Former Hampshire Chemical Corp. Facility, Waterloo, New York, Site No. 850001A

Sitewide Corrective Measures Study

Final

February 2020

Hampshire Chemical Corporation

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Contents

Tables

Figures

Acronyms and Abbreviations

µg/L	micrograms per liter
amsl	above mean sea level
AOC	area of concern
bgs	below ground surface
CH2M	CH2M HILL Engineers, Inc.
CMS	corrective measures study
COC	constituent of concern
CSM	conceptual site model
DER	Division of Environmental Remediation
Dow	The Dow Chemical Company
HCC	Hampshire Chemical Corp.
IC	institutional control
ICM	interim corrective measure
Jacobs	Jacobs Engineering Group Inc.
LTM	long-term monitoring
MIBK	methyl isobutyl ketone (4-methyl-2-pentanone)
MNA	monitored natural attenuation
MPA	mercaptopropionic acid
NFA	no further action
NYSDEC	New York State Department of Environmental Conservation
O&M	operations and maintenance
OB&G	O'Brien & Gere Engineers, Inc.
PCB	polychlorinated biphenyl
QAPP	quality assurance project plan
QC	quality control
RAO	remedial action objective
RCRA	Resource Conservation and Recovery Act
RFI	Resource Conservation and Recovery Act facility investigation
RTA	remedial target area
SAOC	Second Amended Order on Consent
SMP	site management plan
SPDES	State Pollutant Discharge Elimination System
SVOC	semivolatile organic compound
SWMU	solid waste management unit
TAL	target analyte list
TOGS	Technical and Operational Guidance Series

USEPA	U.S. Environmental Protection Agency
VOC	volatile organic compound
WWTP	wastewater treatment plant

1. Introduction

Hampshire Chemical Corporation (HCC) is submitting this Resource Conservation and Recovery Act (RCRA) Corrective Measures Study (CMS) Report for the former HCC facility located at 228 East Main Street, Waterloo, New York (facility; Figure 1-1). HCC has retained environmental liabilities for the facility in accordance with the Order on Consent signed with New York State Environmental Conservation (NYSDEC 2002, 2004, 2011). Evans Chemetics, a wholly owned subsidiary of Bruno Bock, currently owns and operates the facility.

In 2004, HCC retained CH2M HILL Engineers, Inc. (CH2M) to perform sitewide environmental work. In December 2018, CH2M was acquired by Jacobs Engineering Group Inc (Jacobs).

1.1 Purpose and Objectives

Two areas (Solid Waste Management Unit [SWMU] 1 and Area of Concern [AOC] A) have been addressed by separate CMS, and the final remedies for these two areas have been completed and approved by NYSDEC. These two areas have been administratively completed and are not addressed in this CMS. Interim corrective measure (ICM) work plans were submitted and approved by NYSDEC for three AOCs (B, C and D). The ICMs were completed and approved by NYSDEC with the understanding that they could serve as final remedies if sufficiently protective. The remedial alternatives were evaluated and selected in the respective ICM work plans and therefore are not reevaluated herein.

This CMS report presents an overview of facility conditions and investigations completed for each AOC or SWMU and the corrective measures (if necessary) at each area. The ICMs for AOC B, C, and D are evaluated as final remedies.

1.2 Facility Description and Background

The facility is located at 228 East Main Street, Waterloo, New York, which is within Seneca County, New York. As shown on Figure 1-2, the main portion of the facility is bordered to the north by East Main Street, to the east by Gorham Street, to the west by East Water Street, and to the south by the Cayuga-Seneca Canal (canal). The facility also includes a property currently owned by Evans Chemetics on the eastern side of Gorham Street, which is used as a parking lot. The facility is surrounded by residential properties (north, east, and southwest) and commercial businesses (west).

The facility consists of 11.11 acres of industrially developed land, including the fenced manufacturing facility and the Gorham Street parking lot. It contains interconnected buildings used as offices; a quality control (QC) laboratory; manufacturing, maintenance, and shipping/receiving operations; and a wastewater treatment plant (WWTP). The facility also has outside drum storage areas and several aboveground storage tanks. An undeveloped open area containing a former dump (SWMU 1) is located near its southwestern boundary.

1.2.1 Facility History

The facility was first owned and operated by the Waterloo Woolen Manufacturing Company, which operated a woolen textile mill from before 1839[1] until approximately 1936, when the mill was closed. Evans Chemetics reopened the facility in 1943 and produced divalent organic sulfur chemical intermediates, which are manufactured there to this day. W. R. Grace Company acquired the facility in 1979, which remained a part of Grace's Organic Chemical Division until 1992, when HCC completed a management buyout of the Organic Chemical Division. Evans Chemetics was part of the management buyout, and the facility became an operating unit of HCC.

[1] The oldest standing onsite building dates from 1839; however, there are indications that buildings were onsite prior to that time.

In 1995, while HCC owned the facility, HCC was purchased by and became a wholly owned subsidiary of Sentrachem, Ltd., a South African chemical company. In 1997, Sentrachem was acquired as a wholly owned subsidiary of The Dow Chemical Company (Dow). In 2005, Dow sold the facility (as well as other assets of Evans Chemetics) to Bruno Bock[2], a German manufacturing company. Evans Chemetics LP is now a wholly owned subsidiary of Bruno Bock and operates the facility.

The facility has undergone significant changes over time. Several buildings were constructed in the 1800s at the facility, some of which are still standing, while others were demolished. The canal and raceway system was much more extensive in the 1800s and early 1900s than it is today. By 1948, most of the canals and raceways were filled and covered (O'Brien & Gere Engineers, Inc. [OB&G] 2003). Figure 1-2 depicts the current facility configuration.

No detailed information is available on the type of operations, processes or raw materials used, or waste management practices at the former woolen mill. The available information suggests Building 4 was the main production building and contained a pit that was used for wool dyeing. Liquid waste from this process was discharged to the canal through outfalls, some of which are abandoned and others that are still in use today. The main outfall from the Building 4 Pit, which is now abandoned, was Outfall 002 (Figure 1-2). From operational records, it appears that storage of many of the raw materials used in the woolen mill process were stored in Building 3, and the West Mill was used to prepare wool for dyeing. Many of the other buildings present at the time of the woolen mill operations appear to have been used primarily for office, storage, or maintenance activities.

The primary chemicals manufactured at the facility by Evans Chemetics after the cessation of woolen operations are thioglycolic acid, mercaptopropionic acid (MPA), and thiodipropionate esters. Most of the manufacturing still occurs in Building 4, while several chemicals are stored in Building 3. The other buildings support the manufacturing processes at the facility. Halogenated and nonhalogenated solvents are used in the laboratories and maintenance shop. Chemical raw materials used at the facility include acids, caustics (sodium hydroxide and sodium hydrosulfide), acrylonitrile, alcohols, alkalis, ammonia, and metals (iron and zinc[3]).

Contact (process) and noncontact (non-process) cooling water for the current operations is obtained from the Cayuga-Seneca Canal Raceway (existing raceway; Figure 1-2). From 1975 to 2000, hot wells received contact cooling water from the steam jet vacuum systems connected to the reactors and condensers, and this water drained to the canal through various outfalls.

In 2000, aboveground stainless-steel tanks were installed to receive noncontact cooling water, before being discharged through the former hot well floor openings and underground piping to State Pollutant Discharge Elimination System (SPDES) permitted Outfalls 001, 004, 005, 008, and 013 at the canal in accordance with Permit NY0001406 (Figure 1-2). The facility SPDES permit has been effective since 1975. Other waste streams, including contact cooling water, are routed to the onsite WWTP before discharge to the canal through Outfall 013.

During the manufacturing processes and operation of the facility, several waste streams are generated, including acidic and alkaline wastes, wash water and spent solvents, and various nonhazardous wastes. Before installation of the WWTP in 1975, waste streams reportedly were discharged directly to the canal through the sewer system, SWMU 29.

1.2.2 Regulatory Background

The facility is regulated under Title 6 of the New York Codes, Rules, and Regulations (1985) Part 373 and RCRA, with NYSDEC as the lead agency. Resource Conservation and Recovery Act facility investigations (RFIs) have been performed at the facility since 1993 to evaluate the nature and extent of

[2] The Evans Chemetics Facility is no longer associated with HCC. Dow sold assets of the Evans Chemetics facility to Bruno Bock (CH2M 2006).

[3] Zinc has not been used since 1993 (CH2M 2006).

releases to the environment. An Order on Consent (Index Number 8-20000218-3281) has been executed between HCC and NYSDEC for the facility, and amended, as follows:

- January 30, 2002—An Order on Consent to implement an RCRA sampling visit work plan at the facility (NYSDEC 2002)
- June 1, 2004—An Amended Order on Consent to develop and implement an RFI work plan (NYSDEC 2004)
- August 12, 2011—A Second Amended Order on Consent (SAOC) to continue RFIs as well as implement and complete corrective actions at the facility (NYSDEC 2011)

As part of the visual facility inspection performed between 1991 and 1992 and the subsequent RCRA facility assessment report (A.T. Kearney 1993), 46 SWMUs and 1 AOC were identified. Of the 46 SWMUs, 36 were recommended for no further action (NFA) based on use of the areas. As documented in Attachment 2, Corrective Measures Implementation Plan of the SAOC[4] (NYSDEC 2011), further investigation and corrective measures were required for:

- Facility-wide Groundwater Contamination
- Facility-wide Soil Vapor/Indoor Air (includes soil vapor beneath a building slab)
- Gorham Street
- AOC A—Cayuga-Seneca Canal and Raceway
- AOC B—Building 4 Pit
- AOC C—Source Area for Polychlorinated Biphenyls (PCBs)
- AOC D—Monitoring Well MW-11S Area
- AOC E—Monitoring Well MW-10 Area
- AOC F—Facility Outfalls
- SWMU 1—Former Village of Waterloo Dump Site
- SWMU 7—Hazardous Waste Container Storage Area
- SWMU 8—Nonhazardous Waste Container Storage Area
- SWMU 25B—MPA Residue Hopper

As documented in the SAOC (NYSDEC 2011), the full list of SWMUs and AOCs at the facility and/or beyond its boundaries are presented in Table 1-1. The table also summarizes its status at the time of the SAOC (NYSDEC 2011).

Several RFI work plans (OB&G 2001a; CH2M 2004a, 2007a, 2007b, 2008a, 2010a, 2010b, 2010c, 2011a) have been submitted to NYSDEC for approval to perform facility investigations at the SWMUs and AOCs (Figure 1-2) to understand the nature and extent of impacted media at the facility. The investigations were performed in accordance with standard operating procedures outlined in the associated quality assurance project plan (QAPP) (OB&G 2001b, as amended; CH2M 2004a), the soil vapor investigation QAPP (CH2M 2007b, Appendix A), and the RFI QAPP (CH2M 2009a, amended 2010). The RFI QAPP was conditionally approved by NYSDEC (2009), and the amended RFI QAPP was accepted by NYSDEC (2017a). The waste materials generated were managed in accordance with the materials management plan (CH2M 2007c, 2008b [revised]).

1.3 SWMU and AOC Descriptions

1.3.1 Facility-wide Groundwater Monitoring

Facility investigation activities have included installing and regularly sampling monitoring wells, the locations of which are shown on Figure 1-3. These monitoring wells were intended to monitor groundwater quality in and around several of the SWMUs and AOCs and across the facility during development of the conceptual site model (CSM) and investigation phases of work. The monitoring wells have been previously sampled for volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), and target analyte list (TAL) metals.

[4] The SAOC also included additional evaluation of sitewide groundwater and vapor intrusion.

1.3.2 Facility-wide Soil Vapor/Indoor Air

Vapor intrusion investigations have been performed throughout the facility and included building surveys and collecting soil vapor, indoor air, outdoor air, and subslab vapor samples for VOCs because potential indoor air exposures in the buildings may result from VOCs in subsurface soil and/or shallow groundwater volatilizing, migrating vertically (and horizontally to a limited extent) through the soil column and entering the buildings through foundation cracks or openings. The VOCs may then be inhaled by building occupants. Sources of constituents potentially contributing to vapor intrusion are the VOCs detected in soil and in groundwater under or near the buildings.

Building surveys were completed before conducting vapor and air sampling events. The vapor intrusion sampling events were conducted during the heating season (October 1 and May 31).

The sampling program commenced with the administrative building (Building 13) where subslab vapor and indoor air samples were collected inside the building, one outdoor air sample was collected near Building 13, and background air samples were collected offsite. The production buildings (Buildings 1, 2, 2-A, 2-B, 3, 4, and the Tank Storage Area) were sampled for indoor air, subslab vapor, and outdoor (ambient) air. The areas sampled for soil gas and ambient air included SWMU 1 and Gorham Street to evaluate the potential vapor intrusion pathways to the residences along Gorham Street, across from the facility, and to the residence south and downgradient of SWMU 1. Indoor air, outdoor air, and crawl space samples were collected at a residential property downgradient of SWMU 1, which HCC later purchased. The results of these investigations were presented in several reports to NYSDEC (CH2M 2007d, 2010d, 2011b, 2011c, 2011d, 2011e, 2013a, 2013b, 2013c).

1.3.3 AOC A—Cayuga-Seneca Canal and Raceway

The Cayuga-Seneca Canal, which also is called the Seneca River, is part of the New York State canal system. The canal is south of the facility and was identified as AOC A (Figure 1-2) because of the former discharges from the facility to the canal. Adjacent to the facility, the canal ranges from approximately 130 to 150 feet wide, with water depths of 14 to 16 feet in the center of the channel (CH2M 2009b). The bottom of the canal consists primarily of a bedrock/cobble bed. Near the facility, the shoreline has been modified with riprap and other fill material.

The existing raceway in the northern area of the facility also was included as part of AOC A for further investigation. Raceways on the facility property historically connected to the canal and have existed in the area since the 1800s. It appears that the raceways were used to deliver raw materials to the buildings such as the West Mill, which was located onsite at the time of the woolen mill operations. NYSDEC has approved an NFA letter request for the raceway (NYSDEC 2012a). Impacts in sediment (primarily PCBs, SVOCs and metals) were identified at AOC A within the canal.

1.3.4 AOC B—Building 4 Pit

AOC B is known as the Building 4 Pit (Figure 1-2), which housed dye vats during the 1800s when the facility operated as a woolen textile mill. The former Building 4 Pit was located along the southern end of Building 4, extending from the western wall nearly the length of the building. The facility has been manufacturing divalent organic sulfur intermediates used for the cosmetic, pharmaceutical, and plastics industries from 1943 to present, and process tanks and chemical barrels were housed in the former pit until 1999, when it was cleaned and abandoned (Radian International 1999).

Impacts primarily in groundwater (methyl isobutyl ketone [MIBK] and VOCs), soil (MIBK, acetone, and metals), and soil vapor (VOCs, hydrogen sulfide, and methane) were identified near AOC B. The soil vapor corrective actions are proceeding with a pilot test of a subslab depressurization system (SSDS) that is being performed.

1.3.5 AOC C/Gorham Street—Source Area for PCBs

An area of Gorham Street adjacent to Building 2 has been identified as AOC C (Figure 1-2) because in 1995, surficial soil in the area was contaminated with less than 100 pounds of sodium hydrosulfide, which had discharged from a tank vent on the roof of Building 2. Another area along the western side of Gorham Street showed exceedances of PCBs, SVOCs, and metals, while the eastern side showed exceedances of PCBs. Impacts in soil (PCBs, arsenic, and cadmium) were identified at AOC C/Gorham Street.

1.3.6 AOC D—Monitoring Well MW-11S Area

AOC D is adjacent and south of Building 3 (Figure 1-2) and was identified as monitoring well MW-11S because of elevated concentrations of metals, specifically arsenic, and elevated groundwater pH. Operations at the Building 3 area include storing and handling various caustic materials, primarily sodium hydrosulfide, which typically has a pH of 11 to 12. Several aboveground storage tanks containing this compound are inside and adjacent to the building. A caustic truck loading/unloading area also is located east of MW-11S. Impacts primarily in groundwater (arsenic) were identified at AOC D.

1.3.7 AOC E—Monitoring Well MW-10 Area

AOC E consists of monitoring well MW-10, which is north of Building 2B near a subsurface sump that collects wash water from floor drains in Buildings 2A and 2B. The area is covered by grass and concrete-paved areas. Impacts in groundwater (MIBK, toluene, and metals) were identified at AOC E.

1.3.8 AOC F—Facility Outfalls

AOC F is composed of various sewer lines, sumps, and trenches that historically and/or currently discharge to the canal. The subsurface outfall pipelines were assessed as an AOC because of the potential conduits by which PCBs and/or other constituents of concern (COCs) may have been introduced into the canal from historical or current operations at the AOC B building. Several SPDES-permitted outfalls operate at the facility. Discharges from historical outfalls near AOC B may have impacted the canal; however, no source areas of COCs appeared to be present along the outfall piping or surrounding bedding.

Impacts in soil (MIBK, mercury, and arsenic) were identified at AOC F and are related to either historical facility activities, the production process, or analytical laboratory. No source of these metals was identified during the investigations.

1.3.9 SWMU 1—Former Village of Waterloo Dump Site

The former Village of Waterloo Dump Site corresponds to SWMU 1 (Figure 1-2), which is in the southwestern corner of the facility. It is bounded to the east by the facility, south by the canal, west by East Water Street, and north by the facility raceway (Figure 1-2).

The SWMU 1 area has been used for various purposes over the years, including as an operational area for the woolen dye production called the West Mill with supporting raceways (1886 to 1911), which were discontinued in 1936. The western edge of SWMU 1 was used as the former Village of Waterloo dump from 1948 to 1951; however, dumping activities may have begun as early as 1911. Some bottle waste from industrial operations was placed at the landfill area. Materials derived from soil excavated during facility construction projects (1981) also were placed at SWMU 1, which raised the elevation of the area to above the original topography.

Impacts primarily in groundwater (VOCs, SVOCs, and metals) and soil (polynuclear aromatic hydrocarbons) were identified at SWMU 1.

1.3.10 SWMU 7—Hazardous Waste Container Storage Area

The hazardous waste container storage area identified as SWMU 7 (Figure 1-2) was a RCRA-regulated storage shed that measured approximately 16 feet by 10 feet and was approximately 200 feet west of Building 16. At present, the area that originally constituted SWMU 7 is within a concrete-paved and diked area that has an engineered foundation to support the WWTP bioreactors. No documented releases exist for this area.

1.3.11 SWMU 8—Former Nonhazardous Waste Container Storage Area

The nonhazardous waste container storage area identified as SWMU 8 (Figure 1-2) is an outdoor area that was built in 1975 in the northwestern portion of the facility within SWMU 1. It was used for temporary storage of 55-gallon plastic drums of nonhazardous still-bottom wastes, which originated from the various facility processes. Initially, the area was unpaved, with an earthen dike on three sides (open to the east). A concrete pad with concrete dikes was constructed in the area and was open to the north. The eastern third of the concrete pad was removed during WWTP construction. The existing SWMU 8 ground cover is paved with concrete, and the area is still used for storing nonhazardous wastes in plastic totes. No releases have been reported from SWMU 8.

1.3.12 SWMU 25B—MPA Residue Hoppers

SWMU 25B (Figure 1-2) is one of three cooling areas for the MPA distillation residue. It is south of the WWTP tanks. No releases have been reported from SWMU 25B.

1.4 Report Organization

This CMS is organized into the following sections:

1. **Introduction**: Describes the purpose of this report, outlines the facility description, history, summarizes the regulatory background, introduces the areas of impacts that have been investigated at the facility, and summarizes the report organization.
2. **Current Conditions, Physical Characteristics, and Investigation Status:** Summarizes the physical characteristics (topography, geology and hydrogeology), and summarizes the RFIs at each AOC and SWMU.
3. **Remedial Goals, Remedial Action Objectives (RAOs), and ICMs:** Defines the goals and objectives that are to be met for the remedial target areas (RTAs), and summarizes the ICMs for AOCs B, C, and D.
4. **Recommended Corrective Measures and Path Forward:** Presents the recommended corrective measures for AOCs B, C, and D, and path forward on facility-wide institutional controls (ICs) and site management plan (SMP).
5. **References:** Lists the references used during preparation of this report.

Table 1-1. Sitewide Corrective Measures Status for Facility-wide Issues, SWMUs and AOCs
Sitewide Corrective Measures Study, Former Hampshire Chemical Corp. Facility, Waterloo, NY

Area	Classification	Facility-wide/ AOC/ SWMU	Description	2011 Second Administrative Order on Consent Requirement	2019 Corrective Measures Status
Facility-wide Issues	Facility-wide	Facility-wide	Facility-wide Groundwater Monitoring	Monitoring Required	LTM in Progress
			Facility-wide Vapor Migration/ Indoor Air	Further Investigation Needed	AOC B Vapor Monitoring and Pilot Study Design in Progress
AOCs	AOC	AOC A	Cayuga-Seneca Canal and Raceway	Further Investigation Needed	Remediation Complete - NFA
		AOC B	Building 4 Pit	Further Investigation Needed	Groundwater LTM per ICM and Vapor Intrusion Assessment in Progress
		AOC C	Gorham Street/ Source Area for PCBs	Corrective Measures Must Be Completed	Remediation Complete - NFA; LTM of Engineering Controls in Progress.
		AOC D	Monitoring Well MW11S Area	CMS Needed	Groundwater LTM per ICM
		AOC E	Monitoring Well MW10 Area	CMS Needed	NFA for groundwater; ICs required for soil
		AOC F	Facility Outfalls	Further Investigation Needed	NFA
SWMUs	Land Disposal Areas - Landfills	SWMU 1	The Former Village of Waterloo Dump Site	Further Investigation Needed	Remediation Complete - NFA; LTM of Engineering Controls in Progress
	Container Storage Areas - Satellite Accumulation Areas	SWMU 2	R&D Laboratory Hazardous Satellite Accumulation Area	NFA	NFA
		SWMU 3	QC Laboratory Hazardous Satellite Accumulation Area	NFA	NFA
		SWMU 4	Carpentry Shop Hazardous Satellite Accumulation Area	NFA	NFA
		SWMU 5	Long-Term Storage Areas	NFA	NFA
		SWMU 6	Former Building No. 16 Drum Storage Area	NFA	NFA
		SWMU 7	Hazardous Waste Container Storage Area	Abbreviated CMS ICs needed	NFA; ICs required
		SWMU 8	Nonhazardous Waste Container Storage Area	Abbreviated CMS ICs needed	NFA; ICs required
		SWMU 9	Intermediate Nonhazardous Waste Container Storage Area	NFA	NFA
		SWMU 10	New Nonhazardous Waste Container Storage Area	NFA	NFA

Table 1-1. Sitewide Corrective Measures Status for Facility-wide Issues, SWMUs and AOCs
Sitewide Corrective Measures Study, Former Hampshire Chemical Corp. Facility, Waterloo, NY

Area	Classification	Facility-wide/ AOC/ SWMU	Description	2011 Second Administrative Order on Consent Requirement	2019 Corrective Measures Status
SWMUs (continued)	Air Pollution Equipment - Caustic Scrubber Units	SWMU 11	Deleted	Deleted	Deleted
		SWMU 12	Department 70 Caustic Scrubber System	NFA	NFA
		SWMU 13	Waste Treatment Plant Caustic Scrubber System	NFA	NFA
	Waste Storage Tanks - Day Tanks	SWMU 14	Spent Scrubber Solution Day Tank (3-HT-30)	NFA	NFA
		SWMU 15	Former Department 68 Day Tank (4-AV-7)	NFA	NFA
		SWMU 16	Department 68 Day Tank (4-AV-4)	NFA	NFA
		SWMU 17	Department 69 Day Tank (2-HT-26)	NFA	NFA
		SWMU 18	Former Department 70 Day Tank (2-HT-22)	NFA	NFA
	Waste Storage Tanks	SWMU 19	MFA Raffinate Tank (16-HT-47)	NFA	NFA
		SWMU 20	Ammonium Bisulfate Tank (16-HT-126)	NFA	NFA
	Miscellaneous Units	SWMU 21	Outside SEM Tail Storage Tank	NFA	NFA
		SWMU 22	Former Building No. 14 Loading Area	NFA	NFA
		SWMU 23	Building No. 16 Loading Area	NFA	NFA
		SWMU 24	Safety-Kleen Unit	NFA	NFA
		SWMU 25	MPA Residue Hopper	NFA	NFA
		SWMU 25A	MPA Residue Hopper	NFA	NFA
		SWMU 25B	MPA Residue Hopper	Abbreviated CMS needed; ICs	NFA; ICs required
		SWMU 26	MPA Lower Acid Layer Tank	NFA	NFA
		SWMU 27	Aboveground Waste Transfer System	NFA	NFA
		SWMU 28	Wash Water Sewer System	NFA	NFA
		SWMU 29	SPDES Sewer System	NFA granted; may change based on investigation of PCB sources required for AOC A	NFA

Table 1-1. Sitewide Corrective Measures Status for Facility-wide Issues, SWMUs and AOCs
Sitewide Corrective Measures Study, Former Hampshire Chemical Corp. Facility, Waterloo, NY

Area	Classification	Facility-wide/ AOC/ SWMU	Description	2011 Second Administrative Order on Consent Requirement	2019 Corrective Measures Status
SWMU (continued)	WWTP - Phase I Waste Treatment System	SWMU 30	Acid Tank (16-HT-31)	NFA	NFA
		SWMU 31	Alkali Tank (16-HT-32)	NFA	NFA
		SWMU 32	Wash Water Holding Tank	NFA	NFA
		SWMU 33	SEM Tailpipe Holding	NFA	NFA
		SWMU 34	East Neutralization Tank (16-HT-33)	NFA	NFA
		SWMU 35	West Neutralization Tank (16-HT-34)	NFA	NFA
		SWMU 36	West Neutralization Tank (16-HT-34) Sludge Holding Tank	NFA	NFA
		SWMU 37	Passavant Plate-and-Frame Filter Press System	NFA	NFA
		SWMU 38	Solid Waste Conveyor	NFA	NFA
		SWMU 39	Filter Cake Storage Container	NFA	NFA
		SWMU 40	Neutralized Slurry Filtrate Tank (16-HT-36)	NFA	NFA
	Phase II Waste Treatment System	SWMU 41	Polishing Plate and Frame Filter Press	NFA	NFA
		SWMU 42	Phase II (Pre-GAC) Holding tank	NFA	NFA
		SWMU 43	GAC Reactor Vessels (16-AB-1)	NFA	NFA
		SWMU 44	Post-GAC Holding Tank (16-HT-118)	NFA	NFA
		SWMU 45	Spent Carbon Transfer Bin	NFA	NFA
	Equalization Tank	SWMU 46	Wastewater Equalization Tank	NFA	NFA

AOC = area of concern
ICM = interim control measure
PCB = polychlorinated biphenyl
SPDES = State Pollutant Discharge Elimination System
CMS = corrective measures study
LTM = long-term monitoring
QC = quality control
GAC = granular activated carbon
MPA = mercaptopropionic acid
R&D = research and development
WWTP = wastewater treatment plant
IC = institutional control
NFA = no further action
SWMU = solid waste management unit

2. Current Conditions, Physical Characteristics, and Investigation Status

The town of Waterloo lies centered between the northern ends of Lake Seneca and Lake Cayuga, east to west, the two largest Finger Lakes. The climate is primarily humid continental, characterized by large seasonal temperatures differences with warm to hot summers and cold winters (National Oceanic and Atmospheric Administration 2012). The average daily high temperatures range from 31.5 degrees Fahrenheit in January to 81.6 degrees Fahrenheit in July. Precipitation is well distributed, averaging slightly greater than 3 inches per month through the year (38.5 inches annually).

2.1 Topography

Various owners have altered the facility topography over years of progressive developments. Several topographic surveys have been performed at the facility by a New York State-licensed land surveyor, and the data collected since 2004 has been compiled and presented on Figure 2-1. Overall, the ground surface generally slopes southward toward the canal, with elevations ranging from about 447 (northern property boundary) to 425 feet above mean sea level (amsl). Slopes increase steeply adjacent to the canal. Mounded fill material at the western portion of the facility overlies a section of a former dump (now designated as SWMU 1). SWMU 1 has been capped and is covered with grass. On the eastern side of the facility is an asphalt-paved area that Evans Chemetics personnel use as a parking lot. The rest of the facility is developed with buildings and covered with asphalt.

Two surface water bodies bound the facility: the canal to the south and the existing raceway to the north. The canal connects the Cayuga and Seneca lakes (Figure 2-2). Overland flow from the facility generally runs south toward the canal. The existing raceway covers much of the northern boundary of the facility and extends eastward from East Water Street up to a small building northwest of the Evans Chemetics main office buildings.

2.2 Geology

2.2.1 Historic Anthropogenic Fill

Fill material has been placed over native soil across most of the facility to depths of at least 3 feet below ground surface (bgs), with thicker levels near the canal bank. The fill material generally consists of silt, sand, and gravel with varying amounts of brick fragments, cinder, coal pieces, ash, and wood pieces. The fill appears to have been placed in the area before operations were started in the 1800s, as the fill also has been identified under the building foundations. It is likely that much of this fill was placed in the area during construction of the canal or to promote development along the canal.

Fill thickness varies across the facility and is generally thickest in the western portion of the facility near the former dump, where it approaches 30 feet thick because of layers of waste when the area operated as a dump and because of construction fill from facility upgrades in the 1990s. The waste includes potential operational waste (glass bottles) and municipal debris (including ceramic and porcelain pieces). Fill thickness east of the former dump area generally ranges from 8 to 15 feet. These soils tend to thicken adjacent to the canal. Offsite and east of the Gorham Street parking lot at the adjacent residential properties, fill thicknesses decrease to about 3 to 5 feet.

2.2.2 Native Soils

Native soils consist of predominately silts and clays (Figure 2-2) interbedded with discontinuous lenses of sand and gravel. The sand content in these deposits is less extensive than in overlying fill. The native soils represent lacustrine and glacial deposits and appear more heterogeneous and coarser-grained near the contact with bedrock. Mixtures of sand and gravel are present at the overburden/bedrock interface. At the eastern area of SWMU 1, native soils were identified up to 5 feet thick beneath the fill. Native soil thickness west of Gorham Street ranges from 3 to 18 feet beneath the fill and increases to the north with distance from the canal. Native soil thickens to about 30 feet east of the Gorham Street parking lot.

2.2.3 Bedrock

Bedrock at the facility consists of a grey limestone. The rocks feature microcrystalline grain size and uneven bedding, which is consistent with literature descriptions of the Manlius Limestone and Onondaga Limestones (Figure 2-3). The bedrock surface elevation was approximately 427 feet amsl along the canal south of SWMU 1 and dips generally toward the east to around 413 feet amsl downgradient of the facility near the Gorham Street parking lot. The elevation of canal bedrock was approximately 415 feet amsl. At SWMU 1, the top of bedrock appeared to dip slightly toward the former raceway.

2.3 Hydrogeology

Hydrogeology across the facility has been evaluated by a network of 40 monitoring wells, 6 piezometers (Figure 1-3), and 2 stilling wells[5] which have identified two hydrostratigraphic units: overburden and bedrock aquifer. The facility monitoring wells are screened across the overburden, except for MW-05I and MW-11I, which are screened in the overburden/bedrock interface.

The overburden water-bearing zone contains saturated fill and native overburden soils with a depth to water ranging from approximately 2 feet bgs on and adjacent to the canal, to approximately 22 feet bgs in SWMU 1, where there is an increase in surface elevation because of fill material. The saturated thickness of the overburden ranges from less than 2 feet bgs on the western side of the facility (because of the shallow depth to bedrock) to approximately 25 feet bgs along the canal banks on the eastern side of Gorham Street (where bedrock is deeper).

The surface water elevation of the existing raceway is approximately 2 feet higher than surrounding groundwater and approximately 12 feet higher than the canal. The surface water elevation of the canal is similar to that of nearby groundwater. Years of groundwater monitoring show that overburden groundwater flows south toward the canal, which is consistent with historical conditions observed at the facility. The horizontal hydraulic gradient on generally ranges from about 0.02 to 0.05 foot per foot.

2.4 Summary of RCRA Facility Investigations

This section summarizes the actions performed at the facility-wide areas, AOCs, and SWMUs at the facility, as requested in the 2011 SAOC (NYSDEC 2011).

2.4.1 Facility-wide Groundwater Monitoring

Facility-wide groundwater investigations began in 2002, and the results were presented in several reports (OB&G 2003; CH2M 2004b, 2006, 2008c). Groundwater monitoring was required for facility-wide groundwater impact. Routine groundwater monitoring began at the facility in 2011 and continues to present. Synoptic depth–to-water measurements are collected from accessible facility monitoring points to evaluate groundwater flow direction and hydraulic gradients onsite. Groundwater samples are collected from sitewide wells for the following analyses:

- VOCs via U.S. Environmental Protection Agency (USEPA) SW-846 via Method 8260B
- SVOCs via Method SW-8270C
- TAL metals via Method SW-601B (total and dissolved)

[5] Stilling well SG-01, which was used to monitor the surface water elevation of the raceway, was destroyed in the winter of 2011 as part of facility construction activities.

In addition, samples are collected to assess groundwater for potential monitored natural attention (MNA) via the following analyses:

- Sulfate via USEPA Method 375.4
- Nitrate via USEPA WW 353.2
- Methane via RSK175
- Carbon dioxide via Standard Method 4500 CO_2
- Alkalinity via USEPA WW 310.1
- Total phosphorous via USEPA WW 365.2
- Total organic carbon via USEPA WW 415.1

The results of these groundwater monitoring activities have been summarized and submitted to NYSDEC in annual reports (CH2M 2010e, 2011f, 2012a, 2012b, 2013d, 2014a, 2015f). In 2015, an MNA program commenced to focus on AOC B and AOC D groundwater monitoring and on the effectiveness of natural hydrologic, biological, mineralogical, and geochemical conditions in reducing the concentrations and attenuating the migration of related COCs in groundwater. Development of the MNA report for the facility follows the procedures outlined in the USEPA Office of Solid Waste Emergency Response Directive 9200.4-17P and several supporting reports (USEPA 1999, 2006, 2007). The groundwater MNA study results have been submitted in periodic reports to NYSDEC (CH2M 2017a, 2018; Jacobs 2019a). NYSDEC approved continued groundwater monitoring for AOCs B and D as ICMs (NYSDEC 2015a, 2015b) and at SWMU 1 as part of the SWMU 1 corrective measure (NYSDEC 2014). Details of these corrective measures are provided in Section 5.

2.4.2 Facility-wide Soil Vapor/Indoor Air

Further investigation was required for facility-wide soil vapor and indoor air. These facility-wide investigations continued to be performed from 2011 through 2012. The investigations (CH2M 2011b, 2011c, 2011d, 2011e, 2013a, 2013b, 2013c) have concluded no further investigation is needed for facility-wide soil vapor and indoor air. Note that additional soil vapor and indoor air investigations at the AOC B area continued through 2019, and facility evaluations for corrective measures are being performed for soil vapor at AOC B.

An SSDS pilot test is being performed to address elevated hydrogen sulfide and methane conditions below the Building 4 floor slab (as described in Section 1.3.4). The pilot system performance data will be used to design and install a final SSDS.

2.4.3 AOC A—Cayuga-Seneca Canal and Raceway

Further investigation was required for the canal and raceway. The canal investigations were performed in three phases, with the results summarized in several facility reports (CH2M 2009b, 2010f, 2011g; HCC 2012a) and a CSM was developed for AOC A to describe the relevant facility features and the surface and subsurface conditions to understand the extent of identified COCs and the potential risk to receptors. Remedial activities of the three impacted canal sediment deposits (North Shore Deposit, Gorham Street Deposit, and Downstream Deposit) were completed in 2016 and summarized in the *AOC A Corrective Measures Construction Completion Report* (CH2M 2016), which was approved by NYSDEC (2016). The raceway sediment was investigated, and the results were presented in the *Raceway Sediment Data Investigation Report* (CH2M 2011h). A detailed summary of the sediment removal activities and post-bathymetric surveys conducted is in the NYSDEC-approved reports for *Sediment Post-Removal Verification* (CH2M 2015a, 2015b, 2015c).

No additional investigation or corrective measure was recommended to NYSDEC for the raceway based on its sediment sampling results and its operational use by Evans Chemetics. The recommendation was based on the following:

- The raceway is a manufactured structure that was designed for and is used for operational purposes.
- Exposure within the raceway is not expected because of its operational use, size, and access control (water is supplied via a pipe upstream of the Waterloo lock system).

- Sampling results of seven surface sediment grab samples did not indicate that facility operations have caused an impact to the raceway.
- The raceway is not hydraulically connected to the canal where facility-related impacts have been detected in canal sediment immediately adjacent and downstream of the facility. The raceway is connected to the canal upstream of the control structure approximately 0.5 mile upstream of the facility.

NYSDEC approved (2012a) the NFA letter request (Dow 2012) for the raceway.

2.4.4 AOC B—Building 4 Pit

Further investigation was required for AOC B. The investigations were performed as part of the facility-wide groundwater and soil vapor/indoor air work, and the results were summarized in several facility reports (CH2M 2010d, 2010e, 2011c, 2011e, 2012a, 2012b, 2012c, 2013a, 2013b, 2015d). Based on these investigations, a CSM was developed for AOC B (Figure 2-4) to describe the relevant facility features, and the surface and subsurface conditions to understand the extent of identified COCs and the potential risk to receptors. The CSM evaluation was discussed in the revised AOC B ICM work plan (CH2M 2013e).

NYSDEC has approved (NYSDEC 2015a, 2015b) the revised AOC B ICM work plan (CH2M 2013e) and *Building 4 Pit and Production Well Decommissioning Summary for AOC B Technical Memorandum* (CH2M 2015d). The ICMs (groundwater) are being performed.

During implementation of the ICMs, subsurface vapors (hydrogen sulfide and methane) were encountered. A SSDS pilot test is being performed to address elevated hydrogen sulfide and methane conditions below the Building 4 floor slab. The pilot system will be used to design a final SSDS.

2.4.5 AOC C/Gorham Street—Source Area for PCBs

Corrective measures were required for AOC C/Gorham Street (for PCBs). Soil excavation corrective measures were performed and documented in the *Construction Completion Report for Gorham Street PCB Remediation* (CH2M 2010g). Additional Gorham Street soil investigation was performed, and the results were summarized in the Gorham Street soil investigation reports (CH2M 2010h, 2012d, 2012e). Based on these investigations, a CSM was developed for AOC C (Figure 2-5) to describe the relevant facility features, and the surface and subsurface conditions to understand the extent of identified COCs and the potential risk to receptors.

An ICM work plan was developed to evaluate potential interim corrective action alternatives for the RTA at AOC C/Gorham Street, as identified by various phases of investigation and CSM, and proposed a remedy for addressing the defined impacted area. NYSDEC approved (NYSDEC 2013a, 2015c) the AOC C/Gorham Street ICM work plan (CH2M 2013f). A combination soil and asphalt cover system was installed over the area of impact, and NYSDEC approved the *Gorham Street Corrective Measures Construction Completion Report* (CH2M 2014b; NYSDEC 2015c, 2015d).

2.4.6 AOC D—Monitoring Well MW-11S Area

A CMS was required for AOC D, and the investigations were performed as part of the facility-wide and AOC D soil and groundwater investigations, with the results summarized in several facility reports (CH2M 2012f, 2013d, 2014a, 2015f). Based on these investigations, a CSM was developed for AOC D (Figures 2-6 and 2-7) to describe the relevant facility features, and the surface and subsurface conditions to understand the extent of identified COCs and the potential risk to receptors. The CSM evaluation was discussed in the AOC D ICM work plan (CH2M 2013g).

NYSDEC approved the AOC D ICM work plan (CH2M 2013g) and the *Technical Memorandum – Review of Remedial Alternatives Presented in the Interim Corrective Measures Work Plan for AOC D* (CH2M 2015e; NYSDEC 2015e). The interim measures (groundwater monitoring) are being implemented.

2.4.7 AOC E—Monitoring Well MW-10 Area

Further investigation was required for AOC E. The investigations were performed as part of the facility-wide groundwater investigations, and the results were summarized in several facility-wide groundwater reports (CH2M 2012b, 2013d, 2014a, 2015f). The more recent groundwater data from AOC E demonstrated no VOC impacts above the Class GA standard, and metals concentrations were consistent with upgradient wells. Therefore, NFA was proposed, and NYSDEC (2012b) agreed with the NFA recommendation for groundwater but requested clarification on how potential exposure to arsenic impacts in soil will be addressed. HCC (2012b) provided a response to NYSDEC's comment letter indicating soil impacts at AOC E will be addressed as part of the facility-wide Deed Notice after completing all other onsite remediation activities.

2.4.8 AOC F—Facility Outfalls

Further investigation was required for AOC F. A *Technical Memorandum - Outfall Evaluation Report* (CH2M 2011i) was submitted to NYSDEC to provide August 2010 data on the active and inactive outfalls piping configuration and condition. An *Outfall Investigation Summary Report* (CH2M 2011j) also was submitted to NYSDEC, documenting the November and December 2010 supplemental investigations to visually observe the bedding material of the facility outfall piping and determine if it is a potential preferential pathway for groundwater migration to AOC A, conduct a direct-push technology investigation adjacent to outfall piping, and conduct test pitting near the outfall piping and pipeline abandonment locations.

Based on the results of the soil samples and test pitting completed at the facility outfalls documented in the *Outfall Investigation Summary Report* (CH2M 2011j), no stained soil or other visual indications of impact from COCs were observed. These results indicate the outfall piping or surrounding bedding materials (if present) were not acting as a preferential pathway for constituent transfer into the canal. Abandoned Outfalls 002 and 007 also were removed, eliminating the potential for a future pathway to the canal. NYSDEC (2018) accepted both investigation reports without comment because the AOC A remedial action had already been completed in August 2016, before NYDSEC's 2018 review.

2.4.9 SWMU 1—Former Village of Waterloo Dump Site

Further investigation was required for SWMU 1. These investigations included groundwater, soil vapor, and methane surveys and were summarized in several reports (CH2M 2008c, 2010e, 2011b, 2011d, 2012a, 2012g, 2013c, 2013d, 2014a, 2015f). Based on these investigations, a CSM was developed for SWMU 1 (Figure 2-8) to describe the relevant facility features, and the surface and subsurface conditions to understand the extent of identified COCs and the potential risk to receptors. The results of these investigations and the CSM understanding were sufficient to evaluating potential interim corrective action alternatives for the RTA at SWMU 1.

In 2014, NYSDEC (2014) approved the SWMU 1 CMS (CH2M 2013h), which included placing a multilayer soil and asphalt capping system. The remedy was completed, and NYSDEC approved the *Construction Completion Report* (CH2M 2017b; NYSDEC 2017b).

2.4.10 SWMU 7—Hazardous Waste Container Storage Area

Abbreviated CMS ICs were required for SWMU 7. The abbreviated CMS (CH2M 2011k) was submitted to NYSDEC on September 2, 2011 and approved by NYSDEC in a letter dated February 9, 2012 (NYSDEC 2012b). As documented in the abbreviated CMS, the ICs for SWMU 7 will be established concurrently with the other facility SWMUs/AOCs that require ICs. As such, corrective measures in the form of ICs are required for SWMU 7.

2.4.11 SWMU 8—Former Nonhazardous Waste Container Storage Area

Abbreviated CMS ICs were required for SWMU 8. The abbreviated CMS (CH2M 2011k) was submitted to NYSDEC on September 2, 2011 and approved by NYSDEC in a letter dated February 9, 2012 (NYSDEC 2012b). As documented in the abbreviated CMS, the ICs will be established concurrently with the other facility SWMUs/AOCs that require ICs. As such, corrective measures in the form of ICs are required for SWMU 8.

2.4.12 SWMU 25B—MPA Residue Hoppers

Abbreviated CMS ICs were required for SWMU 25B. The abbreviated CMS (CH2M 2011k) was submitted to NYSDEC on September 2, 2011 and approved by NYSDEC in a letter dated February 9, 2012 (NYSDEC 2012b). As documented in the abbreviated CMS, the ICs will be established concurrently with the other facility SWMUs/AOCs that require ICs. As such, corrective measures in the form of ICs are required for SWMU 25B.

3. Remedial Goals, Remedial Action Objectives, and Interim Corrective Measures

Remedial goals and RAOs form the basis for identifying remedial technologies appropriate to facility conditions, screening technologies, and assembling accepted technologies into remedial alternatives for evaluation. The remediation goals that will help achieve the facility RAOs are outlined in the SAOC (NYSDEC 2011).

RAOs are designed to protect human health and the environment at the facility over the course of implementing the remedial action and the indefinite period following remediation. The NYSDEC Division of Environmental Remediation (DER)-10 *Technical Guidance for Site Investigation and Remediation* document (NYSDEC 2010) serves as a guide in assigning primary consideration to remedial alternatives that attain or exceed RAOs.

NYSDEC DER-10 (2010) states that where applicable, generic RAOs identified on NYSDEC's website can be used for various media. NYSDEC's website provides a listing of generic RAOs that can be used in developing the RAOs and the capability to develop facility-specific RAOs based on facility conditions. The generic RAOs are broken out for groundwater, soil, surface water, sediment, and soil vapor, with each having a component of protection of public health and the environment.

Based on the target areas defined and complete pathways for constituent migration, applicable RAOs are for soil, groundwater, vapor, and sediment. The facility areas where corrective measures have been implemented are AOC A, AOC B, AOC C, AOC D, and SWMU 1. The facility areas that require ICs are AOC B, AOC C, AOC D, AOC E, SWMU 1, SWMU 7, SWMU 8, and SWMU 25B.

3.1 Remedial Goals and Remedial Action Objectives for Impacted Soil

The remediation goals that will help achieve the facility RAOs are outlined in the SAOC (NYSDEC 2011). The SAOC specifies that impacted soil at the facility or soil that has migrated from the facility must not exceed state and federal regulatory limits that are promulgated at the time of the approval of the corrective measures, guidance values, or other criteria developed as part of the RCRA corrective action program (NYSDEC 2011). The remedial goal criteria for soil are:

- Contaminated soil must be appropriately managed to prevent human exposure and migration from the facility.
- Areas where contaminated soil is known to exist must be subject to a revised SMP that includes requirements for monitoring and maintenance of the cover materials, if required, and proper disposal of excavated contaminated soil.
- Contaminated soil on or migrating from the facility does not pose a threat to human health or the environment.

3.1.1 Soil Remedial Action Objectives for Public Health Protection

Soil RAOs were developed for AOCs B and C; however, soil RAOs were not developed for AOC D because the COCs are associated with groundwater. The soil RAOs for public health protection that were used to develop the alternatives for AOC B are:

- Prevent ingestion/direct contact with MIBK-, arsenic-, and mercury-impacted soil in specific areas at AOC B
- Prevent inhalation of dust created from MIBK-, arsenic-, and mercury-impacted soil movement activity at AOC B
- Prevent MIBK-, arsenic-, and mercury-impacted soil migration to the canal at AOC B

The soil RAOs for public health protection that were used to develop the alternatives for AOC C are:

- Prevent ingestion/direct contact with arsenic and cadmium contaminated soil
- Prevent inhalation of dust created from arsenic- and cadmium-contaminated soil movement activity
- Per DER-10 (NYSDEC 2010), Section 4.1(e)2, prevent arsenic and cadmium impacted soil migration to the canal and adjacent properties

3.1.2 Soil Remedial Action Objectives for Environmental Protection

The soil RAOs for environmental protection that were used to develop the alternatives for AOC B are:

- Prevent migration of MIBK, arsenic, and mercury in soil that would result in surface water or sediment impacts
- Prevent MIBK, arsenic, and mercury impacts to biota from ingestion/direct contact with soil causing toxicity or impacts from bioaccumulation through the terrestrial food chain

The soil RAOs for environmental protection that were used to develop the alternatives for AOC C are:

- Prevent migration of arsenic and cadmium in soil that would result in surface water or sediment contamination
- Prevent arsenic and cadmium impacts to biota from ingestion/direct contact with soil causing toxicity or impacts from bioaccumulation through the terrestrial food chain

3.1.3 Soil RAO Status

The RAOs for soil are being met because the AOC B area is paved with asphalt and concrete, and AOC C is paved with asphalt and has a soil cover. These paved areas and soil cover protect public health and the environment because there is no direct contact with the underlying soil. The paving also serves to protect the environment because it limits infiltration of surface water that may cause leaching of soil COCs. Additionally, in the associated ICM approval letters (NYSDEC 2013a, 2015a), NYSDEC concurred that the soil RAOs are being met at AOCs B and C.

3.2 Remedial Goals and Remedial Action Objectives for Impacted Groundwater

Impacted groundwater corrective measures remedial goals and objectives apply to AOCs B and D as well as facility-wide groundwater that is not associated with a specific AOC or SWMU. The remediation goals that will help achieve the facility RAOs as outlined in the SAOC (NYSDEC 2011). The SAOC specifies that groundwater must comply with applicable state and federal groundwater quality standards that are promulgated at the time of approval of the corrective measure, guidance values, or other criteria developed as part of the RCRA corrective action program (NYSDEC 2011).

3.2.1 Groundwater Remedial Action Objectives for Public Health Protection

For the AOC B and D groundwater RTA plus facility-wide groundwater, the RAOs for public health protection used to develop the alternatives within the CMS are:

- Prevent, to the extent practicable, ingestion of groundwater with constituent levels exceeding drinking water standards
- Prevent, to the extent practicable, direct contact with, or inhalation of volatiles, from contaminated groundwater

3.2.2 Groundwater Remedial Action Objectives for Environmental Protection

For the AOC B and D groundwater RTA plus facility-wide groundwater, the RAOs for environmental protection used to develop the alternatives within the CMS are:

- Restore groundwater aquifer to predisposal/pre-release conditions, to the extent practicable
- Prevent, to the extent practicable, the discharge of contaminated groundwater to surface water that does not meet the NYSDEC Class GA ambient water quality standards
- Remove, to the extent practicable, the source of groundwater or surface water contamination

3.3 Remedial Goals and Remedial Action Objectives for Vapor

During implementation of the AOC B ICM, subsurface vapors (hydrogen sulfide and methane) were encountered. Although vapor at AOC B was not identified as part of the Consent Order, and therefore there is no remediation goal set for this area, HCC has performed several sampling events to delineate the extent of the potential impact below Building 4. Additionally, the impact is being addressed by a SSDS pilot test, which is designed to extract hydrogen sulfide and methane below the Building 4 floor slab. The pilot system will be used to design a final SSDS.

The remedial goal for vapor at AOC B, as established in the *Building 4 Vapor Intrusion Mitigation System Pilot Test - Vapor Remedial Design Work Plan* (Jacobs 2019b), is to demonstrate that a sustained negative pressure differential of at least 1 pascal (cold weather conditions) or 2.5 pascal (warm weather conditions) can be measured and maintained at the existing subslab probes within a determined radius (or zone) of influence.

The RAOs for vapor at AOC B are:

- Protect workers in Building 4 from potential exposure to elevated hydrogen sulfide and methane collecting below the floor slab and intruding into the building

3.3.1 Vapor Remedial Action Objectives Status

A SSDS pilot test is being performed to address elevated hydrogen sulfide and methane conditions below the Building 4 floor slab. The pilot system will be used to design a final SSDS. Since the AOCs and SWMUs have been through the technology screening process already as part of remedial measures via an ICM work plan or CMS, the following summarizes the options evaluated for each.

Several ICM work plans were submitted and approved by NYSDEC for AOCs B, C, and D. An abbreviated CMS also was submitted and approved for SWMUs 7, 8, and 25B. The ICMs were completed and approved by NYSDEC with the understanding that they could serve as final remedies if sufficiently protective.

3.4 Summary of Interim Corrective Measures

3.4.1 Summary of AOC B Interim Corrective Measures

3.4.1.1 Groundwater Interim Corrective Measures

The technologies and process options for AOC B were assembled into the following four remedial alternatives for further evaluation and detailed in the AOC B ICM work plan (CH2M 2013e):

- Alternative 1—No Action
- Alternative 2—MNA
- Alternative 3—Long-Term Periodic Groundwater Recovery, Offsite Disposal, and Monitoring
- Alternative 4—Short-Term Periodic Groundwater Recovery, Offsite Disposal, and Monitoring

Full descriptions of these alternatives are presented in the NYSDEC-approved AOC B ICM work plan (CH2M 2013e; NYSDEC 2013b). The selected alternative was Alternative 2, MNA. Figure 3-1 shows the locations of the AOC B wells monitored as part of Alternative 2.

Natural attenuation relies on natural processes to attenuate COCs in soil and groundwater. Monitoring these conditions to evaluate the success and rate of natural attenuation is an important component of this technology. The time to attain cleanup goals by MNA depends on type and concentrations of COCs present, size and depth of the impacted area, type of soil, and the geochemical conditions present. These factors vary at facilities, but cleanup by MNA usually takes years to decades. MNA was retained at this facility because historical groundwater records indicate degradation of MIBK through natural processes occurs in subsurface conditions at AOC B, and the degradation is measurable over short periods of time (1 to 5 years).

MNA provides the least disturbance of impacted media and groundwater flow to the canal. Groundwater is monitored at a predetermined frequency to track the concentrations of facility-specific COCs to verify the trends in COC concentrations are stable or decreasing.

The baseline event was the first round of quarterly sampling for six of the ten wells. These six wells were sampled for the remaining three quarters of the first year, and annually thereafter up to a maximum of 30 years. During each event, the quarterly and annual groundwater samples were analyzed for field chemistry, VOCs, and metals. A second set of four wells were sampled during the baseline event, and then every 5 years thereafter up to a maximum of 30 years. After the baseline event, these samples were analyzed for field chemistry and selected geochemical parameters. Annual reports are submitted to NYSDEC throughout the duration of the remedy (CH2M 2017a, 2018; Jacobs 2019a). These reports contain maps, graphs, and calculations that track attenuating COC concentrations and plume dimensions.

If concentrations exceeding the Technical and Operational Guidance Series (TOGS; NYSDEC 1998) standard persist after 30 years, monitoring will continue in increments of 5 years until concentrations decline below the standard. Conversely, the monitoring program may evolve to a reduced number of analytes should concentrations of COCs decline below the TOGS standards before the 30-year milestone.

Monitoring was initiated in 2014 and continues to date, with 2019 being the first 5-year expanded event.

3.4.1.2 Vapor Intrusion Interim Corrective Measures

Elevated concentrations of methane and hydrogen sulfide exist beneath the Building 4 floor slab. In April and May 2017 as part of a pre-design investigation,15 subslab sampling ports were installed across the facility and sampled for hydrogen sulfide, methane, and VOCs. In addition, a building survey and vapor intrusion attenuation testing was undertaken to gather information useful for assessing interim mitigation actions. Results of the studies were reported in the *Evaluation of Subslab Hydrogen Sulfide and Methane Concentrations Technical Memorandum* (CH2M 2017c).

In a response letter dated March 1, 2018, NYSDEC's approval of the *Evaluation of Subslab Hydrogen Sulfide and Methane Concentrations Technical Memorandum* (CH2M 2017c) included a request to conduct a feasibility study for long-term mitigation/remediation alternatives for hydrogen sulfide and methane. The NYSDEC-approved the pilot test mitigation alternative (Jacobs 2019b; NYSDEC 2019) which includes using a SSDS to mitigate vapor under the Building 4 slab.

The objective of the SSDS pilot test is to demonstrate that a sustained negative pressure differential of at least 1 pascal (under cold weather conditions) or 2.5 pascal (under warm weather conditions) can be measured and maintained at the existing subslab probes within a determined radius (or zone) of influence. The negative pressure differential created and maintained by the SSDS will cause potentially hazardous subslab vapors to be captured and subsequently treated by an existing facility scrubber system before discharge to the atmosphere. Reversing the pressure differential across the slab and capturing the subslab vapors will reduce the likelihood of potentially hazardous subslab vapor migrating into and impacting indoor air at Building 4.

Additional details of the SSDS design criteria and performance procedures are presented in the *Building 4 Vapor Intrusion Mitigation System Pilot Test - Vapor Remedial Design Work Plan* (Jacobs 2019b). The SSDS pilot test has been initiated and is expected to be completed in early 2020. The results of the pilot test will be used to design a final SSDS system.

3.4.2 Summary of AOC C Interim Corrective Measures

The technologies and process options have been assembled into the following four remedial alternatives for further evaluation and were detailed in the *AOC C/Gorham Street ICM Work Plan* (CH2M 2013f):

- Alternative 1—No Action
- Alternative 2—ICs with Inspections
- Alternative 3—Engineering and ICs, Excavation, and Monitoring
- Alternative 4—Excavation and Offsite Disposal

Full descriptions of these alternatives are presented in the AOC C ICM work plan (CH2M 2013f). The selected alternative was Alternative 3 – Engineering and ICs, Excavation, and Monitoring.

The objectives of Alternative 3 are to eliminate direct contact to impacted media, windborne transport, and eliminate potential runoff to adjacent receptors, such as the canal or adjacent residential properties. Shallow soil within the offsite residential area (DE-33 area) was excavated and removed from the property. Based on results of previous soil sampling, the soil removal around DE-33 was defined to an area of approximately 2,600 square feet and 1 foot deep for a total volume of 96 cubic yards, which was disposed of offsite. The excavated area was restored with imported clean fill, and the ground surface was graded and reshaped to control runoff and erosion.

The paved asphalt parking lot that is used as part of Evans Chemetics for employee parking will continue to be used as the engineering control in that area. For other areas of the Evans Chemetics property, New York State Canal Corporation right-of way, and Village of Waterloo right-of-way, a soil cover was installed.

The soil cover was placed using a minimum 12-inch-thick cover consisting of a 6-inch low-permeability soil layer and a 6-inch-thick layer of vegetative topsoil. A demarcation layer was placed under the soil cover to alert future workers to the presence of impacted soil below the cover. The cover area was seeded during construction to reestablish vegetation for stabilization and erosion control.

After completing backfilling operations, the parking lot was extended to the south. The area west of Gorham Street has an extreme slope that will not support placement of a soil cover; therefore, the existing facility security fence was extended to include this area. The vegetation in the fenced area is maintained to minimize the potential for soil erosion.

Additional details of the ICM implementation are presented in the *Gorham Street Corrective Measures Construction Completion Report* (CH2M 2014b). An interim inspection program has been in place since 2014 (CH2M 2014c) to bridge the gap until the SMP is put into place.

3.4.3 Summary of AOC D Interim Corrective Measures

The technologies and process options have been assembled into the following four remedial alternatives for further evaluation and were detailed in the *AOC D ICM Work Plan* (CH2M 2013g):

- Alternative 1—No Action
- Alternative 2—MNA
- Alternative 3—pH Adjustment, Short-Term Periodic Groundwater Recovery, Offsite Disposal, and Monitoring
- Alternative 4—Zero Valent Iron Permeable Reactive Barrier and Monitoring

Full descriptions of these alternatives are presented in the AOC D ICM work plan (CH2M 2013g). The selected alternative was Alternative 2, MNA. Figure 3-1 shows the locations of the AOC D wells monitored as part of Alternative 2.

Natural attenuation relies on natural processes to attenuate COCs in soil and groundwater. Monitoring these conditions to evaluate the success and rate of natural attenuation is an important component of this technology. MNA provides the least disturbance of impacted media and groundwater flow to the canal. Groundwater will be monitored at a predetermined frequency to track the concentrations of facility-specific COCs to verify the trends in COC concentrations are stable or decreasing.

The time to attain cleanup goals by MNA depends on type and concentrations of COCs present, size and depth of the impacted area, type of soil, and the geochemical conditions present. These factors vary at facilities, but cleanup by MNA usually takes years to decades. MNA is retained at this facility because facility investigations and groundwater records indicate high adsorption of arsenic through natural processes in subsurface conditions at AOC D.

The main components of Alternative 2 involve installing three new 2–inch-diameter monitoring wells in Building 3 to optimize the AOC D well network for long-term monitoring. Including these new wells, nine monitoring wells will be sampled during an initial, baseline event. Analysis of the initial round of samples will include field chemistry, total and dissolved metals, and a comprehensive list of geochemical indicator parameters.

The initial baseline event counted as the first quarterly round of sampling for six of the nine wells. These six wells were sampled quarterly for the remaining three quarters of the first year and then annually thereafter. After the initial baseline event, samples were collected quarterly, and then annual frequency will be analyzed for field chemistry and total and dissolved metals.

A second group containing three wells was sampled during the baseline sampling event, and then every 5 years. Monitoring was initiated in 2014 and continues to date, with 2019 being the first 5-year expanded event. Reports have been submitted annually (CH2M 2017a, 2018; Jacobs 2019a).

4. Recommended Corrective Measures and Path Forward

The AOC A corrective measures (sediment removal) were completed in general accordance with the final construction drawings, and no future performance data are required (CH2M 2016). It was a cost-effective remedy that complied with federal, state, and local regulations; protected human health and the environment; and met the project objectives; therefore, it is not included in this report. Similarly, the SWMU 1 corrective measures (multilayer cover system) was completed in general accordance with the final construction drawings, and only a groundwater monitoring component (Figure 3-1) remains, which will be addressed as part of the SMP. It was a cost-effective remedy that complied with federal, state, and local regulations; is protective of human health and the environment; and met the project objectives; therefore, it is not included in this report.

4.1 AOC B Recommended Corrective Measures

The main COCs in groundwater at AOC B are MIBK, acetone, and chromium. Elevated concentrations of the three COCs appear in the same monitoring wells, forming groundwater plumes extending from beneath Building 4 to wells adjacent to the canal, which forms the southern edge of the facility. Total and dissolved arsenic was detected at a concentration above the NYSDEC ambient water quality standards at MW-03 and PZ-03. However, arsenic is not considered a COC at AOC B because it displays limited distribution and no continuity between adjoining monitoring wells in comparison to the other COCs.

Performance sampling has been conducted for 4 years at AOC B at all ten AOC B groundwater monitoring wells (MW-01, MW-02, MW-03, MW-33, MW-34, PZ-01, PZ-03, PZ-04, PZ-06, and PZ-07R). Groundwater samples were analyzed for TAL metals, VOCs, cations, anions, nutrients, and general water quality constituents. In addition to laboratory analytes, field parameters were measured while purging the monitoring wells, including temperature, pH, dissolved oxygen, specific conductance, oxidation-reduction potential, ferrous iron, sulfide, and/or sulfate were obtained. Together, the field and laboratory analyses were used to evaluate MNA effectiveness at AOC B.

Data from the Year 4 MNA ICM implementation period (May and June 2018) showed continuing declines in MIBK concentrations. Chromium concentrations in groundwater samples collected in 2018 exceeded the TOGS Class GA Standard in only one well, MW-33 at 219.9 micrograms per liter (µg/L), significantly lower than 2,844 µg/L, which was recorded upon beginning the MNA study in November 2014. Concentrations in MW-3 fell just below the TOGS Class GA Standard at 48 µg/L. Elsewhere, monitoring wells at AOC B displayed chromium concentrations less than 5 µg/L.

MIBK and chromium concentrations have declined over the relatively short period covered by the Year 1 through Year 4 MNA ICM implementation period. Concentrations of MIBK and chromium have declined below method detection limits in monitoring wells adjacent to the canal, and in 2018, each concentration exceeded the TOGS Class GA Standard in only one monitoring well. Therefore, the AOC B ICM (Alternative 2, MNA) has been performing as designed and is recommended as the final corrective measure for AOC B groundwater.

A SSDS is recommended as the final remedy for AOC B vapor intrusion. A NYSDEC-approved SSDS pilot test (NYSDEC 2019) is being performed to support the design of the final remedy. It is anticipated that the final remedy design will be submitted to NYSDEC in 2020. Table 4-1 summarizes the estimated costs for the AOC B vapor intrusion corrective measure alternatives.

Table 4-1. Summary of Estimated Costs for AOC B Vapor Intrusion Corrective Measure Alternatives
Sitewide Corrective Measures Study, Former Hampshire Chemical Corp. Facility, Waterloo, NY

Alternative Description	Capital Costs ($)	Operation and Maintenance ($)	Present Worth Costs ($)	Total Cost ($)
1. No Action	$0	$0	$0	$0
2. SSDS and Monitoring	$2,619,000*	$191,000	$5,555,000	$5,555,000

*- SSDS capital cost is based on a +50%/-30% order of magnitude cost estimate

4.2 AOC C Recommended Corrective Measures

Alternative 3 – Engineering and ICs and Excavation was the selected alternative for the AOC C ICM. Four years of annual operations and maintenance (O&M) inspections have been performed and have shown that containment using the existing asphalt parking lot as a cap and the constructed soil cover over the remaining area around the parking lot has been effective. Additionally, the removal of shallow soil from the adjacent residential area near location DE-33 has been effective at:

- Removing the potential for direct contact to impacted soil
- Removing facility-related (from previous fill placement) impacted shallow soil from the adjacent residential property
- Reducing potential runoff of the impacted surface soil to adjacent properties and the canal
- Providing both short- and long-term protection

Therefore, based on the performance data collected to date, the AOC C ICM is recommended as the final corrective measure at this AOC.

4.3 AOC D Recommended Corrective Measures

At AOC D, arsenic in groundwater is the only COC. Spills of caustic sodium hydroxide and sodium hydrosulfide in Building 3 have infiltrated to groundwater and increased pH from approximately 6.5 to as high as 12. The alkaline groundwater pH alters the surface charge on common, metal oxide mineral surfaces like hydrous ferric oxide and hydrous aluminum oxide from positive to negative. As a result, negatively charged oxyanions, like arsenic, previously adsorbed to these surfaces are repelled, desorbing from the surfaces, and increasing arsenic concentrations in groundwater. Accordingly, laboratory analytes and field chemistry measurements were tailored to evaluate arsenic concentrations with time, constituents that influence its mobility, along with characterizing geochemical conditions beneath AOC D that influence arsenic persistence and migration.

Performance sampling over 4 years at AOC D was conducted at all nine AOC D groundwater monitoring wells (MW-11S, MW-21, MW-24, MW-29, MW-30, MW-31, MW-35, MW-36, and MW-37). Groundwater samples were analyzed for TAL metals, cations, anions, nutrients, and general water quality constituents. Field parameters also were measured while purging the monitoring wells, including temperature, pH, dissolved oxygen, specific conductance, oxidation-reduction potential, ferrous iron, sulfide, and/or sulfate. Together, the field and laboratory analyses were used to evaluate MNA effectiveness at AOC D.

Data from the 4-year MNA ICM implementation period indicates arsenic plume strength and size were stable or decreasing. The pH increased in several monitoring wells with measurements over the monitoring period; however, the pH measurements did not exceed historical maxima.

Based on the performance data, the arsenic plume has been shown to be stable or decreasing; therefore, the AOC D ICM is recommended as the final corrective measure.

4.4 Facility-wide Institutional Controls

ICs will be established for the entire facility including all AOCs and SWMUs. The ICs will consist of groundwater use restrictions, facility use will remain as nonresidential, and intrusive construction activities will be performed in compliance with the site-specific materials management plan. The ICs established for the entire facility also will meet the abbreviated CMS requirements for AOC E, SWMU 7, SWMU 8, and SWMU 25B. The ICs will be in the form of an environmental easement between the facility owner, HCC, and NYSDEC.

4.5 Site Management Plan

Upon approval of the final remedies for the facility, an SMP will be developed to present the O&M requirements for the entire facility, including:

- Inspections and repairs
- Performance monitoring (groundwater and vapor monitoring)
- Reporting

4.6 Corrective Measures Alternatives Costs

The summary of estimated costs for the selected AOCs and SWMUs corrective measures are presented in Table 4-2. The estimated total present worth cost for implementing the remedies for 30 years at a net present value of 5% is $9,075,000. The estimated capital costs are $2,834,000, and the annual O&M costs are estimated at $406,000.

Table 4-2. Summary of Estimated Costs for Corrective Measures Alternatives

Sitewide Corrective Measures Study, Former Hampshire Chemical Corp. Facility, Waterloo, NY

Facility-wide/ AOC/ SWMU	Description	Corrective Measure Alternative	Capital Costs ($)	Annual Costs ($)	Total Present Worth ($)
Project Management and Administrative Support	Capital - Sitewide CMS, Statement of Basis Public Meeting, Site Management Plan and Access Agreements Annual - Sitewide Groundwater; SWMUs 1, 7, 8, 25B; AOC B, C, D, E Areas	Sitewide	$162,000	$32,000	$654,000
Facility-wide	Facility-wide Soil and Groundwater	ICs[a]	$95,000	NA	$95,000
	Facility-wide Groundwater Monitoring	LTM for Groundwater[b]	$0	$167,000 (Monitoring, Maintenance and Reporting)	$2,567,000
	Facility-wide Vapor Migration/ Indoor Air	No further action, except for AOC B; see AOC B SSDS	NA	NA	NA
AOC B	Building 4 Pit	MNA[b] and ICs[a], SSDS and Monitoring	$2,577,000 (SSDS)	$163,000 (SSDS Operations, Monitoring, Maintenance and Reporting)	$5,083,000 (SSDS)
AOC C	Gorham Street/ Source Area for PCBs	Engineering and ICs[a], Excavation, and Monitoring	$0	$20,000 (Maintenance)	$307,000
AOC D	Monitoring Well MW11S Area	MNA[b] and ICs[a]	NA	NA	NA

Table 4-2. Summary of Estimated Costs for Corrective Measures Alternatives

Sitewide Corrective Measures Study, Former Hampshire Chemical Corp. Facility, Waterloo, NY

Facility-wide/ AOC/ SWMU	Description	Corrective Measure Alternative	Capital Costs ($)	Annual Costs ($)	Total Present Worth ($)
AOC E, SWMU 7, 8 and 25B	Monitoring Well MW10 Area, Hazardous Waste Container Storage Area, Nonhazardous Waste Container Storage Area, and Intermediate Nonhazardous Waste Container Storage Area	ICs[a]	NA	$2,000 (Maintenance)	$31,000
SWMU 1	The Former Village of Waterloo Dump Site	Soil Cover, Asphalt Cap, and ICs[a] with Monitoring, and Groundwater Monitoring[b]	$0	$22,000 (Maintenance)	$338,000
Total Costs			**$2,834,000**	**$406,000**	**$9,075,000**

[a] ICs costs for AOCs B, C, D, and E, and SWMUs 1, 7, 8, and 25B are presented in the facility-wide soil and groundwater cost.
[b] Groundwater monitoring costs for AOCs B and D MNA, SWMU 1, and supplemental sitewide wells are presented in the facility-wide cost.
NA - Costs identified as not applicable are represented in combined sitewide groundwater and institutional controls monitoring, maintenance and reporting costs.
The SSDS cost is based on a +50%/-30% order of magnitude cost estimate.

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Figures

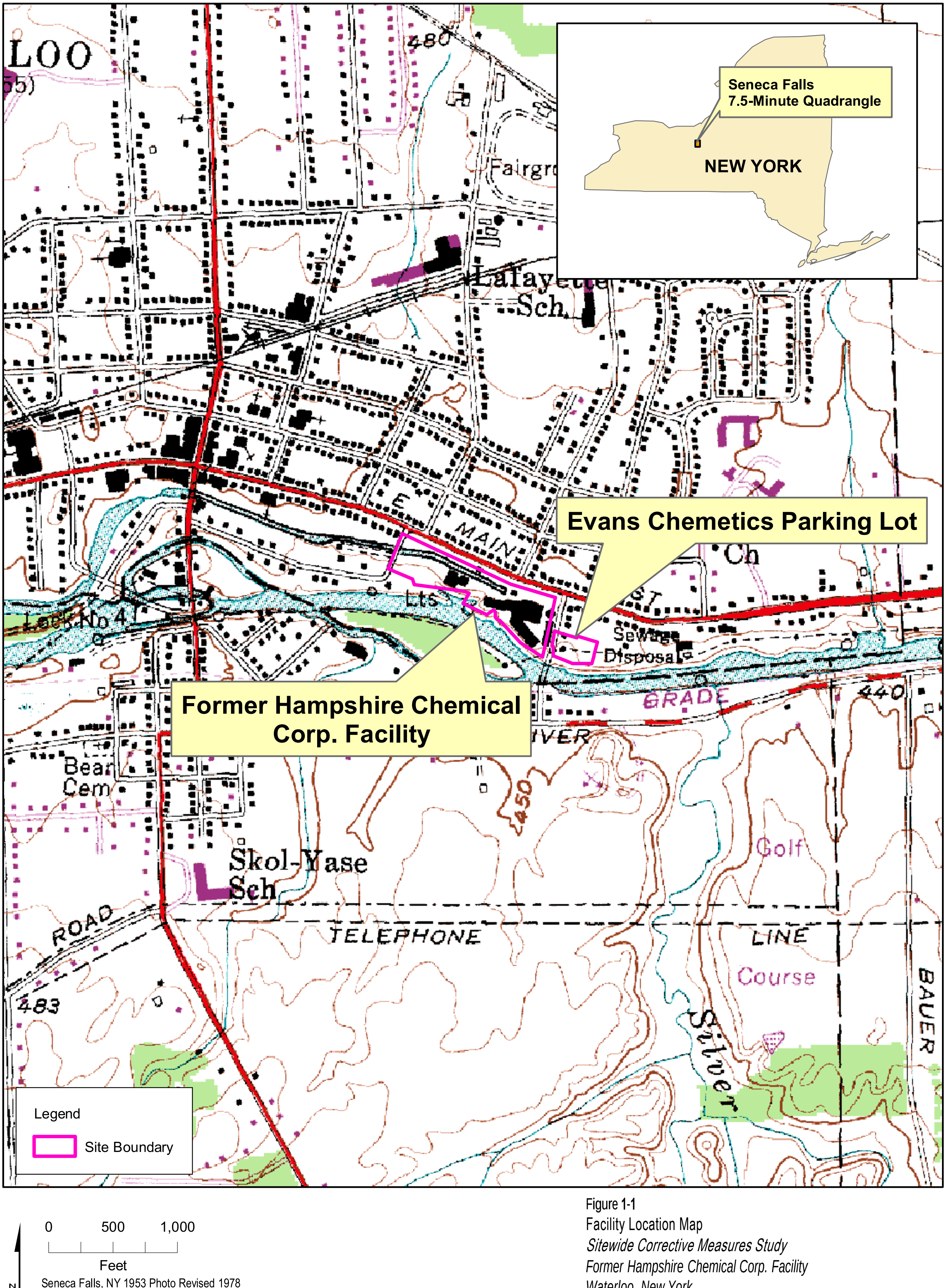

Figure 1-1
Facility Location Map
Sitewide Corrective Measures Study
Former Hampshire Chemical Corp. Facility
Waterloo, New York

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Notes:
NFA - No further action
NFA issued by NYSDEC on Dec. 2, 2003.
SWMU 28 (NFA) - Wash Water Sewer System (Buildings 2, 3, 4, 9, 13, 14 and 16)
SWMU 29 (NFA) - SPDES Sewer System (Buildings 1, 2, 2A, 2B, 3, 4, 5, 14 and Reactor)

Figure 1-2
Facility Layout and SWMU/AOC Locations
Sitewide Corrective Measures Study
Former Hampshire Chemical Corp. Facility
Waterloo, New York

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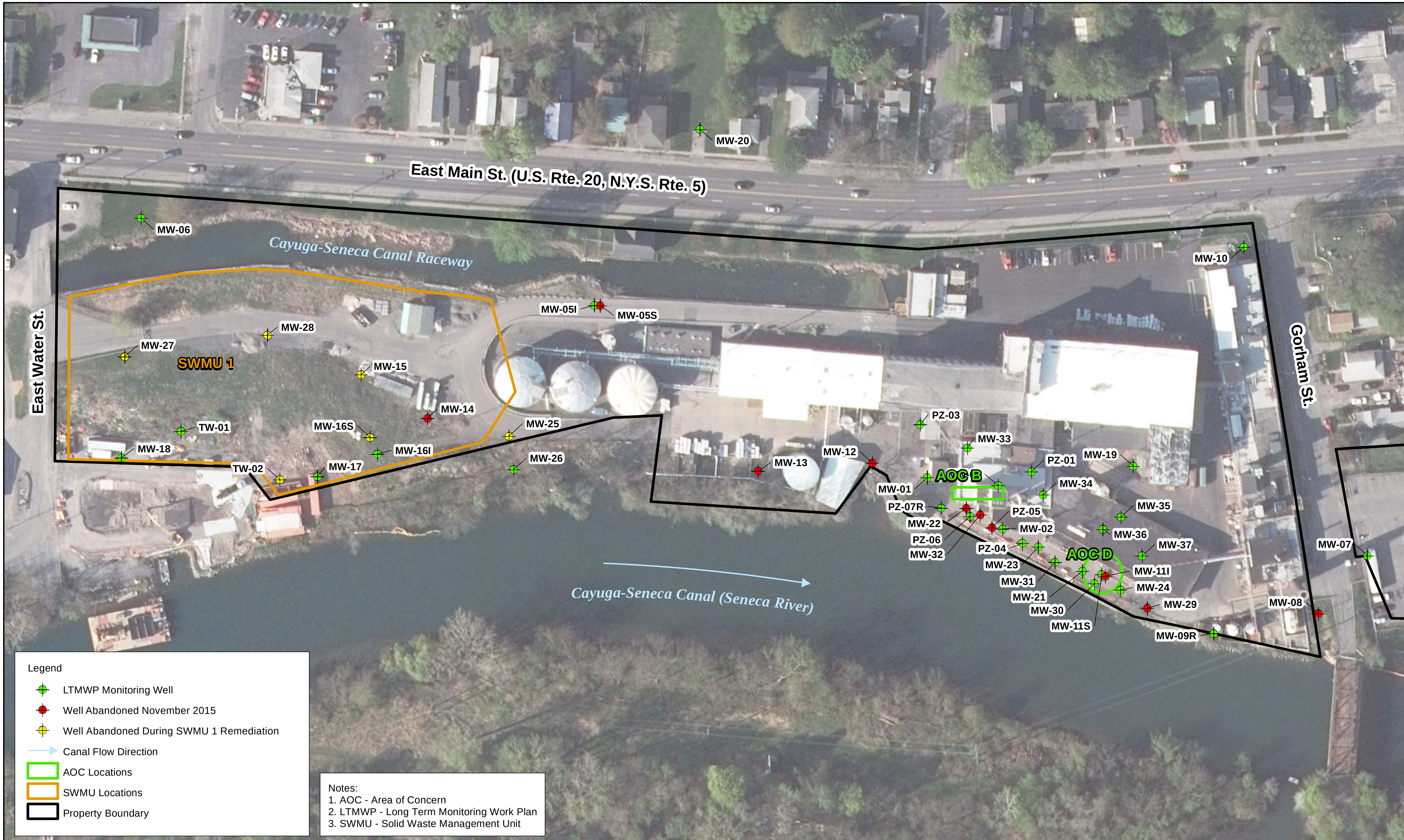

0 100 200

Feet

Figure 1-3

Sitewide Wells and Piezometers Locations

Sitewide Corrective Measures Study

Former Hampshire Chemical Corp. Facility

Waterloo, New York

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MKE \\LAKEFRONT\PROJ\GIS\DOW\WATERLOO\REPORTS\2016\GWMONITORINGRESULTS_NOV2015\MAPFILES\FIGURE 1-2 - SITE LAYOUT MAP.MXD JHANSEN1 8/9/2016 8:27:48 PM

LEGEND

ELEVATION CONTOURS (1foot, NGVD 1929)

425 — MAJOR CONTOUR (5 ft INTERVAL)

MINOR CONTOUR (1 ft INTERVSL)

NOTE:
CONTOUR LINES ARE BASED ON SURVEYS OF SELECT AREAS, AND LINES MAY END ABRUPTLY AT WATER BODIES, SITE BUILDINGS AND LIMITS OF SURVEY.

Figure 2-1
Site Topographic Map
Sitewide Corrective Measures Study
Former Hampshire Chemical Corp. Facility
Waterloo, New York

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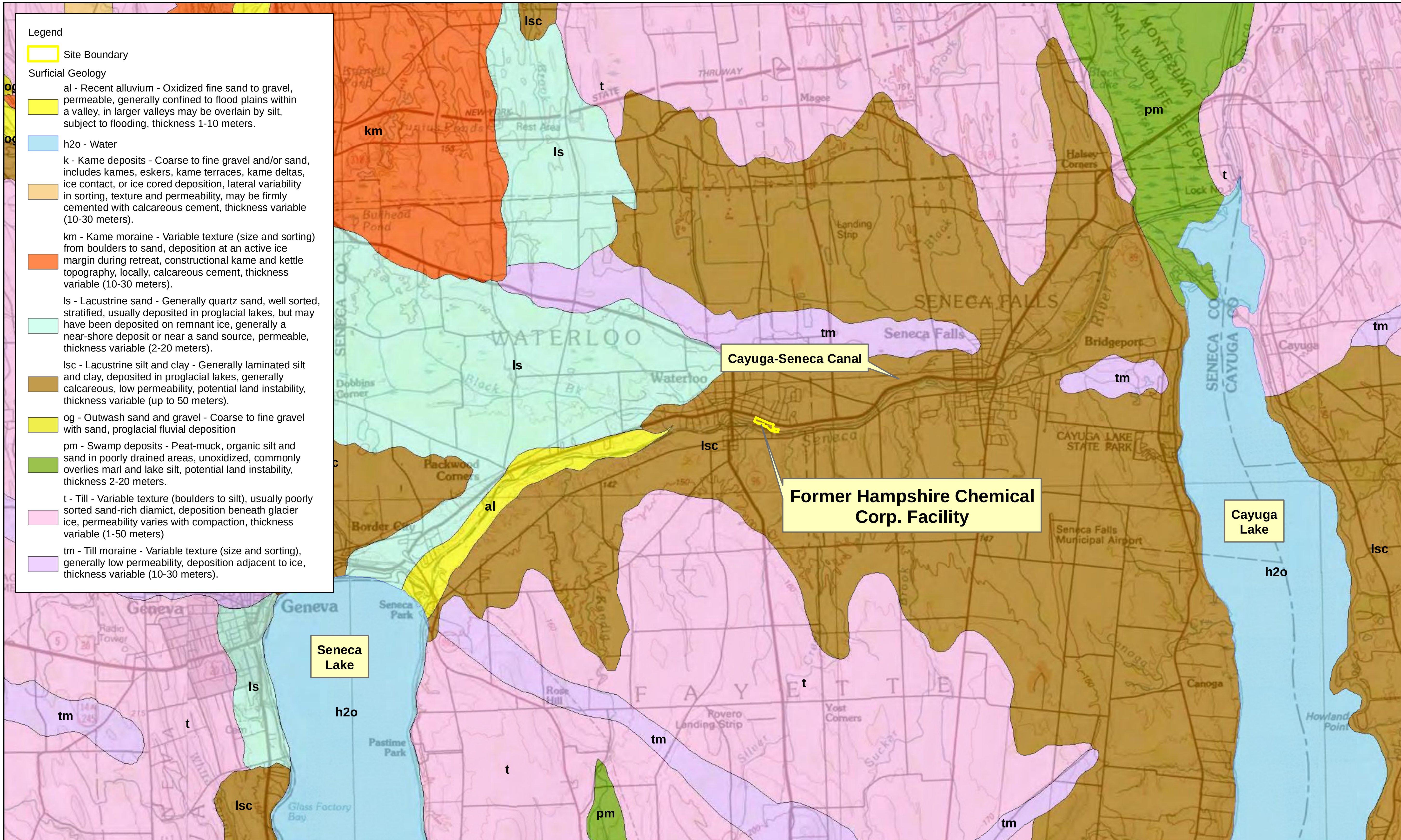

0 6,250 12,500
Feet

Source: Surficial Geologic Map of New York, Finger Lakes Sheet, 1:250,000 scale, New York State Museum - Geological Survey, Map and Chart Series No. 40, Compiled and Edited by Ernest H. Muller and Donald H. Cadwell, 1986.

Figure 2-2
Regional Surficial Geology Map
Sitewide Corrective Measures Study
Former Hampshire Chemical Corp. Facility Waterloo, New York

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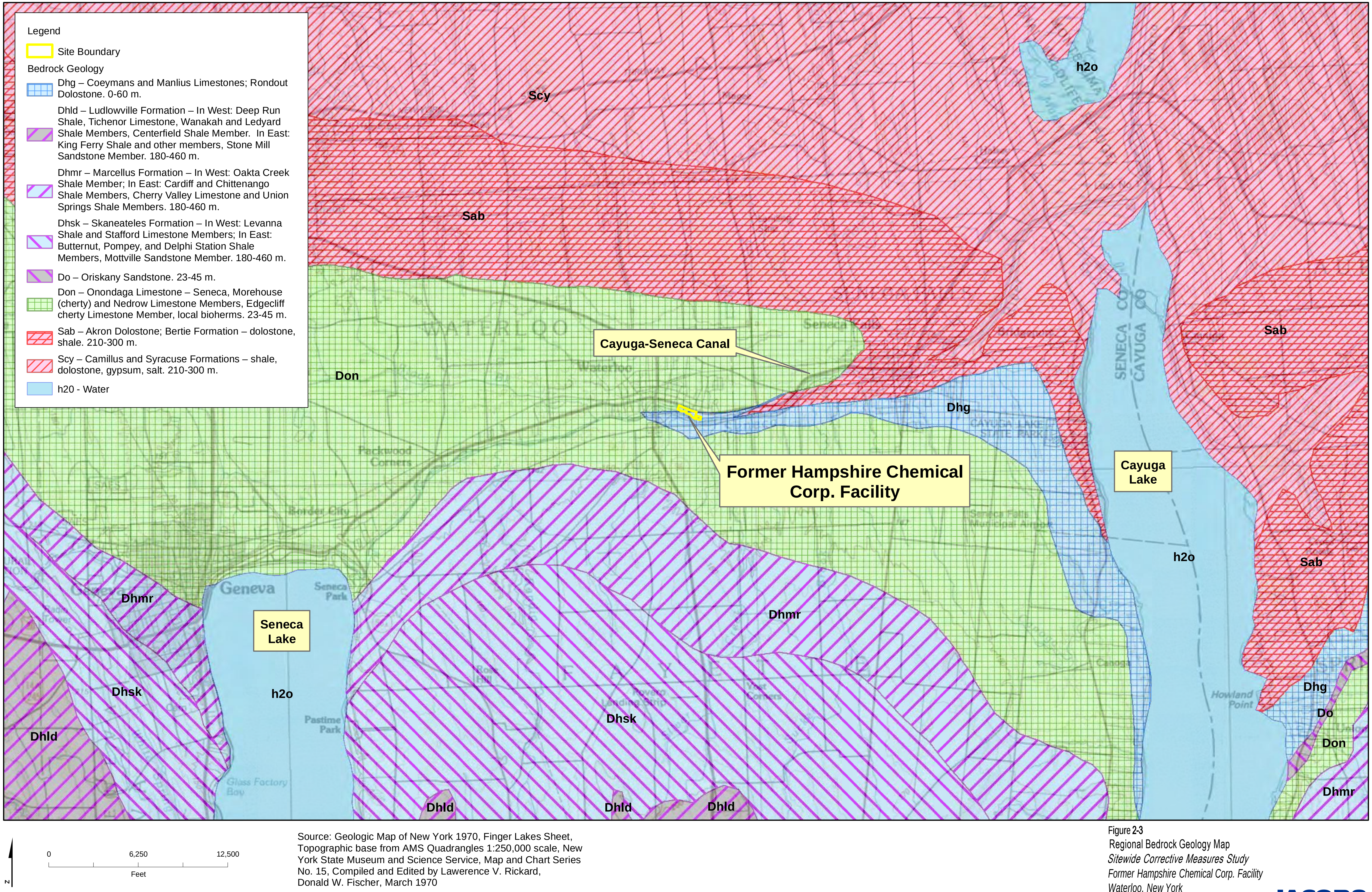
MKE \\LAKEFRONT\PROJ\GIS\DOW\WATERLOO\REPORTS\2012\RFIREPORT\MAPFILES\FIGURE2-1_SURFICIALGEOLOGY.MXD JCROCKET 4/24/2014 12:18:25 PM



Source: Geologic Map of New York 1970, Finger Lakes Sheet, Topographic base from AMS Quadrangles 1:250,000 scale, New York State Museum and Science Service, Map and Chart Series No. 15, Compiled and Edited by Lawerence V. Rickard, Donald W. Fischer, March 1970

Figure 2-3
Regional Bedrock Geology Map
Sitewide Corrective Measures Study
Former Hampshire Chemical Corp. Facility
Waterloo, New York

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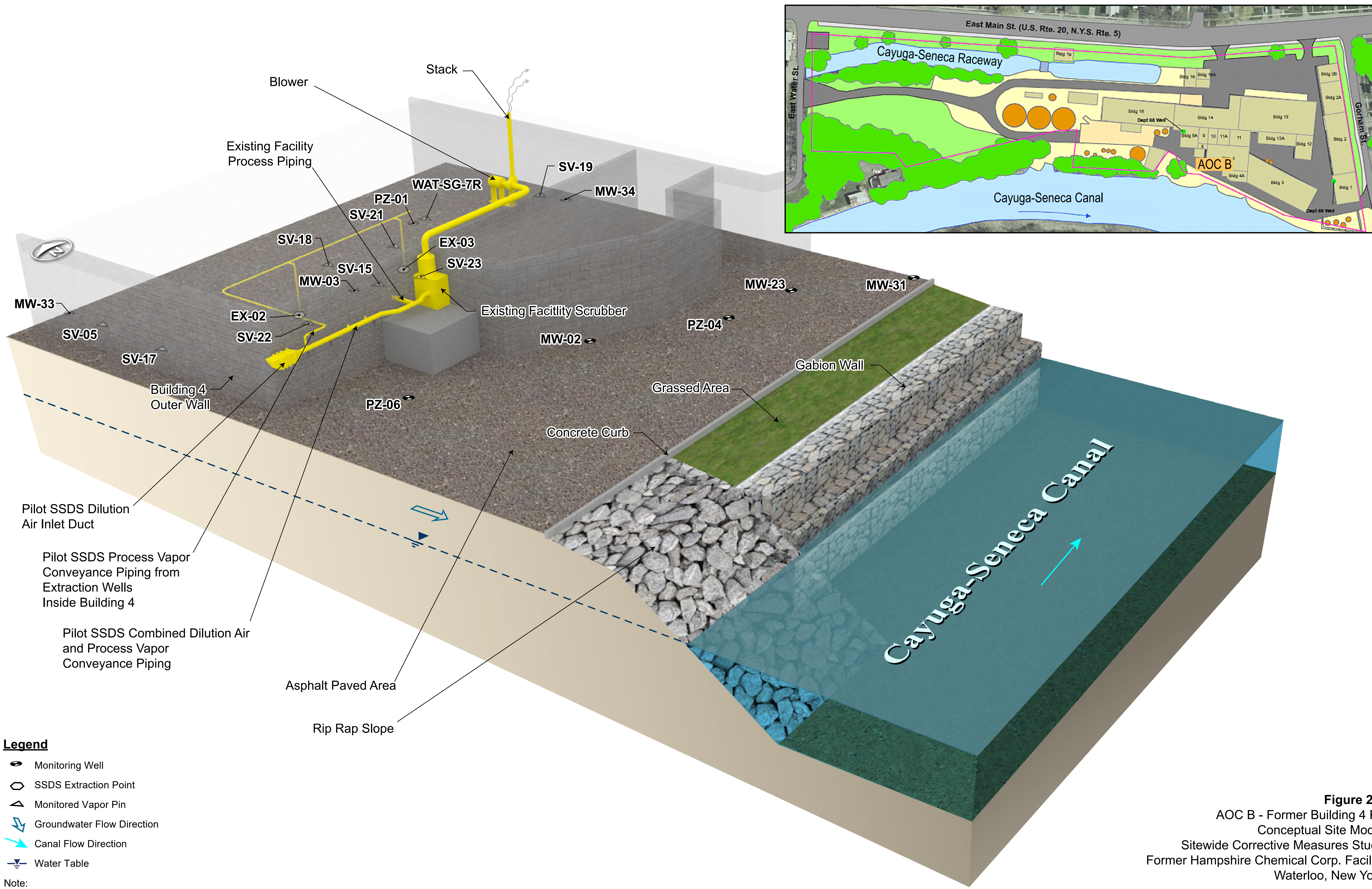
MKE \\LAKEFRONT\PROJ\GIS\DOW\WATERLOO\REPORTS\2012\RFIREPORT\MAPFILES\FIGURE2-2_BEDROCKGEOLOGY.MXD JCROCKET 4/24/2014 12:25:22 PM



Legend

- Monitoring Well
- SSDS Extraction Point
- Monitored Vapor Pin
- Groundwater Flow Direction
- Canal Flow Direction
- Water Table

Note:
SSDS = Subslab Depressurization System

Figure 2-4
AOC B - Former Building 4 Pit
Conceptual Site Model
Sitewide Corrective Measures Study
Former Hampshire Chemical Corp. Facility
Waterloo, New York

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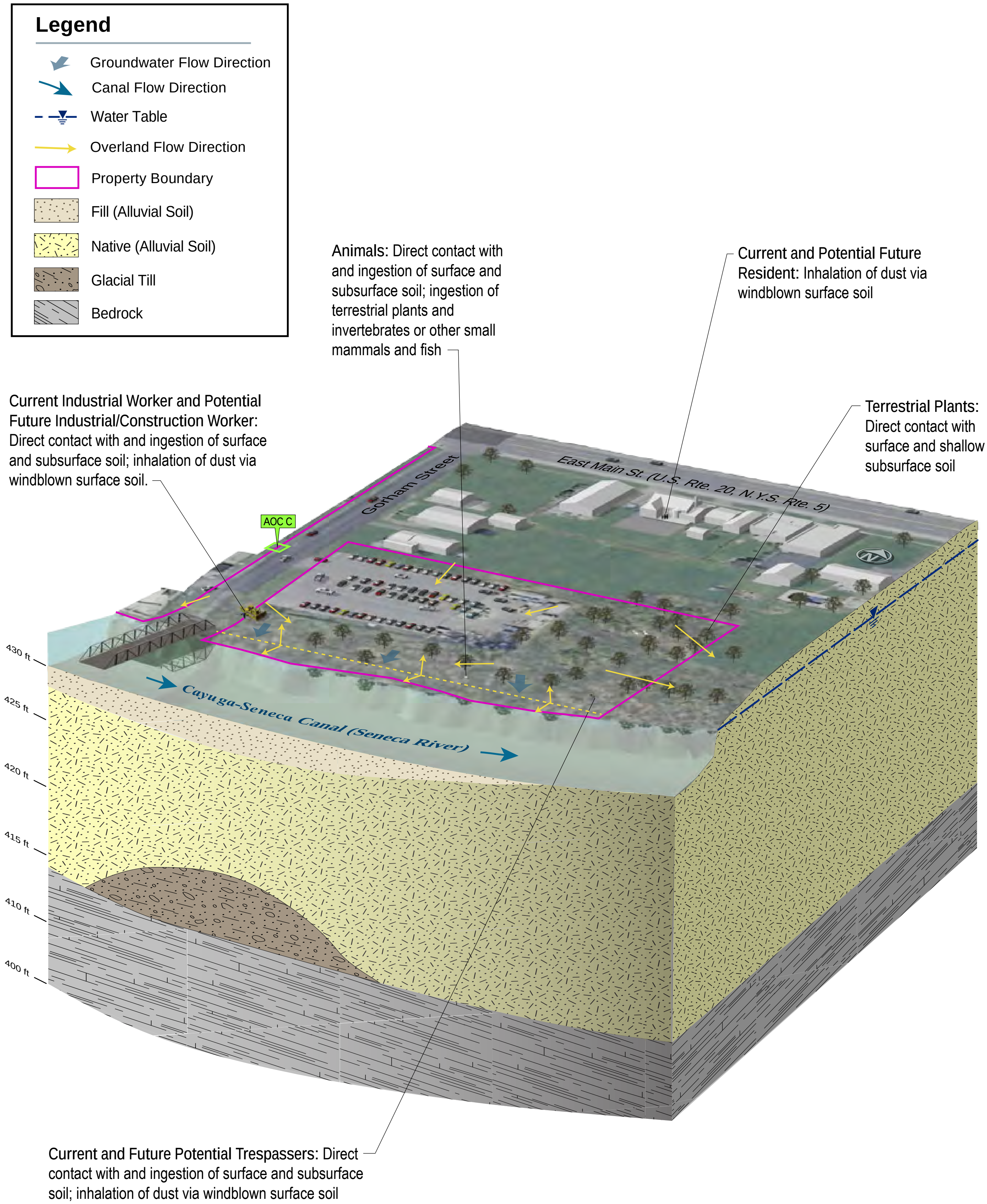

Figure 2-5
AOC C/Gorham Street Conceptual Site Model
Sitewide Corrective Measures Study
Former Hampshire Chemical Corp. Facility
Waterloo, New York

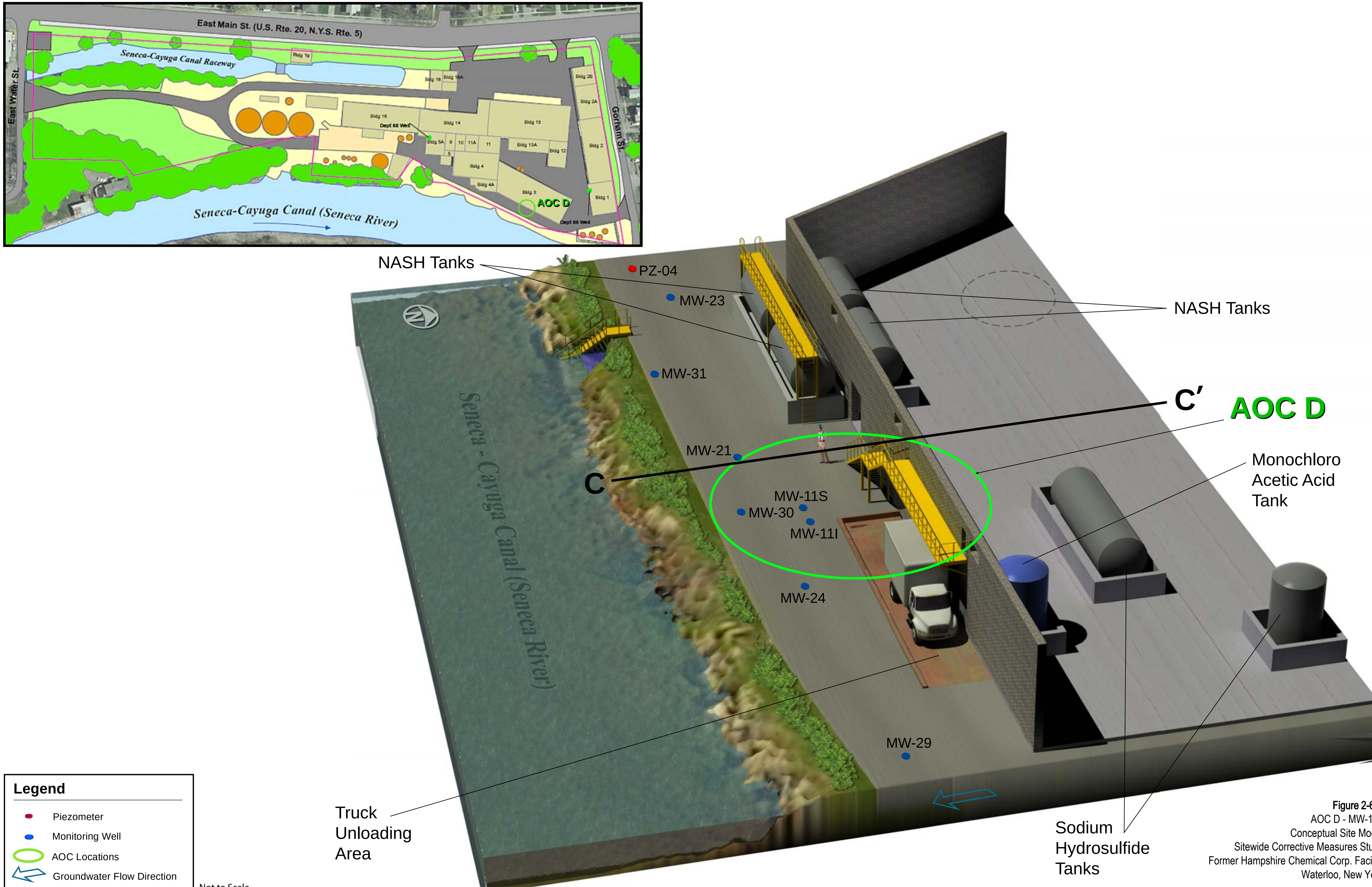

Figure 2-6
AOC D - MW-11S
Conceptual Site Model
Sitewide Corrective Measures Study
Former Hampshire Chemical Corp. Facility
Waterloo, New York

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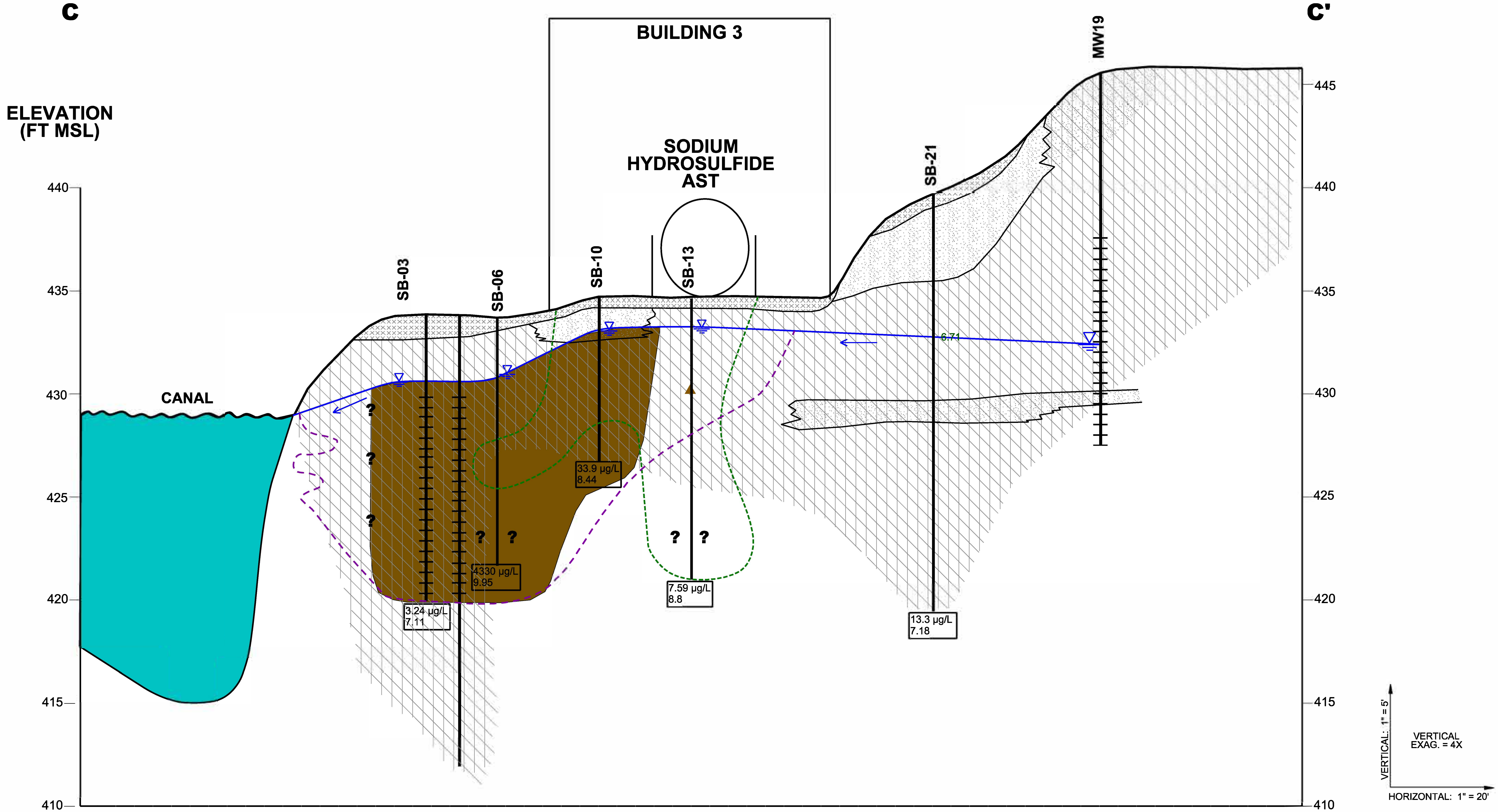
f22_328180.dgn



LEGEND

BLACKTOP OR CONCRETE

SAND OR GRAVEL

SILT OR CLAY

8.5 pH ISOPLETH - GROUNDWATER

8.5 pH ISOPLETH - SOIL

25 µg/L DISSOLVED ARSENIC ISOPLETH - GROUNDWATER

FILL INDICATOR (BRICK, WOOD, ETC.)

? NO RECOVERY/INFERRED

WATER TABLE

SCREENED INTERVAL

Diss. As 3.24 µg/L pH 7.11 GROUNDWATER SAMPLE

NOTE

1.) ELEVATIONS ARE ESTIMATED

2.) BUILDING NOT TO SCALE

3.) THE DEPICTED STRATIGRAPHY FOR MW-11S IS BASED ON THE BORING LOG FOR MW11I, WHICH IS LOCATED APPROXIMATE 5 FEET EAST OF MW-11S. THE DEPICTED STRATIGRAPHY IS CONCEPTUAL/SIMPLIFIED.

Figure 2-7
AOC D Conceptual Site Model Section C - C'
Sitewide Corrective Measures Study
Former Hampshire Chemical Corp. Facility
Waterloo, New York

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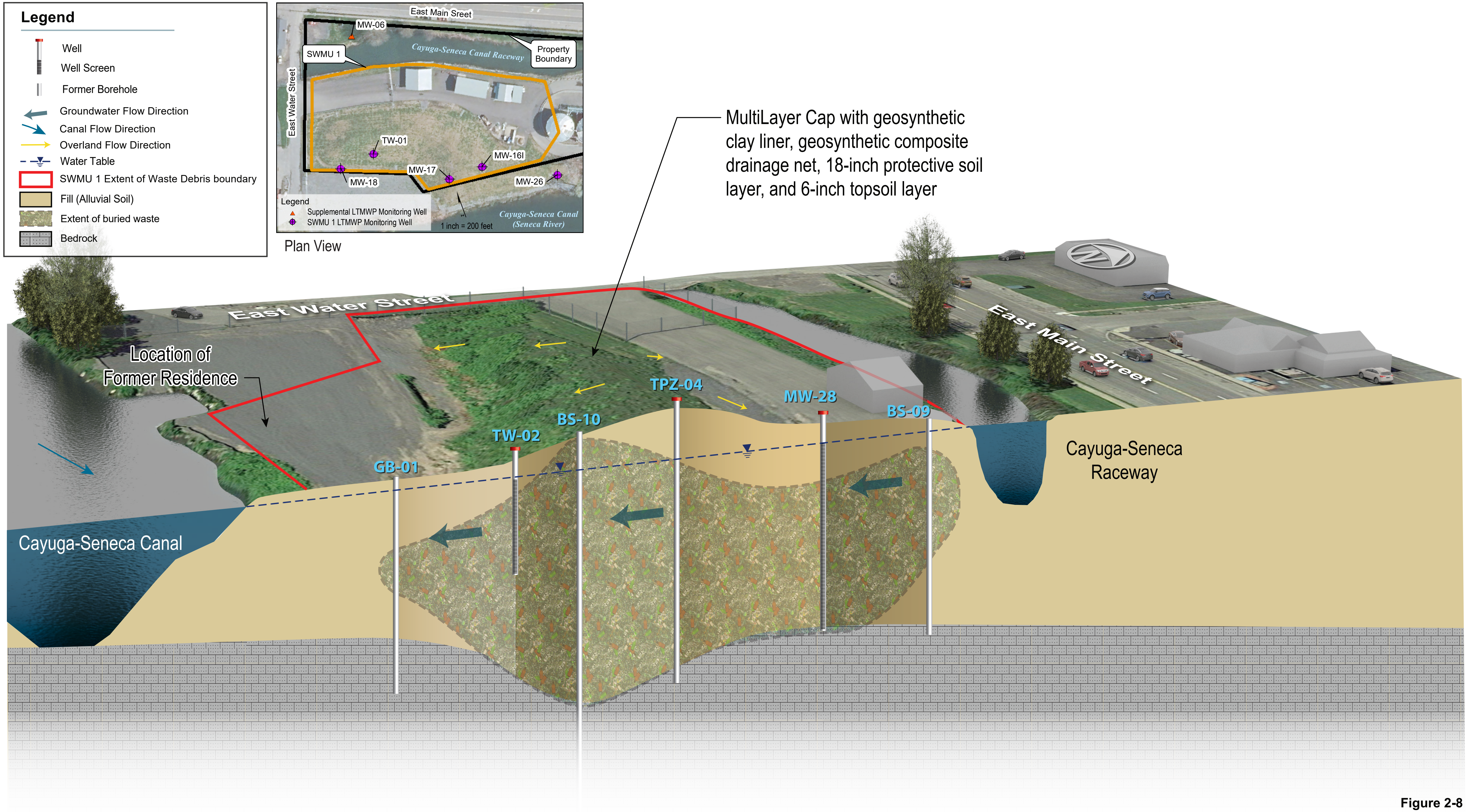

Note:
TW-02 well screen: 5.5 ft to 10.5 ft bgs
MW-28 well screen: 6 ft to 16 ft bgs

Not to Scale

Figure 2-8
SWMU 1
Conceptual Site Model
Sitewide Corrective Measures Study
Former Hampshire Chemical Corp. Facility
Waterloo, New York

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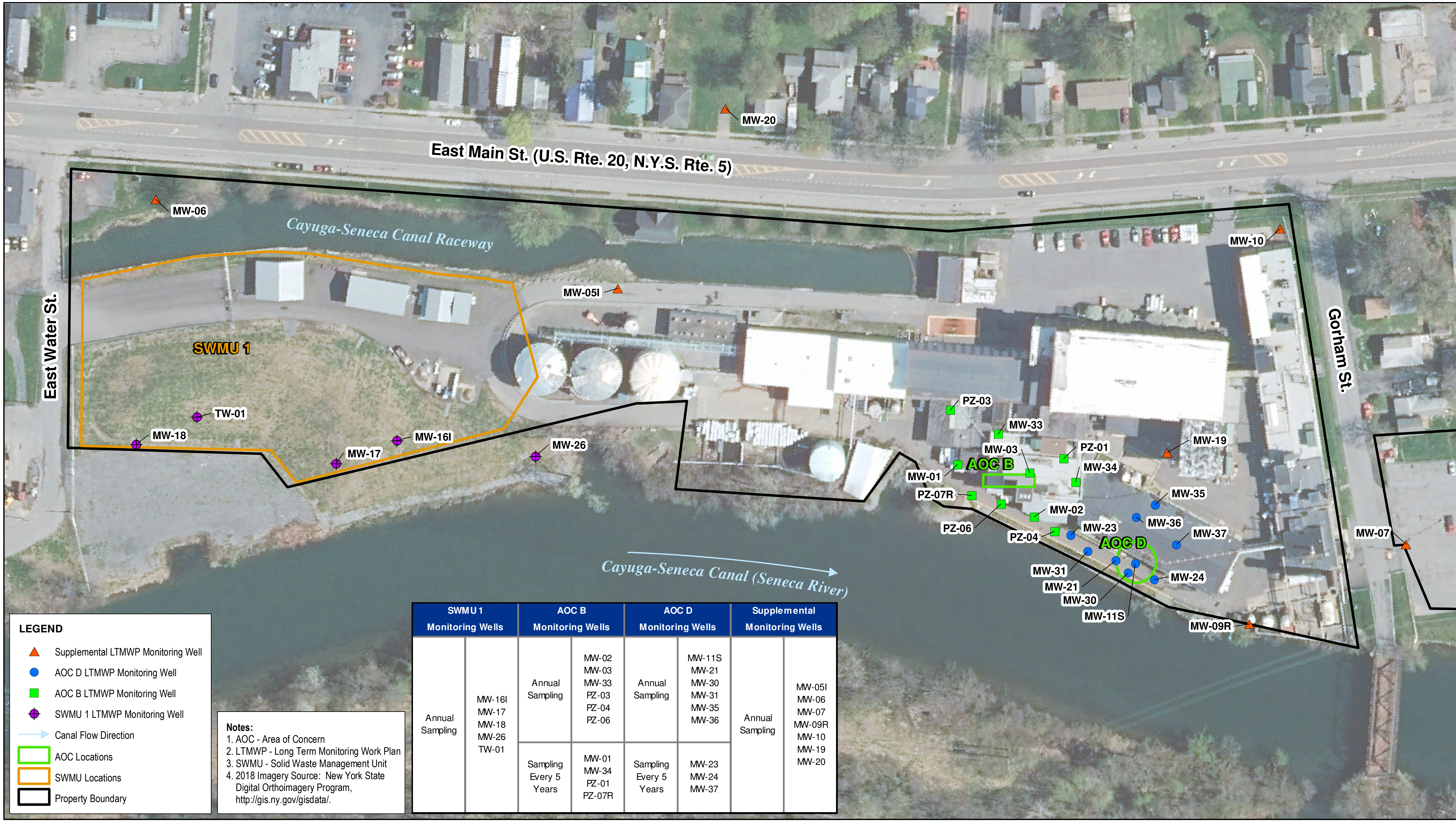

LEGEND

- Supplemental LTMWP Monitoring Well
- AOC D LTMWP Monitoring Well
- AOC B LTMWP Monitoring Well
- SWMU 1 LTMWP Monitoring Well
- Canal Flow Direction
- AOC Locations
- SWMU Locations
- Property Boundary

Notes:
1. AOC - Area of Concern
2. LTMWP - Long Term Monitoring Work Plan
3. SWMU - Solid Waste Management Unit
4. 2018 Imagery Source: New York State Digital Orthoimagery Program, http://gis.ny.gov/gisdata/.

SWMU 1 Monitoring Wells		AOC B Monitoring Wells		AOC D Monitoring Wells		Supplemental Monitoring Wells	
Annual Sampling	MW-16I MW-17 MW-18 MW-26 TW-01	Annual Sampling	MW-02 MW-03 MW-33 PZ-03 PZ-04 PZ-06	Annual Sampling	MW-11S MW-21 MW-30 MW-31 MW-35 MW-36	Annual Sampling	MW-05I MW-06 MW-07 MW-09R MW-10 MW-19 MW-20
		Sampling Every 5 Years	MW-01 MW-34 PZ-01 PZ-07R	Sampling Every 5 Years	MW-23 MW-24 MW-37		

N

0 100 200
Feet

Figure 3-1.
AOC B, AOC D and SWMU 1 Long Term Monitoring Well Network
Sitewide Corrective Measures Study
Former Hampshire Chemical Corp. Facility, Waterloo, New York

\\LAKEFRONT\PROJ\GIS\DOW\WATERLOO\REPORTS\2020\SITEWIDE_CMS\MAPS\REPORT\FIGURE 3-1 - LTM NETWORK.MXD JHANSEN1 1/13/2020 8:23:24 AM

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