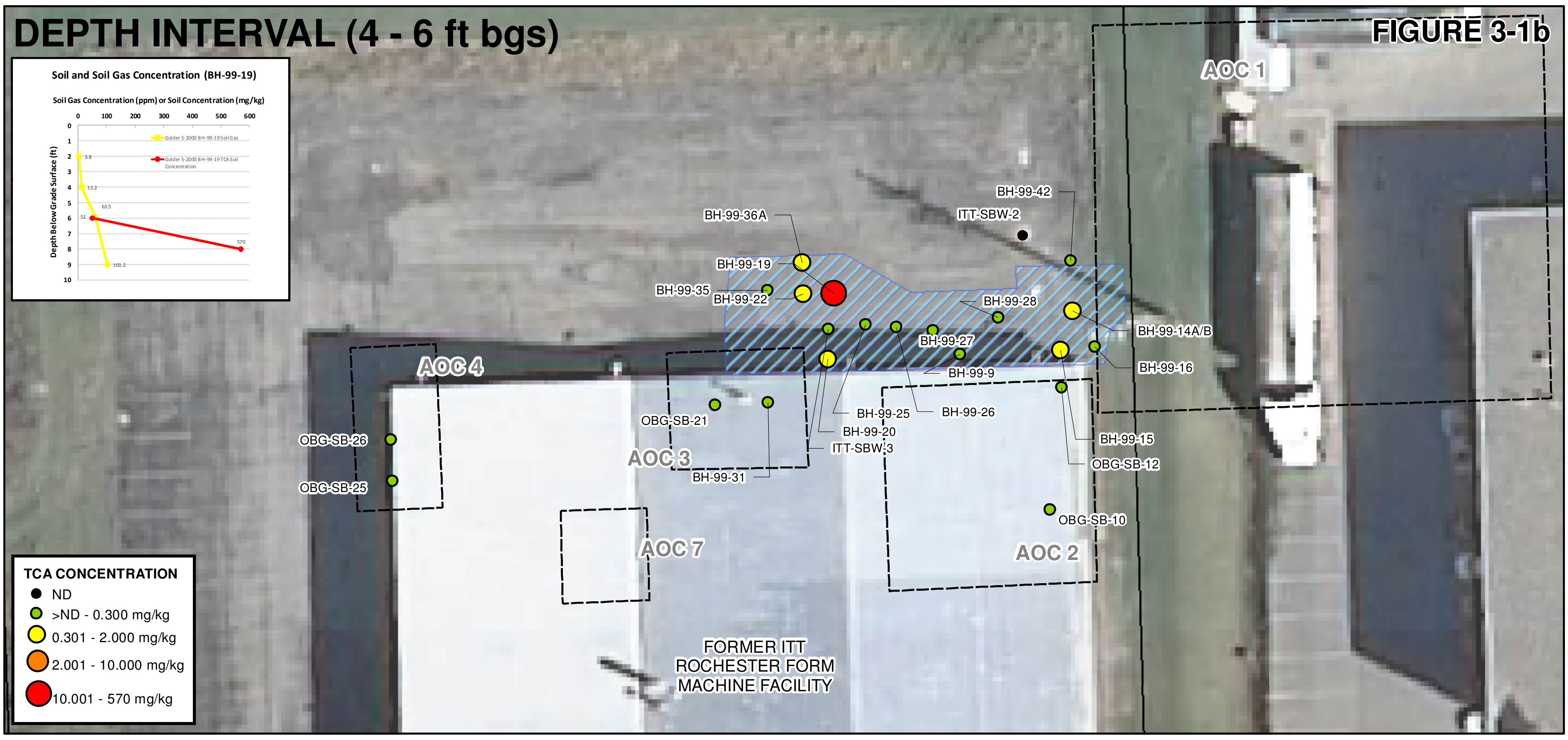

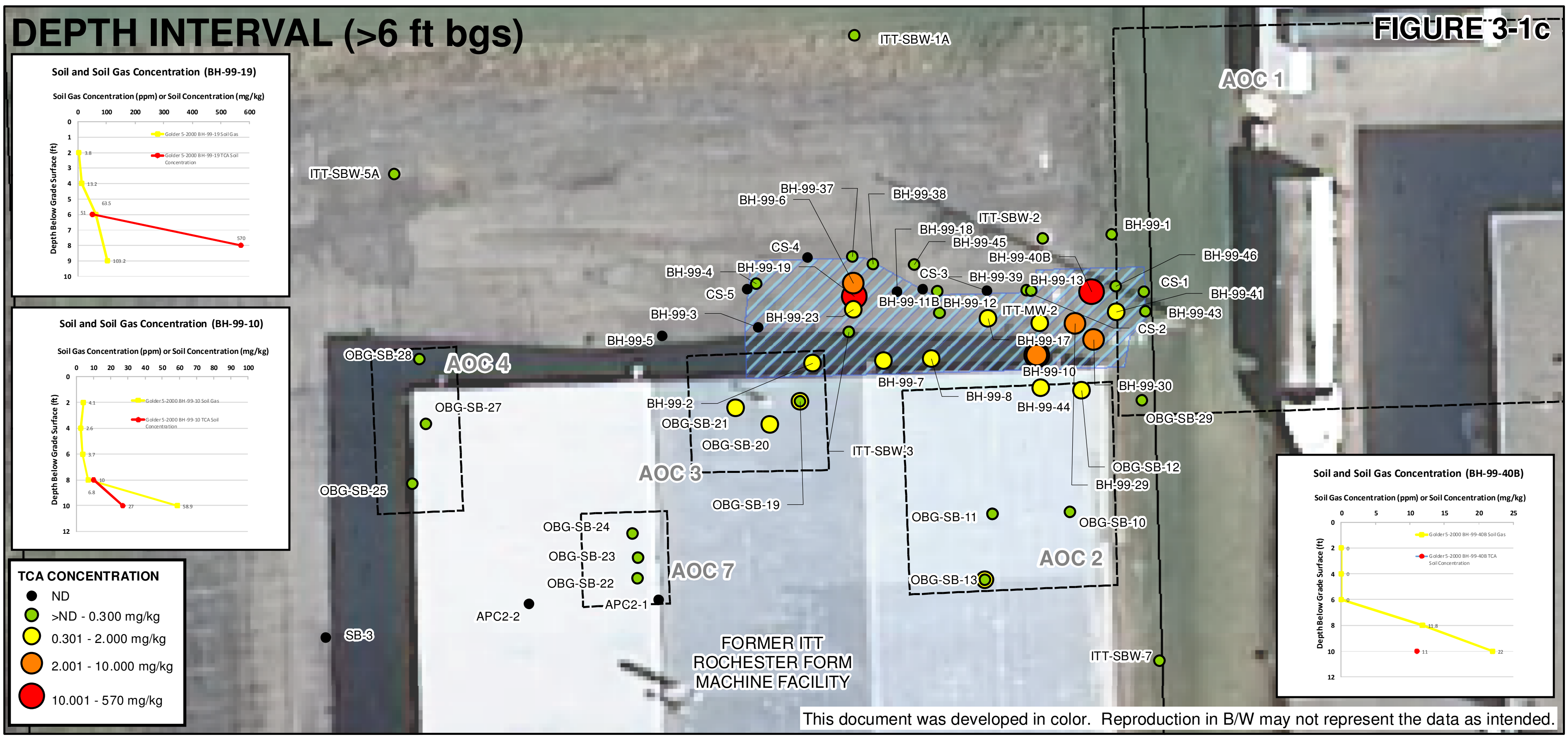

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LEGEND

- PROPERTY LINE
- AREA OF CONCERN (AOC)
- 1999 FORMER RFM SOIL REMEDIATION AREA

NOTE: LOCATIONS OF BORINGS AND EXCAVATION LIMITS BASED ON FIGURE 7 FROM GROUNDWATER INVESTIGATION (MARCH 2000) REPORT

TCA CONCENTRATIONS IN SOIL AT THE FORMER RFM SITE

FORMER ITT ROCHESTER FORM
MACHINE FACILITY
TOWN OF GATES, NEW YORK
SITE #8-28-112

N

0 15 30 60
Feet

FIGURE 3-1

NOVEMBER 2014
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FIGURE 3-2

N

LEGEND

- ⬚ AREA OF CONCERN (AOC)
- ▨ 1999 FORMER RFM SOIL REMEDIATION AREA
- — PROPERTY LINE

1,4-DIOXANE CONCENTRATION

- ● ND
- ● <0.130 mg/kg
- ● 0.130 - 0.170 mg/kg
- ● 0.170 - 0.690 mg/kg
- ● 0.690 - 0.930 mg/kg

NOTE:
-ANALYTICAL RESULTS PRESENTED ARE FROM USEPA METHOD 8270.
-MULTIPLE COLOR DOTS AT A LOCATION REPRESENT MULTIPLE SAMPLES WITHIN DEPTH INTERVAL
-LOCATIONS OF BORINGS AND EXCAVATION LIMITS BASED ON FIGURE 7 FROM GROUNDWATER INVESTIGATION (MARCH 2000) REPORT

FORMER ITT ROCHESTER FORM
MACHINE FACILITY
TOWN OF GATES, NEW YORK
SITE #8-28-112

1,4-DIOXANE CONCENTRATIONS IN SOIL AT THE FORMER RFM SITE

0 30 60 120
Feet

NOVEMBER 2014
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Appendix B

Basis of Alternative 5 Screening Cost

APPENDIX B. Basis of Alternative 5 Screening Cost

	Treatment to 55-ft	Treatment to 110-ft
Thermal Treatment - 42,000 square feet - Per TRS Quotations prepared 4/23/2015 and 4/29/2016; attached - Does not include groundwater flow management to mitigate heat loss due to high flow rates	$ 6,589,000	$ 11,867,000
Groundwater Flow Management - Reduce groundwater flow to 1.0 fps to control heat loss; see vendor correspondence attached - May not be achievable based on site conditions; see note	Not Estimated	Not Estimated
Common Remedial Components - Site security fencing - Develop Site Management Plan - Abandon recharge well - Excavation/Disposal of surface soils (30 cubic yards) - Pavement Repair (100 square feet)	$ 132,000	$ 132,000
Indirect Costs - Engineering/Design Field Oversight (10%) - Legal (2%) - Contingency (15%)	$ 1,815,000	$ 3,240,000
Post Treatment Groundwater Monitoring - 20 wells sampled annually for 5 years - Site inspection and reporting - Present worth value at 7% Discount Factor	$ 195,000	$ 195,000
Estimated Conceptual Construction Cost, without necessary groundwater control	**$ 8,731,000**	**$ 15,434,000**

Note. Costs for bedrock groundwater flow control under conditions greater than 1 ft/day are not provided because no feasible method of limiting flow of bedrock groundwater into the treatment zone was identified. As discussed in Section 7.2.2 of the Revised Feasibility Report (April, 2016) both hydraulic and physical approaches to control groundwater flow were considered, but no successful technology could be identified.

Gates Option 3 Remediation Parameters

www.thermalrs.com

Electrical Resistance Heating Treatment Area:	42,000 sq. ft	
Average Shallow Extent of ERH:	2 ft	
Average Deep Extent of ERH:	110 ft	
Typical Depth to Groundwater:	10 ft	
Treatment Volume:	168,000 cu. yd	
Assumed Total Organic Carbon Content of Soil:	0.25%	
Number of Electrodes:	158	
Electrode Boring Diameter (in.):	12-inch o.d.	
Average Distance Between Electrodes:	17.5 ft	
Total Depth of Electrodes:	111 ft	
Depth to Top of Electrode Conductive Zone:	4 ft	
Number of Co-located Vapor Recovery Wells:	158	
Number of Temperature Monitoring Points:	18 (avg. 23 sensors each)	
Is a New Surface Cap Required?	no	
	Hydrolysis Controlled	
Controlling Contaminant:	1,1,1-TCA	
Average Clean-up Percent:	99.8%	
Assumed VOC Mass:	820 lb	This VOC mass is based on an assumed average conc. of 2 mg/kg.
Vapor Recovery Air Flow Rate:	1840 scfm using a 130-hp vapor recovery blower	
Condensate Production Rate:	5 gpm	
Vapor Treatment Method:	carbon	
Assumed Activated Carbon Required:	10,000 lb	
Power Control Unit (PCU) Capacity:	6000 kW	
Average Electrical Heating Power Input:	3480 kW	
Total Heating Treatment Time:	192 - 256 days	
Design Remediation Energy (kWh):	17,810,000	An additional 550,000 kWh is used by surface equipment.
Assumed Number of Confirmatory Borings:	18	With 11 soil samples per boring. Budget for 317 total confirmatory samples.

The above remediation parameters are estimated +/- 20%. Final parameters will be determined during system design.

Budgetary (+/- 20%) Standard Fixed Price for Gates Option 3

Price Charged by TRS Group	**Price**	**Percent**	
Design, Work Plans, Permits:	$454,000	4%	
Electrode Materials Mobilization:	$2,194,000	18%	Payment due before starting field work.
Subsurface Installation:	$581,000	5%	
Surface Installation and Start-up:	$1,131,000	10%	
Remediation System Operation:	$2,635,000	22%	
Demobilization and Final Report:	$116,000	1%	
Total TRS Price	**$7,111,000**	**60%**	Based on net 30 day payment. Add 1% for net 60 days.

The above cost estimate is valid for 30 days from 04/23/2015.

Estimated Costs by Others	**Cost**	**Percent**	**Key Assumptions**
TRS recommends getting quotes to verify Costs by Others.			
Drilling and Soil Sampling:	$2,134,000	18%	assumes $94 per ft
Drill Cuttings and Waste Disposal:	$207,000	2%	assumes $300 per ton
Electrical Permit and Utility Connection to PCU:	$120,000	1%	This is a highly variable cost.
Electrical Energy Usage:	$2,203,000	19%	assumes $0.12 per kWh
Carbon Usage, Transportation & Regeneration:	$26,000	0%	assumes $2.60 per lb
Condensate Disposal:	$0	0%	condensate disposal by TRS
Other Operational Costs:	$66,000	1%	includes vapor sampling
Total Estimated Costs by Others	**$4,756,000**	**40%**	

carbon neutral info

Total Estimated Remediation Cost:	**$11,867,000**	**$71 per cu. yd**	
Go Carbon Neutral (No Net CO_2), Add:	**$128,500**	**1%**	***Ask us how!***

Prepared for Luke McKenney, 315-956-6402, luke.mckenney@obg.com

Some Included Items for Remediation of Gates Option 3

Design, Work Plans, Permits:	**TRS Scope**	**Shared Scope**	**Scope by Others**	**Estimated Cost by Others (included above)**
Design or "Kick-off" Meeting	□	■	□	
Work Plan	□	■	□	
Health and Safety Plan	□	■	□	
QA/QC Plan	□	□	□	
Sample Analysis Plan	□	□	□	
Air Permit	□	■	□	
Sewer Discharge Permit	□	■	□	
Regulatory Negotiations and Client Interface	□	□	■	difficult for TRS to estimate
Subsurface Installation:				
Pre-installation Building Structural Survey	□	□	□	
Electrode Materials and Well Screen	■	□	□	
Drilling Subcontractor for Electrodes	□	□	■	$1,639,803 for 17,538 ft
Drilling Subcontractor for VR Wells	□	□	□	co-located with electrodes
Drilling Subcontractor for TMPs	□	□	■	$77,033 for 1,980 ft
Drilling Subcontractor for New MWs	□	□	□	
Abandonment/Replacement of Existing PVC Wells	□	□	■	difficult for TRS to estimate
Concrete Coring	□	□	■	$25,366 for 176 cores.
Utility Locator Survey	□	□	■	$1,507
Installation (pre-ERH) Soil Sample Analysis	□	□	■	$54,450 for 198 samples.
Drill Cutting Disposal	□	□	■	$206,700 for 689 tons
Drill Cutting Disposal Labor	□	□	■	$21,582
Forklift or Skid-Steer for Drilling	□	□	■	$3,223
Photoionization Detector for Drilling	□	□	■	$8,943
Boring Logs and Report	□	□	■	$7,480
TRS On-Site Electrode Installation Supervision	■	□	□	assumes 90 work days of drilling
Traffic-rated Well Vaults and Installation	□	□	□	
Trenching and Restoration	□	□	□	
New Surface Cap	□	□	□	not required
Biological Amendment and Addition	□	□	□	
Surface Installation and Start-up:				
Surface Remediation Equipment Mobilization	■	□	□	
Crane to Offload/Position Equipment	■	□	□	
Perimeter Fence and Security System	■	□	□	
Vapor Recovery Piping	■	□	□	
Steam Condenser	■	□	□	
40 hp VR Blowers	■	□	□	
Granular Activated Carbon and Regeneration	□	□	■	$26,000 for 10,000 lb
0 scfm Chlorinated VOC Oxidizer	□	□	□	
Oil-Water Separator	□	□	□	not required
Equipment Sound Wall	■	□	□	
Electrical Permit and Utility Connection to PCU	□	□	■	assumed to be $120,000
Telephone Connection to PCU	■	□	□	
Garden Hose Connection to Condenser	■	□	□	
Remediation System Operation:				
ERH Control and Temperature Monitoring	■	□	□	
Vapor Sampling and Analysis	□	□	■	$29,766 for 116 samples.
Condensate/Discharge Sampling and Analysis	□	□	■	$9,839 for 43 samples.
Sampling Labor and Operational Checks	□	□	■	$26,290 for 250 hours.
Groundwater Sampling and Analysis	□	□	■	difficult for TRS to estimate
Electricity Usage	□	□	■	$2,203,000 for 18,360,000 kWh.
Offset for Carbon Dioxide Emissions	□	□	□	
Water/Condensate Disposal	■	□	□	
Separate Phase Product Disposal	□	□	□	none expected
Demobilization and Final Report:				
Drilling Subcontractor for Confirmatory Borings	□	□	■	$112,830 for 3,190 ft
Soil Sample Analysis	□	□	■	$79,250 for 317 samples.
Well Abandonment	□	□	■	$71,040 for 158 wells.
Demobilize Surface Equipment	■	□	□	
Final Report	□	■	□	

Gates Option 4 Remediation Parameters

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Electrical Resistance Heating Treatment Area: 42,000 sq. ft
Average Shallow Extent of ERH: 2 ft
Average Deep Extent of ERH: 55 ft
Typical Depth to Groundwater: 10 ft
Treatment Volume: 82,400 cu. yd
Assumed Total Organic Carbon Content of Soil: 0.25%

Number of Electrodes: 158
Electrode Boring Diameter (in.): 12-inch o.d.
Average Distance Between Electrodes: 17.5 ft
Total Depth of Electrodes: 56 ft
Depth to Top of Electrode Conductive Zone: 4 ft
Number of Co-located Vapor Recovery Wells: 158
Number of Temperature Monitoring Points: 18 (avg. 12 sensors each)
Is a New Surface Cap Required? no
Hydrolysis Controlled
Controlling Contaminant: 1,1,1-TCA
Average Clean-up Percent: 99.8%
Assumed VOC Mass: 400 lb — This VOC mass is based on an assumed average conc. of 2 mg/kg.
Vapor Recovery Air Flow Rate: 1400 scfm using a 100-hp vapor recovery blower
Condensate Production Rate: 4 gpm

Vapor Treatment Method: carbon
Assumed Activated Carbon Required: 8,000 lb

Power Control Unit (PCU) Capacity: 4500 kW
Average Electrical Heating Power Input: 2603 kW
Total Heating Treatment Time: 119 - 159 days
Design Remediation Energy (kWh): 8,290,000 — An additional 250,000 kWh is used by surface equipment.
Assumed Number of Confirmatory Borings: 18 — With 6 soil samples per boring. Budget for 173 total confirmatory samples.

The above remediation parameters are estimated +/- 20%. Final parameters will be determined during system design.

Budgetary (+/- 20%) Standard Fixed Price for Gates Option 4

Price Charged by TRS Group	**Price**	**Percent**	
Design, Work Plans, Permits:	$330,000	5%	
Electrode Materials Mobilization:	$1,111,000	17%	Payment due before starting field work.
Subsurface Installation:	$327,000	5%	
Surface Installation and Start-up:	$938,000	14%	
Remediation System Operation:	$1,382,000	21%	
Demobilization and Final Report:	$67,000	1%	
Total TRS Price	**$4,155,000**	**63%**	Based on net 30 day payment. Add 1% for net 60 days.

The above cost estimate is valid for 30 days from 04/29/2016.

Estimated Costs by Others	**Cost**	**Percent**	**Key Assumptions**
TRS recommends getting quotes to verify Costs by Others.			
Drilling and Soil Sampling:	$1,123,000	17%	assumes $94 per ft
Drill Cuttings and Waste Disposal:	$104,000	2%	assumes $300 per ton
Electrical Permit and Utility Connection to PCU:	$120,000	2%	This is a highly variable cost.
Electrical Energy Usage:	$1,025,000	16%	assumes $0.12 per kWh
Carbon Usage, Transportation & Regeneration:	$22,000	0%	assumes $2.70 per lb
Condensate Disposal:	$0	0%	condensate disposal by TRS
Other Operational Costs:	$40,000	1%	includes vapor sampling
Total Estimated Costs by Others	**$2,434,000**	**37%**	

carbon neutral info

Total Estimated Remediation Cost: **$6,589,000** **$80 per cu. yd**

Go Carbon Neutral (No Net CO$_2$), Add: **$59,800** **1%** ***Ask us how!***

Prepared for Luke McKenney, 315-956-6402, luke.mckenney@obg.com

Some Included Items for Remediation of Gates Option 4

Design, Work Plans, Permits:	**TRS Scope**	**Shared Scope**	**Scope by Others**	**Estimated Cost by Others (included above)**
Design or "Kick-off" Meeting	☐	■	☐	
Work Plan	☐	■	☐	
Health and Safety Plan	☐	■	☐	
QA/QC Plan	☐	☐	☐	
Sample Analysis Plan	☐	☐	☐	
Air Permit	☐	■	☐	
Sewer Discharge Permit	☐	■	☐	
Regulatory Negotiations and Client Interface	☐	☐	■	difficult for TRS to estimate
Subsurface Installation:				
Pre-installation Building Structural Survey	☐	☐	☐	
Electrode Materials and Well Screen	■	☐	☐	
Drilling Subcontractor for Electrodes	☐	☐	■	$827,288 for 8,848 ft
Drilling Subcontractor for VR Wells	☐	☐	☐	co-located with electrodes
Drilling Subcontractor for TMPs	☐	☐	■	$38,522 for 990 ft
Drilling Subcontractor for New MWs	☐	☐	☐	
Abandonment/Replacement of Existing PVC Wells	☐	☐	■	difficult for TRS to estimate
Concrete Coring	☐	☐	■	$25,366 for 176 cores.
Utility Locator Survey	☐	☐	■	$1,507
Installation (pre-ERH) Soil Sample Analysis	☐	☐	■	$29,700 for 108 samples.
Drill Cutting Disposal	☐	☐	■	$104,100 for 347 tons
Drill Cutting Disposal Labor	☐	☐	■	$11,902
Forklift or Skid-Steer for Drilling	☐	☐	■	$3,223
Photoionization Detector for Drilling	☐	☐	■	$7,183
Boring Logs and Report	☐	☐	■	$7,480
TRS On-Site Electrode Installation Supervision	■	☐	☐	assumes 73 work days of drilling
Traffic-rated Well Vaults and Installation	☐	☐	☐	
Trenching and Restoration	☐	☐	☐	
New Surface Cap	☐	☐	☐	not required
Biological Amendment and Addition	☐	☐	☐	
Surface Installation and Start-up:				
Surface Remediation Equipment Mobilization	■	☐	☐	
Crane to Offload/Position Equipment	■	☐	☐	
Perimeter Fence and Security System	■	☐	☐	
Vapor Recovery Piping	■	☐	☐	
Steam Condenser	■	☐	☐	
40 hp VR Blowers	■	☐	☐	
Granular Activated Carbon and Regeneration	☐	☐	■	$22,000 for 8,000 lb
0 scfm Chlorinated VOC Oxidizer	☐	☐	☐	
Oil-Water Separator	☐	☐	☐	not required
Equipment Sound Wall	■	☐	☐	
Electrical Permit and Utility Connection to PCU	☐	☐	■	assumed to be $120,000
Telephone Connection to PCU	■	☐	☐	
Garden Hose Connection to Condenser	■	☐	☐	
Remediation System Operation:				
ERH Control and Temperature Monitoring	■	☐	☐	
Vapor Sampling and Analysis	☐	☐	■	$17,113 for 65 samples.
Condensate/Discharge Sampling and Analysis	☐	☐	■	$6,386 for 22 samples.
Sampling Labor and Operational Checks	☐	☐	■	$16,863 for 149 hours.
Groundwater Sampling and Analysis	☐	☐	■	difficult for TRS to estimate
Electricity Usage	☐	☐	■	$1,025,000 for 8,540,000 kWh.
Offset for Carbon Dioxide Emissions	☐	☐	☐	
Water/Condensate Disposal	■	☐	☐	
Separate Phase Product Disposal	☐	☐	☐	none expected
Demobilization and Final Report:				
Drilling Subcontractor for Confirmatory Borings	☐	☐	■	$56,420 for 1,595 ft
Soil Sample Analysis	☐	☐	■	$43,250 for 173 samples.
Well Abandonment	☐	☐	■	$48,270 for 158 wells.
Demobilize Surface Equipment	■	☐	☐	
Final Report	☐	■	☐	

Trevor Staniec

From: Michelle Nanista <mnanista@thermalrs.com>
Sent: Friday, April 29, 2016 12:35 PM
To: Trevor Staniec
Cc: David Fleming; Tracy Ashlock Barton
Subject: P1859 Gates, NY Groundwater Pumping System

Trevor,

Based on previous discussions and emails with Luke, the Gates, New York site has high permeability soils and the potential for high groundwater flow rates through the treatment volume. We also discussed a scenario where there is no gradient to drive groundwater flow through the treatment area.

Groundwater flow through an ERH treatment region is a factor we must pay close attention to as the groundwater will carry heat with it. If the groundwater flow rate is high, it will result in increased heat loss that our system must be designed to counteract. In some situations, the groundwater flow rate is so high, that an upgradient pumping system should be installed to slow the flow of groundwater through the treatment area. This has been done on previous ERH projects when the goal is just to slow the groundwater flow rate through the treatment area to protect against increased heat loss. We begin to evaluate increased heat loss with groundwater velocities around 0.5 ft/day. Around 1 ft/day is when we suggest evaluating an upgradient pumping system.

If your review of the gradient data indicates velocities do not exceed 1 ft/day, then the ERH system would be effective, even with high permeability soils. During an ERH remediation as water is converted to steam and the steam is recovered with the vapor recovery system, there will be a natural influx of cooler water into the treatment area from outside – either laterally or below the treatment volume. This is a slow and continual process once we reach steaming temperatures. The ERH system can supply the energy required to heat this new groundwater. It is actually because of this that we design our electrodes to have a total depth 1 to 2 ft deeper than the target treatment interval. So if the target treatment interval is to 25 ft bgs, the electrodes will actually extend to 26 or 27 ft bgs.

Thanks,

Michelle Nanista
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