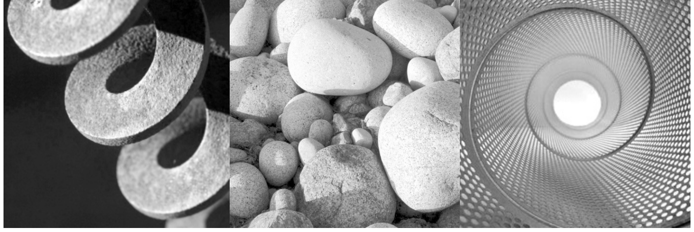

Consulting
Engineers and
Scientists

Feasibility Study Report

Canastota Non-Owned Former MGP Site
Canastota, New York
NYSDEC Site # 727014

Submitted to:
National Grid, USA
300 Erie Boulevard West
Syracuse, NY 13202

Submitted by:
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February 9, 2021, Revised August 31, 2021
Project #034390

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Abbreviations and Acronyms

AWQS	Ambient Water Quality Standards, Guidance Values, and Groundwater Effluent Limitations
bgs	below ground surface
BTEX	Benzene, Toluene, Ethylbenzene, and Xylene
BTU	British Thermal Unit
CAMP	Community Air Monitoring Program
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
COC	Constituent of Concern
CP-51 Soil Cleanup Guidance	Soil Cleanup Guidance, NYSDEC Policy, October 21, 2010
CY	cubic yard
DER	Department of Environmental Remediation
DER-10	NYSDEC DER-10 Technical Guidance for Site Investigation and Remediation, May, 2010
DPW	Department of Public Works
EPA	United States Environmental Protection Agency
FS	Feasibility Study
GAC	Granular Activated Carbon
GEI	GEI Consultants, Inc., P.C.
GRA	General Response Action
HASP	Health and Safety Plan
IC/ECs	Institutional Controls/Engineering Controls
ISCO	In-Situ Chemical Oxidation
ISS	In-Situ Stabilization /Solidification
LTTD	Low-Temperature Thermal Desorption
MGP	Manufactured Gas Plant
mg/kg	Milligrams per kilogram (equivalent to ppm)
MNA	Monitored Natural Attenuation
MSL	mean sea level
NAPL	Non-Aqueous Phase Liquid
NAVD88	North American Vertical Datum 1988
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
OM&M	Operations, Maintenance and Monitoring
PAH	Polycyclic Aromatic Hydrocarbon
PCB	Polychlorinated Biphenyl
PDI	Pre-Design Investigation
POTW	Publically Owned Treatment Works
ppb	parts per billion
PPE	Personal protective equipment

Abbreviations and Acronyms (cont.)

ppm	parts per million (equivalent to mg/kg in soil)
PSC	New York State Public Service Commission
PRAP	Proposed Remedial Action Plan
RAO	Remedial Action Objective
RI	Remedial Investigation
RIR	Remedial Investigation Report
ROD	Record of Decision
ROW	Right-of-way
SCG	Standards, Criteria, and Guidance
SCO	Soil Cleanup Objective
SCS	Soil Conservation Service
SMP	Site Management Plan
TBC	To Be Considered
TOGS	Technical and Operational Guidance Series
USDA	United States Department of Agriculture
VCO	Voluntary Consent Order
VOC	Volatile Organic Compound

Engineer's Certification

In accordance with NYSDEC DER-10 Section 1.5 (b) 2,

I, Daniel R. Kopcow, certify that I am currently a NYS registered professional engineer, and that this Report was prepared in accordance with all applicable statutes and regulations and in substantial conformance with the NYSDEC Division of Environmental Remediation (DER) Technical Guidance for Site Investigation and Remediation (DER-10).

<u>August 31, 2021</u>
Date

Engineer's Seal
GEI Consultants, Inc., P.C.

It is a violation of New York State Education Law for any person, unless acting under the direction of a licensed professional engineer, to alter in any way plans, specifications, plates, and reports to which the seal of a professional engineer has been applied. If an item bearing the seal of an engineer or land surveyor is altered, the altering engineer shall seal the item and add the notation "altered by", sign and date such alteration, and provide a specific description of the alteration.

Executive Summary

Introduction and Purpose

This report describes the Feasibility Study (FS) undertaken for a former manufactured gas plant (MGP) site located on East North Canal Street in the Village of Canastota, Madison County, New York. The location of the site is shown on Figure 1. The FS was conducted pursuant the Order on Consent and Administrative Settlement, CO number 7-20180629-27 between National Grid and the New York State Department of Environmental Conservation (NYSDEC) and is based on a series of environmental studies performed by National Grid, culminating in the Remedial Investigation Report (RIR) of May 2012, revised January 2015. The FS describes options for remediation of the site, located primarily within a property now owned by the Village of Canastota and operated as the village's Department of Public Works (DPW) facility. A portion of a bordering commercial property, owned by Greater Lenox Ambulance Service, Inc., is also discussed in this FS.

The purpose of this FS is to: 1) identify and comparatively evaluate appropriate remedial alternatives for soil and groundwater, 2) recommend media-specific alternatives that adequately mitigate potential threats to human health and the environment due to the constituents of concern (COCs) from former MGP operations, and 3) identify alternatives that are consistent with the remedial objectives for the future contemplated site use.

Site Description and History

From 1906 until 1926, The Central New York Power Company operated an MGP at the site. Today, the site is owned by the Village of Canastota and is used as the DPW garage and service yard (Figure 2).

The location of the former MGP is at the southern end of a parcel that is approximately 10 acres. The site is bounded by East North Canal Street to the south, Roberts Street and undeveloped land owned by Canastota Central School Board of Education to the north, the Greater Lenox Ambulance Service and residential properties to the west, and residential properties to the east.

MGP Impacts and Subsurface Structures

The former MGP structures were located in the southern end of the DPW parcel, and consisted of two gas holders, tar well/tar separator, purifier building, "hot well", retorts, repair shop, condenser, and scrubber (Figure 3).

Media investigated during the Remedial Investigation (RI) included surface soil, subsurface soil, soil gas vapors, and groundwater. The RI found that the majority of MGP soil impacts are related primarily to coal tar (also referred to as non-aqueous phase liquid [NAPL] herein) within three former

MGP structures, including the small Gas Holder, the area associated with the tar well/tar separator, and to a lesser extent the large Gas Holder (Figure 3).

Investigation of the off-site residential and undeveloped areas to the east and north, and along the southern border with East North Canal Street indicate that MGP impacts have not migrated to these areas. The off-site commercial area to the west (Greater Lenox Ambulance Service) was also investigated, and MGP-like odors were observed at SB24 and SB39 (Figure 5). These locations were delineated and no other impacts were observed on the commercial property. In total, the impacted soil area is approximately 0.8 acres. NAPL was not observed at depths greater than 15 feet.

The RI identified benzene, toluene, ethylbenzene, and xylene (BTEX) and polycyclic aromatic hydrocarbon (PAH) compounds in groundwater above Ambient Water Quality Standards. The elevated results were generally confined to wells within the central portion of the site, with some downgradient detections at MW-7 on the undeveloped portion of the DPW property (Figure 5).

During the RI, analysis of soil vapor identified concentrations of a variety of chemicals commonly found in air; these concentrations are reflective of ambient conditions. Although indoor air was not sampled due to prevalence of interfering substances associated with the DPW operations, the RI results did not identify MGP-related vapor intrusion concerns associated with the DPW garage.

Human Health Exposure

Soil in the vicinity of former MGP structures exceeds commercial Soil Cleanup Objectives (SCOs) and may present an exposure risk should excavation occur. In other words, complete exposure pathways at the site exist, but only if invasive excavation, construction, or utility maintenance were to occur. No ongoing or existing exposure pathways or threats are active for the site. Therefore, only potential exposure pathways exist.

General Response Actions (GRAs) and Remedial Technologies

To meet the remedial action objectives (RAOs) developed for the site (Section 4), the following GRAs and remedial technologies were identified:

1. No Action
2. Institutional Controls and Engineering Controls (IC/ECs) Pertaining to Soil or Groundwater
3. Containment of Soil and Groundwater
4. In-Situ Treatment of Soil and Groundwater
5. Removal and Off-site Treatment/Disposal of Soil and NAPL/Groundwater

Specifically, the following actions, technologies, and methods were used in the development of the remedial alternatives:

1. No Action – This response action is listed for compliance with the NYSDEC Division of Environmental Remediation’s guidance document DER-10 [NYSDEC, 2010a], but would not result in meeting the RAOs and is not contemplated for this site.

2. Institutional Controls and Engineering Controls (IC/ECs) – ICs include land use restriction agreements between National Grid and third-party owners. ECs include activities such as signage and maintenance of physical barriers such as pavement.
3. Containment Technologies – Containment technologies include surface caps such as pavement, and vertical barriers to mitigate contaminant migration and reduce recontamination of remediated areas.
4. In-situ Treatment of Subsurface Soil – Technologies that provide containment, immobilization (e.g., solidification), transformation, or recovery of contamination.
5. Subsurface Soil Removal – Conventional excavation methods for removing impacted soil. Temporary control of odors and emissions can be accomplished using odor-controlling foam and plastic covering for excavated areas.
6. In-situ groundwater treatment and monitored natural attenuation (MNA) – In-situ groundwater treatment and MNA relies upon the natural degradation and mitigation processes that occur in the subsurface to remedy groundwater impacts over time. Natural processes can be enhanced by modifying the subsurface conditions either biologically, chemically, or physically, to provide active in-situ groundwater management.
7. Excavation Support – Due to the extent of impacts near property lines and structures, simple sloping and benching of the excavations will not be feasible around the entire perimeter of the impacted area and excavation support systems will be required.
8. Excavation Dewatering and Water Management – Because of the hydrogeologic conditions, dewatering and water management within the excavation areas will be a critically important aspect of excavations performed at this site. Specific techniques for groundwater management will be selected during the design and construction phase of the remedy.

Development and Analysis of Alternatives

A range of alternatives for additional remedial actions were developed based on the results of the RI, land use approaches, RAOs, and GRAs and the identified applicable remedial technologies. A total of four potential alternatives were developed for detailed analysis:

1. No Action (required for comparison purposes by DER-10)
2. Soil removal to Part 375 Commercial levels, up to 8 feet deep with deeper impacts addressed by in-situ stabilization/solidification (ISS)
3. Soil removal to Part 375 Commercial levels
4. Soil removal to Part 375 Unrestricted levels

FS Evaluation

A detailed comparative evaluation of alternatives was performed using criteria defined by DER-10. With the exception of Alternative 1 (No Action), the three remaining alternatives would meet the requirements to protect human health and would allow for current and reasonably anticipated future property uses. Alternative 2 achieves the RAOs at a lower cost than Alternatives 3 or 4, and would also be more implementable with less community disruption and short-term risks. Compared to the cost for Alternative 2, the higher costs of Alternatives 3 and 4 do not offer a commensurately higher value with respect to added environmental protection, nor do they increase the potential land use options.

Recommended Remedy

Alternative 2, excavation of soil to Commercial SCOs combined with ISS to address deeper impacts, is the recommended remedy. As summarized in the comparative analysis, Alternative 2 will achieve a substantial reduction in impacts with lower cost and equivalent effectiveness relative to Alternatives 3 and 4, which involve deep excavations. Alternative 2 provides an emphasis on a balance of effectiveness and cost. This alternative is implementable with moderate short-term impacts, and meets the RAOs for the site, to the extent practicable.

The recommended remedy would involve excavation of an estimated 6,900 cubic yards (CY), as well as solidification of 4,800 CY of material in-situ, for an estimated total cost of $7.4 million. This cost estimate includes engineering design and management, capital costs, operations, maintenance, and monitoring costs, and a 30% contingency.

This remedial alternative includes the following sequential actions:

- Rerouting of sewer line, utilities, and fueling station.
- Decommissioning of monitoring wells in the excavation area.
- Excavation and disposal of subsurface structures including the tar well/separator and hot well.
- Excavation and disposal of approximately 6,900 CY of soil from the impacted area to a maximum depth of 8 feet.
- ISS of impacted material from 6 feet to 15 feet.
- Placement of a demarcation layer above the ISS mass.
- Placement of a minimum of 4 feet of imported granular fill to provide subgrade for the selected site cover.
- Site cover restoration.
- Development of an MNA program.
- Establishment of a Site Management Plan (SMP) providing for IC/ECs.

The recommended remedy for the site represents a consistent approach appropriate for its current and future land use and minimizes disruption to the community. Additionally, in accordance with DER-31 Green Remediation, this alternative would have a moderate environmental footprint, primarily associated with the initial removal and disposal of impacted soil and debris, the ISS process, and the placement of the backfill material.

The next step for the NYSDEC will be: Following the 30-day public comment period on the draft Feasibility Study and the memorialization of the selected remedy by the NYSDEC in a Decision Document, a pre-design investigation for the remedy, remedial design, and detailed drawings and specifications for remedial construction will follow.

1. Introduction and Scope

This report describes the Feasibility Study (FS) undertaken for a site located on East North Canal Street in the Village of Canastota, Madison County, New York. The site is the location of a former manufactured gas plant (MGP) that operated at the site in the late 19th and early 20th century. The location of the site is shown on Figure 1.

The FS was conducted pursuant to the Order on Consent and Administrative Settlement, CO number 7-20180629-27 , between National Grid and the New York State Department of Environmental Conservation (NYSDEC). This report has been prepared in accordance with applicable regulations and guidance documents of the NYSDEC and the New York State Department of Health (NYSDOH) and will be submitted to these agencies for review and approval.

1.1 Purpose of Report

As requested by the NYSDEC, this FS Report has been prepared by the party responsible for performing remediation, and is being submitted to the NYSDEC Department of Environmental Remediation (DER) for approval prior to the implementation of the remedy. The FS develops and evaluates options for remedial action in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) [40 CFR 300.430(e)] and 6NYSCRR Part 375 to address the impacted media at the site or area of concern that is being addressed by cleanup actions. The purpose of this FS is:

- To identify the goal of the remedial program;
- To define the nature and extent of the MGP-related residuals to be addressed by the developed alternatives;
- To develop remedial action objectives (RAOs) for the site;
- To develop a set of remedial action alternatives;
- To complete an initial screening and detailed analysis of the identified alternatives;
- To implement the specified decision process identified in DER-10 to identify and evaluate appropriate remedial options;
- To develop and provide a detailed description of the recommended site remedy; and
- To demonstrate that the recommended remedy can achieve the cleanup objectives for the site.

1.2 Report Organization

The balance of this document is divided into the following sections, in accordance with NYSDEC's guidance document DER-10 [Section 4.4 (b) 4]:

- **Section 2.0 - Site Description and History**. This section provides a description of the current layout of the site, and the history of the MGP.
- **Section 3.0 - Summary of the Remedial Investigation (RI) and Exposure Assessment**. This section describes the results of the environmental investigation, and evaluates the resulting potential for current or potential future site users to be exposed to MGP-related constituents of concern (COCs).
- **Section 4.0 - Remedial Goals and Remedial Action Objectives**. This section introduces the documents that govern the FS evaluation, and presents the requirements that are applied to the MGP site.
- **Section 5.0 - General Response Actions (GRAs) and Volume Estimates**. This section describes the broad categories of remedies under consideration for this site and provides estimates of the volumes of the impacted media present at the site.
- **Section 6.0 - Identification and Screening of Technologies**. This section names and describes the principal technologies that might be brought to bear for the remedy of the site, and screens these technologies for applicability to the Canastota MGP site.
- **Section 7.0 - Development and Analysis of Alternatives**. In this section, a range of alternatives consisting of several technologies are described, evaluated in accordance with a standard set of criteria, and compared with one another.
- **Section 8.0 - Recommended Remedy**. This section presents the principal elements and sequence of implementation of the remedy.
- **Section 9.0 - References**. This section lists the references cited in this report.

Supporting information in the form of tables, figures, and appendices are included herein and referenced throughout this FS Report.

2. Site Description and History

This section describes the site and provides a summary of the site history based on information presented in the RI Report (RIR) for the former Canastota MGP site (GEI, 2015).

2.1 Site Description

The site is located at East North Canal Street, on the east side of the Village of Canastota and immediately across the street from the old Erie Canal (Figure 1). The layout of the site and the surrounding properties as they are today is shown on Figure 2. The location of the former MGP is at the southern end of a parcel that is approximately 10 acres. It is owned by the Village of Canastota and is in active use as the Department of Public Works (DPW) garage and service yard. The site is bounded by East North Canal Street to the south, Roberts Street and undeveloped land owned by the Canastota Central School Board to the north, the Greater Lenox Ambulance Service and residential properties to the west, and residential properties to the east.

The Village of Canastota identifies the portion of the DPW property where the former MGP was located as Section 36.55, Block 1, Lot 64 (Figure 2). The three parcels that will be part of the remediation are: 36.55-1-63 (Lenox Ambulance), 36.55-1-64 (DPW garage), and 36.55-1-65 (eastern portion of DPW yard) (Figure 2). These lots are zoned Industrial (IN) (as of late 2017) and will be where remedial activities are performed (Appendix A).

Asphalt paved areas are present adjacent to the east side of the DPW garage building. Gravel areas are located in the central portion of the property and grassed and wooded areas are located on the northern portion and perimeter of the site. A concrete sidewalk is present on the site along East North Canal Street.

2.2 Site History and Former Structures

The RIR contains a chronology of the site from the 1887 to 1969, which was compiled from a number of sources, including records obtained from the New York Public Service Commission (PSC), the Browns Directory of American Gas Companies, the Village of Canastota, National Grid, and the Sanborn Map Company. As discussed below, some of the information is inconsistent with respect to the years and types of gas production for the MGP, but the overall history of the MGP can be constructed from the information. Based on this information, the approximate locations of the historical features of the MGP are shown with dashed outlines on Figure 3.

A title binder prepared by National Grid for the MGP site indicated that gas production in Canastota began in 1887. However, no records were found that describe gas operations in the Village from 1887 to 1906, and the 1902 topographic map of the site does not show a building at the site under investigation (though the railroad line is shown on this map). Documents on display at the Canastota

Canal Town Museum indicated that the Canastota Gas Company was formed in 1904. Records also describe the formation of an electric company in 1887 (the Canastota Electric Light & Power Company), and the use of electric streetlights from that time.

In 1906, the property where the subject site is located was acquired by the Central New York Power Company. Newspaper reports from 1907 described the construction of the MGP and village gas lines by this company (Hartgen, 2010). Production is believed to have begun in the second half of that year. One Sanborn Fire Insurance Map (Appendix A of the RIR) dated 1911 depicts the MGP site, owned by the Central New York Power Company. At this point, the site consisted of two circular gas holders, a tar well, a purifier building, a “hot well”, and retorts as well as a repair shop, condenser, and scrubber.

Two undated historic photographs are also presented in Appendix A of the RIR, showing the MGP from the north and south sides. The layout of these historical features is shown on Figure 3. Based on the correlation between the photos and the Sanborn Map, it is our assumption that these photographs were taken some time after 1911 as the photographs show the addition of a tank to the north of the MGP next to a pond, and an additional two-story structure and attached shed at the east side of the gas plant building. The land north of the MGP shown on these photos appears to be undeveloped and used for agriculture. Additionally, the photos show both gas holders to be constructed with above-grade steel tank sections, not as pit holders. However, measurements of the lift sections of each tank bell indicate that the bottom of the concrete foundation for the small gas holder is below-grade. This was confirmed by the test pit investigations conducted during the RI.

The Browns Directory of American Gas Companies (Browns Directory) was reviewed for listings of the Canastota MGP. Listings were found for the years 1914 through 1928, with the last two years being repeats of the 1926 listing (Table 2 of the RIR). Ownership is listed as the Central New York Power Company. From 1927 onwards the listing for the Utica Gas and Electric Company cited that it supplied gas to Canastota. Based on this information, it appears that site operations ceased after 1926.

The Browns Directory cited gas production by both the Lowe (water gas) process and coal process in 1914. No production method was cited in 1915, and all subsequent entries cited the coal process. British Thermal Unit (BTU) content for the gas (when noted) was 600 BTUs. The total gas holder capacity is listed at 70,000 cubic feet.

It is unknown when the plant was demolished, but it likely occurred in the 1930s or 1940s, as the building and the adjacent railroad line are not shown on the 1946 topographic map of the area. Aerial photographs of the site and areas north of East North Canal Street show the entire area as vacant for most of the 1950s and 1960s, with the exception of the development of houses along the north side of East North Canal Street. The vacant land appears to be mowed, with few scattered trees. The current DPW operations area appears to have some disturbed ground in the aerial photos, but the source and purpose of the disturbance cannot be determined.

In 1969, the site property was sold by Niagara Mohawk Power Corporation, a successor to the Central New York Power Company, to the Village of Canastota. The current DPW garage building was constructed in 1973, and the site has been developed and operated continuously as the DPW garage and storage yard since that time. Activities at the site include:

- Heavy vehicle maintenance and storage;
- Equipment cleaning;
- Vehicle and fuel storage and dispensing (initially from underground storage tanks, now from above-ground tanks);
- Road salt storage (in uncovered stockpiles until approximately 2008, when a covered salt storage unit was erected);
- Staging of roadbed materials; and
- Staging of wood waste from tree clearing activities.

Additionally, a small portion of the DPW property has been used as a fire training facility by the local fire department. This area is located immediately to the north of the salt storage unit. It is a fenced-off area 110 by 100 feet in size. Within the fence is a small metal building and junk cars used for training.

2.2.1 Historical Site Features

The historical research identified former site features that may have been potential source areas for MGP-related residuals, and as such, those areas were targeted for investigation during the RI. The key features of the MGP, shown on Figure 3, are summarized below:

- **Small Gas Holder** – This was the gas holder located partially under the DPW garage in the center of the site. Evidence of this gas holder was observed during investigation activities.
- **Large Gas Holder** – A second larger gas holder was constructed to the west of smaller gas holder. Soil boring refusal was encountered at some borings in this area, suggesting that there are foundation remains of this holder in the subsurface.
- **Tar Well/Tar Separator** – A tar well/separator was identified east of the smaller gas holder as shown on Figure 3. Several borings and test pits targeted this area. Below-grade structures and slight MGP impacts were observed.

2.2.2 Other Site Uses

As discussed above, the site has been used as the Village of Canastota DPW garage and storage yard since 1973.

2.3 Physical Setting and Local Land and Water Use

2.3.1 Topography

The site topography was mapped by Delta Engineers, Architects, & Surveyors as part of developing the site base map. The site topographic contours are presented in 1-foot increments on Figure 2.

Ground surface elevation generally decreases from southeast to northwest. The topographic high is approximately elevation (El.) 427 feet within the central portion of the former MGP process area at the DPW garage, and the topographic low is approximately El. 417 feet at the northwest site corner. The vertical datum used during the RI was the National Geodetic Vertical Datum of 1929 (NGVD29), and is also referenced in the survey and this report as mean sea level or MSL.

Surface water flow during storm events generally follows the topographic contours. However, some small ponding has been observed in the gravel area along East North Canal Street, where there are small depressions in the ground surface. There is also a small drainage channel (ditch) along the eastern property boundary. This ditch begins at the southeast side of the DPW property and drains to the north along the eastern parcel boundary. The typical depth of the ditch with respect to the adjacent ground surface is about 3 to 4 feet. The ditch drains to a culvert under Roberts Street to the north.

The area to the northwest on the DPW property forms a seasonal wetland, which was delineated in 2009 on behalf of the Canastota Central School District (for evaluation of construction of a new bus garage). The base of the wetland is approximately 3 feet below the surrounding fill at its southern end, and about 6 feet below at the northeast side.

2.3.2 Land Use

As described previously, the site is used for several purposes. The main portion of the site is the Village of Canastota DPW garage and storage yard. To the west is the Greater Lenox Ambulance Service facility, where one of the gas holder foundations is beneath the driveway/parking area.

2.3.3 Zoning

Prior to 2017, the site was zoned R-1 Residential according to the Village of Canastota. However, this was not consistent with the ongoing site usage, as the parcels were grandfathered in under the zoning regulations. As a result, both DPW (Canastota tax parcel IDs 36.55-1-64 and 36.55-1-65) and the Greater Lenox Ambulance Service (Canastota tax parcel ID 36.55-1-63) properties were re-zoned in 2017 to non-residential Industrial (Appendix A).

2.3.4 Utilities and Infrastructure

The site and other occupied surrounding properties are served by municipal water and sewer (Figure 2). The sewer and water conduits come into the DPW yard from East North Canal Street, beneath the paved driveway apron. Natural gas service also comes into the garage building from East North Canal Street, via subsurface conduit. The depths of the underground utilities is unknown.

Electricity is provided to the DPW via overhead wires along East North Canal Street, and the service connection to the DPW garage is on the south side of the building. Inside the DPW yard, subsurface electric lines are present within the investigation area. An underground electric line extends from the garage building to a utility pole east of the building. Other underground lines connect this pole to the above-ground fuel storage tank pumps and to a sewer pump station. This pump station takes flow from the residential area to the east of the site and conveys it southwest under the DPW yard to a sewer main along the north side of East North Canal Street.

2.3.5 Water Supply in the Area

The site and surrounding area is supplied by municipal water through the Onondaga County Water Authority.

2.4 Site Geology

The site is located in an area of New York State where the surficial soils are the Minoa series and the Swanton series, according to the United States Department of Agriculture (USDA) Soil Conservation Service (SCS) and the Cornell University Agricultural Experiment Station (USDA, 1981). The Minoa soils are a very fine sandy loam, and the Swanton soils are a fine sandy loam. Local surficial soils are characterized as nearly level, in glacial lacustrine deposits, and deep, poorly or somewhat poorly drained. These soils were formed in lake-laid deposits with high percentages of clay and silt and very fine to fine sand.

The soil units encountered during the RI are described as follows:

- **Fill** – A zone of fill and reworked soils 2 to 11 feet thick below a topsoil layer. The fill consists of sand, gravel, brick fragments, glass, ash, asphalt, slag, and silt. Based on the history of the site, it is likely that much of the fill was placed during the construction of the MGP, and later from the removal of the elevated railroad grade formerly located along the east side of the site. Debris and the likely remnants of concrete foundation material were encountered near the two former gas holder locations. Based upon the depth of the foundation concrete and debris, it appears that the ground surface has been raised by several feet since the MGP stopped operating. The historical photographs show the top of the gas holder foundations were previously above the ground surface.
- **Native Sand, Silt, Clay** – Native soils containing varying amounts of sand, silt, and clay are located beneath the fill layer. This unit ranges in thickness from approximately 2 to 26 feet. These materials are likely to be alluvial deposits. The clay deposits are likely to be glacial lake deposits.
- **Glacial Till** – The sand, silt, and clay unit is underlain by a dense glacial till. The till was found to be predominantly silt with lesser amounts of clay, sand, and gravel. Based upon

previous geotechnical testing performed during the RI, the till is dense and relatively impermeable (permeability in the 10^{-8} to 10^{-9} cm/sec range). The depth to the top of the till increases towards the north, indicating a sloping surface for this contact (see Figure 9 of the RIR). Based on the subsurface data, a trough is present in the till surface, from the former pond location and sloping to the north.

Depth to bedrock was not assessed during the RI. Bedrock in the Canastota region has been identified as part of the Vernon formation (Rickard and Fisher, 1970). The Vernon formation has been identified as upper Silurian shale and dolostone, which is part of the Salina group. Vernon formation of Salina group contains at least four eurypterid-bearing black shale horizons in western New York. The thickness of the formation is estimated to be between 400 and 700 feet.

2.5 Site Hydrogeology

2.5.1 Site Surface Water and Drainage

Standing water has been observed near MW-2 and MW-6 in gravel surfaced areas or where there is believed to be poor surface drainage. The Erie Canal runs parallel to East North Canal Street and is located across the street and south of the site. There are no surface water connections between the site and the canal.

Below grade storm drainage structures or pipes were not observed within the site. There is a drainage ditch on the eastern edge of the site that carries surface runoff to the north. Other storm water runoff from the site enters the municipal storm water system via catch basins and drainage infrastructure within East North Canal Street and Leland G Wright Avenue.

2.5.2 Groundwater

Groundwater at the site is shallow and was generally encountered at depths up to 5 feet. Groundwater elevations were measured during the 2005 groundwater sampling event and during ten subsequent site visits. Table 10 of the RIR presents groundwater elevations collected to date.

Groundwater elevations appear to have a consistent pattern. There appears to be a small divide at the central portion of the site coinciding with the highest topographic elevation, with flow diverted to the south-southeast and northwest.

Figure 4 presents the most recent groundwater contours, developed in September 2014. Groundwater flows in two directions at the site, to the southeast and to the northwest. The groundwater contours from 2009, 2011, 2012, 2013, and 2014 are similar to those generated from the initial 2005 sampling event. Slight changes in groundwater elevations have been observed in the areas where monitoring wells are present. Our observations indicate a total change in elevation of 4.1 feet, and a gradient in September 2014 ranging from approximately 0.015 to 0.036 feet per foot.

Monitoring wells MW-11D and MW-12D are screened in the native soils and just above the till contact. The other wells are screened across the water table (see Figures 5 through 8 of the RIR). Slightly negative vertical gradients were occasionally observed between well pairs MW-3 and MW-12D (-0.022 ft/ft) and MW-7 and MW-11D (-0.053 ft/ft). Although these well pairs are not immediately adjacent to each other, this does indicate that minor downward gradients are present in the aquifer. The soils above the till appear to be acting as a single unconfined aquifer unit.

3. Summary of the RI and Exposure Assessment

This section summarizes the results of the RI including the human health exposure assessment.

3.1 Site Condition Summary

The areas of concern for the site are defined based on specific areas of impacts or by former MGP features. Information regarding the conditions observed at the former MGP features, and the nature and extent of MGP-related residuals associated with the features, is summarized below. The locations of the test pits, soil borings, and monitoring wells are shown on Figure 5.

Of the former MGP structures historically present on site and investigated as part of the RI (including two gas holders, tar well/tar separator, purifier building, "hot well", retorts, repair shop, condenser, and scrubber), three were identified as the primary source areas. The primary source areas are described in detail below and shown on Figure 3. Their outlines are also shown on Figures 5 and 6 with respect to the locations of the subsurface investigation.

Small Gas Holder

The foundation for the small Gas Holder is still present in the subsurface at the location shown on Figure 3. The foundation is now covered by approximately 12 feet of fill, which is comprised predominantly of sand, gravel, and brick fragments. The diameter of the foundation is approximately 45 feet.

Visible evidence of NAPL-impacted soil was observed as tar-coated to tar-saturated soil from 5 to 12.5 feet in the center portion of the holder at soil borings SB55 and SB56 and with tar-saturated soil identified in soil boring log for SB54 from 8 to 11.5 feet. The horizontal extents of the impacts beneath the holder have not been identified.

Large Gas Holder

Based on the soil borings advanced in the footprint of the large Gas Holder, the foundation for the holder is still present in the subsurface. The foundation consists of a concrete slab that is approximately 70 feet in diameter about 7 feet below existing grade. The foundation is covered with fill material consisting of silt, gravel, sand, glass and brick fragments. MGP-like odors were observed beneath the foundation, and also occasional sheen or staining. The thickness of the slab is unknown.

Tar Well/Tar Separator

Remains of tar well/separator were observed in several RI locations, and is located just east of the small gas holder. Based on observations from a test pit excavated during the RI, this structure was described as a rectangular structure with concrete walls with a wooden baffle wall present on one side. The structure was filled with miscellaneous fill including bricks and glass bottles to a depth of approximately 11 feet. The width of the tar well/separator was measured to be approximately 17 feet, the length was not measured by the RI. MGP impacts observed were odor, sheen, NAPL coating, and blebs of NAPL.

3.2 Off-Site Areas

Additional sampling during the RI was performed at off-site locations to assess the presence or absence of MGP-related residuals in these areas. These parcels include the Greater Lenox Ambulance Service parcel to the west, and the residential parcel to the northwest of the site.

Off-Site Residential

The residential parcel (Figure 5) was investigated for potential off-site migration. No MGP features are located in the residential areas. One monitoring well (MW14) was installed between the former MGP site and the residential dwellings. No impacts were observed in the off-site residential location.

Off-Site Commercial

The commercial parcel (Greater Lenox Ambulance Service; Figure 5) was investigated for potential off-site migration. Due to the location of the former gas holder, the eastern portion of the parking area/driveway (Leyland G Wright Avenue) is included within the site boundary. During the RI, two soil borings (SB24 and SB39), one monitoring well (MW9), and one soil vapor point (SG-2) were installed. MGP-like odors were observed at SB24 (6 to 13 feet deep) and SB39 (4 to 6 and 8 to 10 feet deep). No exceedance in the soil vapor sample at SG-2 was detected. No other impacts were observed in the off-site commercial parcel.

3.3 Nature and Extent of MGP-Related COCs

The horizontal limits of observed MGP-related residuals are summarized as follows:

- The majority of the soil borings showing visible evidence of MGP-related residuals were in the vicinity of the small Gas Holder and the tar well/tar separator.
- The area with visible evidence of MGP-related residuals was delineated along the north side of the site by the borings and wells installed near the current salt storage unit. Visible evidence of MGP-related residuals was not observed in the line of borings and wells installed on the eastern side of the site area or to the south along East North Canal Street. The western limits of MGP-related residuals were delineated along the Greater Lenox Ambulance Service parcel and the adjacent residential parcel.
- Visible evidence of MGP-related residuals was not observed at the northern portion of the site.

Within the impacted area described above, MGP impacts were not observed at depths greater than 24 feet.

Media investigated during the RI included surface soil, subsurface soil, soil gas vapors, and groundwater. Conclusions for each are summarized below.

3.3.1 Surface Soil

Because of the modern uses of the site, a comprehensive surface soil investigation was not performed. Two surface soil samples were collected at the site. Benzene, toluene, ethylbenzene, and xylenes (BTEX) were not detected in either of the surface soil samples. PAH compounds were detected in both surface samples, with both samples containing one or more PAHs that exceeded either the Unrestricted Use SCOs or Commercial Use SCOs. The highest concentration of PAHs in surface soil was detected in SS-01 located on the south side of the existing DPW garage building, downgradient of the former purifier building. The sample collected from a now grassy area and had total PAH concentration of 16.14 mg/kg.

Both of the surface soil samples contained lead, mercury, and/or zinc at concentrations greater than the Unrestricted Use SCOs but less than the Commercial SCOs.

Total cyanide was detected in one of the surface soil samples. However, the result was well below the Unrestricted Use SCO of 27 mg/kg.

3.3.2 Subsurface Soil

Subsurface soil observations and analytical results are presented according to two different depth intervals; 0 to 15 feet deep and greater than 15 feet deep. The 0 to 15 feet depth interval corresponds to the NYSDEC's approach of managing soils down to 15 feet using Part 375-6 SCOs [NYSDEC, 2006]. For depths below 15 feet, the focus is on the management of MGP "source material" as described by DER-10 [NYSDEC, 2010a] and by CP-51 – Soil Cleanup Guidance [NYSDEC, 2010b].

0 to 15 feet deep

A total of 109 subsurface soil samples were collected in the interval from 0 to 15 feet deep for volatile organic compounds (VOCs). BTEX compounds were detected in the subsurface samples, with 31 samples exceeding the Unrestricted Use SCOs for individual VOCs. Six of the samples had VOC concentrations exceeding the Commercial Use SCOs. The highest concentration of total BTEX in this depth interval was detected near the former tar well/separator in SB-5 with total BTEX concentrations up to 2,163 mg/kg.

A total of 111 subsurface soil samples were collected for PAHs. Forty-six of the 111 samples had individual PAH concentrations exceeding the Unrestricted Use SCOs. Forty-three of the 111 samples also had individual PAH concentrations exceeding the Commercial Use SCOs. The exceedances of the SCOs were predominantly PAH compounds. Where detected, the total PAH concentrations ranged from 0.016 mg/kg, to 23,644 mg/kg. The highest total PAH concentration was from a sample of non-aqueous phase liquid (NAPL)-impacted soil from SB-5 located in the former tar well/separator area.

Nine of the 55 samples analyzed for metals had concentrations exceeding the Unrestricted Use SCOs. One of the 55 samples, SB-42 (5 to 9 ft deep), exceeded the Commercial Use SCOs for arsenic.

Three of the 88 samples analyzed for total cyanide had concentrations exceeding the Unrestricted Use SCOs [SB-2 (4 to 5.6 ft deep), SB-5 (8 to 10 ft deep), and SB-42 (5 to 9 ft deep)]. Free cyanide was detected at trace or low concentrations at 12 of the 51 samples where it was analyzed. Where detected, the highest concentration was estimated at 1.4 mg/kg at SB-42 (5 to 9 ft deep) located near the former small gas holder.

Polychlorinated biphenyls (PCBs) and pesticides were analyzed in two samples and there were no detections.

15 feet and Deeper

Deeper subsurface samples were collected between 15 and 29 feet deep.

None of the 17 samples analyzed for VOCs had concentrations of individual VOCs exceeding the Unrestricted or Commercial Use SCOs.

One of the 17 samples analyzed for PAHs had concentrations of individual PAHs exceeding the Unrestricted SCOs (SB-43, 22 to 24 ft deep). In addition, the concentration of an individual PAH (benzo(a)pyrene) was also greater than the Commercial Use SCO. Where detected, the total PAH concentrations ranged up to 53.9 mg/kg, the highest concentration being from the sample collected at SB-43 (22 to 24 ft deep), which is well below the Commercial Use SCO of 500 mg/kg.

One of the 13 samples analyzed for metals had a concentration exceeding the Unrestricted Use SCOs (SB-25, 16 to 18 ft deep, for copper). None of the samples had metals concentrations exceeding the Commercial Use SCOs.

None of the 15 samples analyzed for cyanide had concentrations greater than the method detection limits. Free cyanide was detected at trace or low concentrations at three of the 13 samples where it was analyzed. Where detected, the highest concentration was an estimated concentration of 0.94 mg/kg at SB-47 (22 to 24 ft deep).

3.3.3 Groundwater

Fifty-nine groundwater samples were collected from 14 wells between December 2003 and September 2014 and analyzed for BTEX, PAHs, metals and/or cyanide, depending on location and date. BTEX and PAH impacts were found to be generally confined to the site, with some downgradient detections at MW-7 on the undeveloped portion of the DPW parcel. Trace detections were also found at MW-9 located on the Greater Lenox Ambulance Service parcel.

BTEX compounds were detected above the ambient water quality standards (AWQS) in 17 of the 59 samples analyzed for BTEX. The highest concentration of total BTEX detected was 8,190 micrograms per liter (µg/L) at MW-7 in 2014. This well is located in the western area of the site downgradient of former small Gas Holder (Figure 5). Other VOCs detected above the AWQS include isopropylbenzene and styrene within one sample collected from MW-10 during one sampling event.

PAH compounds were detected above the AWQS in 15 of the 33 groundwater samples analyzed for PAHs. These exceedances were found in three of the 14 wells in one or more sampling events: MW-6, MW-7, and MW-10. Similar to the BTEX results, the greatest concentration of total PAHs was detected in the western area of the site at MW-7 (3,655 µg/L in 2011).

The majority of the samples from the wells contained iron, magnesium, manganese, and sodium in concentrations greater than the groundwater standards for metals. These metals are commonly found to be elevated in groundwater throughout New York State and the concentrations detected likely reflect ambient conditions. In addition, barium and lead were occasionally found above the groundwater standards.

Total cyanide was identified in concentrations below the groundwater standard of 200 µg/L for most of the 14 wells installed at the site. Free cyanide was occasionally detected in groundwater samples, usually at estimated levels below the quantitation limit. The highest concentration of free cyanide detected was an estimated 4.5 µg/L at MW-6 and MW-7 in January 2011.

3.3.4 Soil Vapor and Air Results

Soil vapor, indoor air, and ambient air samples were collected at the site. Three soil vapor samples were collected. One indoor air sample was collected in the DPW garage office, and one ambient air sample was collected during the indoor air sampling event. The locations of these samples are presented on Figure 5.

For comparison purposes, indoor air results are compared to the background indoor air 95th percentile concentrations [NYSDOH, 2006]. Indoor air sample IA-1, collected from the DPW garage office, had exceedances of the 95th percentile indoor values for cis-1,2-dichloroethene and trichloroethene, neither of which are MGP-related compounds. There were no other compounds detected above the 95th percentile in any of the soil vapor samples.

Each sample contained concentrations of a variety of VOCs that are commonly found in ambient air, indoor air, and soil vapor samples. The results do not indicate a concern with regard to vapor intrusion of MGP-related compounds into the DPW garage.

3.4 Fate and Transport Mechanisms

Conclusions for each media investigated during the RI are summarized below.

3.4.1 Surface Soil

Surface soil at the site is generally covered by grass, with the DPW garage building, and parking lot or paved area covering the central portion of the site. The COCs identified in the surface soil samples were at generally low-level concentrations, where only one constituent in one sample was slightly elevated above the Commercial Use SCOs.

The surface soil data demonstrate that the site has sustained minor shallow impacts above the applicable Commercial or Unrestricted SCOs. The source of the impacts is likely to be from post-MGP operations as a garage subsequent to the previous usage, or from other manmade sources of combustion materials that may have mixed into the fill (including ash and coal from the former elevated railroad grade along the east side of the site).

Based on the short duration of work that would be performed in the grass-covered areas of the site, the potential for an exposure to COCs in surface soil is considered to be low. It is unlikely that the migration of COCs in surface soil by wind or water erosion would result in impacts to surface water or sediment near the site.

3.4.2 Subsurface Soil

Site-related subsurface impacts were identified in subsurface soils. Test pits identified the presence of former structures below current ground surface and also indicated presence of fill materials across the site. NAPL-saturated soils have been observed and BTEX and PAHs have been detected above Commercial or Unrestricted SCOs in the south-central portion of the site (i.e., the area of former MGP features) during test pit and soil boring investigations. Impacts are generally less than 15 feet deep. Soil impacts have been well delineated both vertically and horizontally.

3.4.3 Groundwater

Groundwater impacts have also been delineated. Groundwater impacts appear to be limited to the central area of the site in the former MGP operations area. Due to the ephemeral nature of the observed downgradient groundwater impacts at MW-6 and MW-7, these appear to be unrelated to the MGP source area or are due to short-term changes in the movement of dissolved contaminants. These observed impacts likely are due to precipitation and surface ponding events that occurred during the summer of 2011. Although there is a component of groundwater flow to the south, these compounds have not been detected in the groundwater samples analyzed from the wells that are downgradient or cross-gradient in the southern portion of the site. MW-14, which was installed in 2014 to determine the downgradient extent of groundwater impact, did not have any detections of BTEX or PAHs in groundwater.

3.5 Exposure Pathways and Potential Receptors

The RIR contains an evaluation of exposure pathways and receptors for the area investigated during the RI. The evaluation examined the following media and potential release mechanisms, and examined how each potential human receptor group might come into contact with impacted media.

- **Fugitive Dust.** COCs in surface and subsurface soil could be a potential source for fugitive dust via physical disturbance.
- **Volatilization.** Volatile COCs may potentially be transported from subsurface soil by volatilizing into soil-pore space and eventually emanate into ambient or indoor air.
- **Leaching.** COCs in surface or subsurface soil could potentially leach to groundwater.

There are three mechanisms by which COCs in groundwater can be transported to other media. These migration pathways include the following:

- **Adsorption.** COCs in groundwater may be sorbed onto subsurface soils.
- **Volatilization to Ambient Air.** Volatile COCs in groundwater may potentially desorb into soil vapor and be transported through the vadose zone into ambient or indoor air.
- **Extraction or Migration.** COCs in groundwater may migrate to other media by extraction or migration and use of impacted groundwater.

Each of these potential release mechanisms was evaluated for each potential receptor group, both on-site and off-site. The receptor groups included:

- On-Site Subsurface Utility or Construction Workers
- DPW Site Workers
- Ambulance Company Workers/Visitors
- Site Visitors or Trespassers
- Off-Site Residents

A qualitative human health exposure assessment was performed for the site. For the on-site DPW worker, subsurface utility worker, or construction worker who may perform excavation work in the central area of the site, the worker may potentially be exposed to NAPL-impacted soil and impacted groundwater. These areas include more shallow depths in the vicinity of the small Gas Holder and the tar well/separator. Only properly trained and equipped personnel should perform the subsurface utility work in this area using methods specified in a site-specific health and safety plan (HASP). There is slight exposure potential for the Ambulance company workers, site visitors or trespassers resulting from the presence of COCs in the surface soil. The presence of a perimeter fence at the site limits contact to the more impacted areas.

Ecological Receptors

The site is located within an industrial/commercial area that is surrounded by residential properties. The area of concern has been heavily disturbed by the DPW activities. There are no apparent ecological receptors within the site limits.

4. Remedial Goals and Remedial Action Objectives

4.1 Standards, Criteria, and Guidance

As defined in the DER-10, standards, criteria, and guidance (SCGs) are the New York State regulations or statutes that dictate the cleanup standards, standards of control and other substantive environmental protection requirements, criteria, or limitations that are generally applicable, consistently applied, officially promulgated and are directly applicable to a remedial action.

The principal SCGs applicable to this site are:

- **6 NYCRR § 375-1**: General Remedial Program Requirements
- **6 NYCRR § 375-2**: Inactive Hazardous Waste Disposal Site Remedial Program
- **6 NYCRR § 375-6**: Remedial Program Soil Cleanup Objectives
- **DER-10** Technical Guidance for Site Investigation and Remediation
- **NYSDEC Policy Memorandum CP-51** on Soil Cleanup Guidance (Soil Cleanup Memo), October 21, 2010 [NYSDEC, 2010b]
- **NYSDEC Technical and Operational Guidance Series (TOGS) 1.1.1** Ambient Water Quality Standards and Guidance Values and Groundwater Effluent Limitations [NYSDEC, 1998]
- **Guidance for Evaluating Soil Vapor Intrusion in New York** [NYSDOH, 2006]
- **DER-31** Green Remediation [NYSDEC, 2011]

Detailed lists of the chemical-specific, action-specific, and location-specific SCGs are provided in Tables 4-1, 4-2 and 4-3, respectively.

The site-specific cleanup levels for the MGP-related COCs in soil and groundwater are the SCGs that will be used to define the RAOs and to develop the remedial alternatives (Table 4-1). Additional SCGs, as well as guidance topics, are identified in Tables 4-1, 4-2, and 4-3. The topics of guidance listed in Tables 4-1, 4-2, and 4-3 are considered "to be considered" (TBC). These topics provide guidance for evaluating the media, constituents, actions or locations, but do not dictate specific requirements for addressing impacted areas. These TBC topics are used in conjunction with SCGs. For example, TBCs may serve to clarify the application of requirements or help ensure the developed alternatives will be acceptable to local stakeholders.

4.2 Soil Cleanup Levels

As stated in the NYSDEC Soil Cleanup Memo CP-51, Section 5, Paragraph A: a soil cleanup level is the concentration of a given COC for a specific site that must be achieved under a remedial program for soil. The determination of soil cleanup levels is dependent on the following criteria (the criteria are provided in italics, below):

1. ***The applicable regulatory program***, which for this site is the Inactive Hazardous Waste Program.
2. ***Whether the groundwater beneath or down gradient of the site is or may become impacted with site related COCs***, which for this site is confirmed by the RIR. Specifically, this site exhibits plume morphology typical of former MGP sites, with dissolved BTEX and PAHs. The extents of the impacted groundwater plume appear to be stable and within the boundaries of the site.
3. ***Whether ecological resources constitute an important component of the environment at or adjacent to the site, and are, or may be, impacted by site-related COCs.*** Ecological resource considerations do not apply for this FS, as established in the RIR, because the site is a developed area.
4. ***Other impacted environmental media such as surface water, sediment, and soil vapor***. These considerations for surface water and sediment are not applicable, as these media are not present within the site. The soil vapor investigation conducted and reported in the RIR concludes that intrusion of MGP-related COCs into the DPW structures is unlikely to be a concern. Additionally, the prevention of potential inhalation of former MGP-related COCs due to soil vapor intrusion into any potential future building at the site property will be addressed by the management of source material and deed restrictions related to requiring a vapor mitigation system as part of future development.

After evaluating the nature and extent of the soil impacts on the site, this FS presents alternatives based on NYSDEC's Soil Cleanup Guideline Approach 2: Restricted Use SCOs [NYSDEC, 2010b]. Within the Restricted Use approach, the Commercial Use SCOs are most applicable to the site soils. This applicability is based on the likely land use and continued ownership by the existing owners. The Residential Use (Unrestricted) SCOs are applicable for the soil in the off-site area containing residences. The development of these SCOs is described in more detail below.

Protection of Groundwater. Protection of Groundwater SCOs (which are the Unrestricted Use SCOs for the PAHs and BTEX compounds at this site) may be deemed not applicable by the NYSDEC, allowing a Restricted Use approach, if the following conditions are met, as described in the NYSDEC Soil Cleanup Memo CP-51, Section V, Paragraph D2 (the Memo text is provided in *italics,* below):

- ***The groundwater standard contravention is the result of an on-site source, which is addressed by the remedial program***. To meet this condition, the remedial alternatives in this FS that are based on the Restricted Use approach include technologies that address the on-site source areas.

- ***An environmental easement or other institutional control will be put in place, which provides for a groundwater use restriction.*** This provision has been included in the alternatives in this FS that are based on the Restricted Use approach.
- ***DEC determines that contaminated groundwater at the site***:
  - *a)* ***Is not migrating, nor likely to migrate, off-site***. As demonstrated by the RI, substantial off-site migration of groundwater with MGP-related COCs was not found to be occurring. ***or***
  - b) ***Is migrating, or likely to migrate, off-site; however, the remedy includes active groundwater management to address off-site migration.*** Not applicable.
- ***DEC determines that groundwater quality will improve over time***. The subsurface soils and source material that impact the on-site groundwater will be addressed by all alternatives (with the exception of the "no action" alternative). Further, groundwater quality improvements over time have been documented at a large number of MGP sites. A scientific report of a 14-year monitoring program at an MGP site has demonstrated that monitored natural attenuation (MNA) is a viable remedial strategy for groundwater after the original source is removed, stabilized, or contained (Neuhauser, et al. 2009).

4.3 Land Use and Cleanup Objectives

4.3.1 Soil Cleanup Levels – On Site

The SCOs as defined in 6 NYCRR Part 375-6 that apply to the site are based on the site use. The on-site area is the Village of Canastota DPW garage. The future site ownership and use is projected to remain as it is today. The following SCOs have been selected for the site:

- **Commercial Use Soil Standards – Applicable to Soil Less than 15 feet deep:** This FS proposes to use a soil cleanup level for Total PAHs of 500 parts per million (ppm), applicable to a depth of 15 feet, as stated in CP-51 Paragraph H. The 500 ppm level will be used in lieu of achieving individual COC-specific cleanup levels. For the purposes of this provision, subsurface soil will be defined as soil beneath at least 1 foot of soil cover or soil that meets the applicable SCOs.
- **Source Removal Below 15 feet deep:** Source removal refers to the removal of a discrete source area, which is defined in DER-10 1.3 (b) 70 as containing "*COCs in soil in sufficient concentrations to migrate in soil, or to release significant levels of COCs to another environmental medium, which could result in a threat to public health and the environment. A source area typically includes, but is not limited to, a portion of a site where a substantial quantity of any of the following is present:*

  i. *concentrated solid or semi-solid hazardous substances;*
  ii. *non-aqueous phase liquids; or*
  iii. *grossly impacted media. [see 6 NYCRR 375-1.2(au)]*

No source material has been identified below 15 feet deep in the RI, and therefore the selected alternatives, with the exception of the "no action" and unrestricted use alternatives, address impacts up to 15 feet deep.

4.3.2 Soil Cleanup Levels – Off Site

Commercial Use SCOs will apply to the soil above 15 feet deep on the Greater Lenox Ambulance Services, Inc. property along the west side of the site.

4.3.3 Groundwater Cleanup Levels

The SCGs for groundwater quality are the Ambient Water Quality Standards, Guidance Values, and Groundwater Effluent Limitations (AWQS) identified in "*NYSDEC Technical and Operational Guidance Series 1.1.1"* (TOGS) [NYSDEC, 1998]. Based on this document, there is a single standard for groundwater in New York, based on the use of groundwater as drinking water.

4.4 Remedial Action Objectives (RAOs)

RAOs are established as the overall goals for the site remediation to provide protection of human health and the environment. The RAOs for this site were developed based on the applicable SCGs and the current and intended future land use. The RAOs are site-specific goals that address the media of concern, specific COCs, and the exposure pathways for the site. Specific COCs to be addressed in this FS are PAHs, BTEX, and total cyanide.

Upon consideration of the SCGs and the nature and extent of MGP impacts, as described in the RI, the following RAOs were developed for the site. These RAOs are goals to be achieved to the extent practicable.

4.4.1 Soil

RAOs for Public Health Protection

- Prevent ingestion/direct contact with soil with COC levels exceeding the applicable SCOs.
- Prevent inhalation of or exposure to COCs volatilizing from soil.

RAOs for Environmental Protection

- Prevent migration of COCs that would result in groundwater, surface water, or sediment impacts.
- Prevent impacts to biota from ingestion/direct contact with soil causing toxicity.

4.4.2 Groundwater

RAOs for Public Health Protection

- Prevent ingestion of groundwater with COC levels exceeding drinking water standards.
- Prevent contact with, or inhalation of, volatiles from impacted groundwater.

RAOs for Environmental Protection

- Prevent the discharge of COCs to surface water or sediment.
- Remove the source of groundwater or surface water impacts, to the extent practicable.
- Restore groundwater aquifer to ambient groundwater quality criteria, to the extent practicable.

4.4.3 Surface Water

- **Not Applicable**. There are no surface water features at the site.

4.4.4 Sediment

- **Not Applicable**. There are no sediments at the site.

4.4.5 Soil Vapor

- **Not Applicable**. As described in Section 3.3.4, the soil vapor investigation conducted as part of the RI shows that soil vapor intrusion of MGP-impacted COCs in the DPW buildings is a not likely a concern.

5. General Response Actions and Estimated Volumes

In accordance with the guidance provided in DER-10 regarding the development and evaluation of remedial alternatives, this section describes the development of General Response Actions (GRAs) to address the RAOs identified in Section 4, and the estimated volumes of impacted media.

5.1 Potentially Site-Derived MGP Constituents of Concern

The potentially MGP-site-related COCs, as identified during the RI, are BTEX, PAHs, and total cyanide. The 18 PAH compounds included in the Total PAH concentrations discussed in this FS include the following:

- Acenaphthene
- acenaphthylene
- anthracene
- benzo(a)anthracene
- benzo(b)anthracene
- benzo(g,h,i)perylene
- benzo(k)fluoranthene
- chrysene
- flourene
- benzo(a)pyrene
- dibenzo(a,h)anthracene
- dibenzofuran
- indeno (1,2,3-cd) pyrene
- fluoranthene
- naphthalene
- phenanthrene
- 2-methylnaphthalene
- pyrene

5.2 Range of General Response Actions (GRAs)

GRAs are not specific to any single technology, but represent categories or approaches that may be combined and further defined to create remedial alternatives. To meet the RAOs developed for the site, the following GRAs were identified:

1. **No Action.** This response action is listed for compliance with DER-10 FS guidance, but would not result in meeting the RAOs and is not applicable for this site.
2. **Institutional Controls and Engineering Controls (IC/ECs) Pertaining to Soil or Groundwater.** These actions, also known as IC/ECs, involve restrictions of legal access to soil or groundwater and engineering controls to limit physical access.
3. **Containment of Soil and Groundwater.** Containment actions involve little or no treatment, but provide physical barriers to exposure, or otherwise remove pathways of exposure. These actions include vertical barriers and surface soil covers or impervious caps.
4. **In-Situ Treatment of Soil and Groundwater.** These actions include on-site reduction in the volume, toxicity, and/or mobility of the COCs. Technologies include in-situ stabilization/solidification (ISS) of impacted soil, in-situ groundwater treatment, active

enhancement of natural attenuation, and monitored natural attenuation (MNA) of groundwater.

5. **Removal and Off-Site Treatment/Disposal of Soil and NAPL/Groundwater**. These actions include excavation of impacted soil and extraction of NAPL, and off-site treatment/disposal of these in properly permitted facilities.

5.3 General Extent of Impacts

The nature and extent of impacts in surface soil, subsurface soil, and groundwater were described in Section 3. In accordance with the guidance provided in DER-10, this section presents the estimated extent of impacts on-site and at the off-site properties. The extent of impacts was selected based on the data presented in the RIR. Laboratory data from the RI were tabulated and compared to chemical-specific SCGs for surface soil, subsurface soil, and groundwater. The estimated areal extent of soil impacts, defined as exceedances of Part 375 Unrestricted Use SCOs, is shown on Figure 6. The estimated extent of groundwater impacts, defined as exceedances of NYSDEC Ambient Water Quality Standards, is also shown on Figure 7.

5.4 Volume Estimates

The volumes of impacted soil and groundwater present on site and off site were estimated for the purpose of providing a basis for the development and evaluation of remedial alternatives. Table 5-1 provides a summary of the volumes for each impacted medium. Volume calculation sheets are provided in Appendix B.

5.4.1 Surface Soils

Surface soils for the MGP site itself are minimally impacted and will generally be addressed by the approaches that address subsurface impacts. Surface soils across the remediated area will be removed and restored so that a minimum of 1 foot of clean soil meeting Unrestricted SCOs is left at the surface.

5.4.2 Subsurface Soils

Impacted soil volumes were estimated as the product of the impacted area and applicable impacted depths. Although non-impacted soils may be present in the upper 4 to 6 feet of soil, these soils were included in the volume estimates because they would need to be excavated to gain access to the deeper impacted soils in most remedial scenarios. Volume calculation sheets are provided in Appendix B. Soil volumes were rounded to the nearest 100 CY.

As discussed in Section 4, the likely future projected land use will continue to be the Village of Canastota DPW garage. Therefore, this evaluation is based on achieving Commercial SCOs in accordance with NYS Part 375 and the NYS Soil Cleanup Policy Memorandum. The estimated total soil volume of 15,300 CY was computed by multiplying the total area of soils exceeding the Commercial SCOs by the estimated average depth of impacts of 13 feet.

The soil volume exceeding the Commercial SCOs was estimated by referring to the data tables from the RIR for soils exceeding the Commercial SCO of PAHs and the individual BTEX compounds, including observed source materials, as source materials would exceed the Commercial SCOs. This volume includes overburden soils that may not exceed the applicable SCOs, but the overburden soil would need to be removed first in order to remove the deeper soils that exceed the Commercial SCOs.

While there were impacts found as deep as 24 feet in some locations, they did not exceed the Commercial SCOs. Therefore, the data collected during the RI does not suggest the presence of source material greater than 15 feet deep in the locations investigated.

5.4.3 Groundwater

The estimated area of impacted groundwater within the site, as shown on Figure 6, is approximately 48,600 square feet. The total volume of impacted water, assuming a 25% soil porosity and an average impacted saturated thickness of 5 feet, is approximately 840,000 gallons.

6. Identification and Screening of Technologies

Remediation technologies are the practical means used to address a specific environmental condition. The goal of the identification and screening of technologies is to enable the most effective and applicable technologies to be applied to meet the site-specific conditions and remedial objectives. The individual technologies and approaches are then grouped to form alternatives, with each alternative addressing the site as a whole.

The identification and screening of technologies was conducted in three stages, in accordance with DER-10 guidance. An initial screening process was first used to determine the most applicable technologies for the site, using literature sources and GEI's experience at similar sites [FRTR, 2002; GRI, 1997; ITRC, 2002; NYSDEC, 1992]. For each of the GRAs identified in Section 5.2 (No Action, Institutional Controls/Engineering Controls, Containment, In-Situ Treatment, and Removal) one or more technologies and process options were identified, described, and screened with respect to site-specific applicability. The general screening criteria used in the initial screening were with respect to site-specific applicability and effectiveness.

Next, the technologies that were not eliminated from consideration due to site-specific applicability were further refined and evaluated. The evaluation at this stage used the criteria of technical implementability, relative cost, and ability to meet RAOs in accordance with the DER-10 guidance.

These evaluations are summarized in Table 6-1. The remainder of this section provides a more detailed discussion of the evaluations for each of the site media individually (surface soil, subsurface soil, and groundwater).

6.1 Surface Soil Technologies

6.1.1 IC/ECs

Institutional controls can provide an effective measure to limit or prevent direct contact exposure to soil. Applicable actions may include access control protocols, deed restrictions with an environmental easement, and managing ground-intrusive activities through the implementation of a Site Management Plan (SMP). Because an SMP would be applicable as an institutional control that would establish protocols for surface soil-disturbing activities at the site, IC/ECs were retained for alternative development.

6.1.2 Surface Cover

Physical barriers may be used to limit the transport of COCs and to prevent potential exposures. Site covers or caps can be constructed of any combination of soil, gravel, asphalt, concrete, clay, or synthetic materials. The design and materials utilized to construct the cap or cover system depends upon the intended post-remedial use of the site, the resistance to potential erosion required, and the desired permeability. Areas to be reused for roadways and parking are typically gravel, asphalt, or concrete covered. Permeability will depend on the degree to which the cover/cap reduces infiltration of precipitation and the required resistance to erosion. Low permeability covers (e.g., asphalt, concrete, clay, or a synthetic material) are used to restrict infiltration and reduce the leaching of soil COCs in the vadose zone. Soil covers are more permeable and are used where infiltration and erosion are not major concerns.

A permeable or impermeable cover or cap could be used to prevent direct contact with soil and potential transport via water and wind erosion. In combination with institutional controls (e.g., SMP), a cover or cap would attain the surface soil RAOs for the protection of public health. By preventing potential off-site migration of impacted soil, a properly maintained cover would also meet the surface soil RAOs for environmental protection. However, placing a cover is not effective in achieving all site RAOs when the soil beneath the surface soil is also impacted. Therefore, permeable and low permeability cover options were not retained for further consideration in the development of remedial alternatives.

6.1.3 Surface Soil Removal

Removal of surface soil alone has limited effectiveness if the soil beneath the surface soil is also impacted. As such, surface soil removal (when combined with subsurface soil removal) was retained for alternative development.

6.2 Subsurface Soil Technologies

Impacted areas below the surface soil zone (i.e., starting 1 or 2 feet below the ground surface, depending on the site classification) and above the water table are addressed by subsurface soil technologies. Impacts below the water table are also generally addressed by groundwater technologies, but the descriptions in this section describe the subsurface soil technologies.

6.2.1 IC/ECs

As discussed in Section 6.1.1, IC/ECs for soils can be an effective component during site remediation, as well as following remediation when combined with other response actions. An example would include the combination of appropriate access restrictions and soil management procedures with measures to control fugitive dust generation and provisions for long-term maintenance to achieve the soil RAOs for the protection of human health and the environment. Site access protocols, soil management protocols, and site maintenance planning (as controlled in an environmental easement under a SMP) are therefore retained for alternative development.

6.2.2 Containment for Subsurface Soil

Subsurface barrier walls have been used at MGP sites to prevent the migration of NAPL in subsurface soils. However, based on the sampling performed during the RI, active migration is not a concern, as there does not appear to be significant mobile free-phase NAPL. Therefore, containment technologies are not retained for alternative development.

6.2.3 In-Situ Treatment of Subsurface Soil

Subsurface soil treatment technologies include those that provide containment, immobilization (e.g., solidification), transformation, or recovery of contamination. Due to the limited mobility of the MGP impacts in soils and the strong sorption of the COCs to soils (recovery of NAPL would still leave impacted soils), technologies that only enhance recovery were not retained for alternative development.

In-Situ Stabilization / Solidification (ISS)

ISS has become a commonplace means of remediation at MGP sites, including many MGP sites in New York State [New York Construction, 2007]. ISS of impacted soil involves the in-place mixing of cementitious reagents (such as Portland cement) with impacted soil with a vertically or horizontally-mounted auger or excavator bucket, or through the use of pressure/jets to inject and mix grout into a column or area of soil,[1] to create a solidified mass. ISS effectively immobilizes COCs and results in the formation of a solid monolith of relatively impermeable material in the saturated zone. Groundwater is forced around and under the ISS monolith, thus mitigating contact of groundwater with the COCs contained in the monolith. ISS results in an expansion of up to 20% in the volume of treated soil, thus requiring either pre-excavation or post-excavation of soil to provide spoil management and maintain the final ISS monolith below the frost line. This technology was retained for alternative analysis development.

In-Situ Chemical Oxidation (ISCO)

Application of ISCO technology has had a varied record of effectiveness at sites with contaminated soils. For highly conductive soils and areas without free product or high concentrations of contamination, the technology may be effective. One of the obstacles to effective implementation of ISCO is heterogeneous subsurface conditions and the presence of fine-grained soils that can limit the distribution of the reagents. Additionally, the technology is generally not applicable for areas with NAPL or highly impacted soils. With the effectiveness of this technology substantially limited by the presence of fine-grained and highly impacted soils, ISCO was not retained for alternative development.

Enhanced In-Situ Bioremediation

Enhanced in-situ bioremediation involves the use of microorganisms to degrade the COCs present in soil and groundwater. It relies on changing the nutrient and oxidation or reduction characteristics in the subsurface by distribution of active agents throughout the affected saturated zone. However, similar to the limitations of ISCO, the presence of fine-grained soils and highly impacted soils can limit the distribution of biologically active amendments and the associated enhancement of

[1] The jet grouting method is often used around obstructions that cannot be removed such as utilities or foundations.

bioremediation beyond natural attenuation. With the effectiveness of this technology substantially limited by the presence of fine grained and highly impacted soils, this technology was not retained for alternative development.

6.2.4 Subsurface Soil Removal

Excavation of soil is implementable and highly effective when coupled with an appropriate treatment or disposal option. Removal of impacted soils would achieve (in part or completely) the RAO for this media. Removal of soils containing NAPL in the matrix would remove a potential source of on-going groundwater impacts. Technologies for excavation include use of conventional track-mounted hydraulic equipment for excavation to depths of up to 30 feet, long-reach hydraulic equipment for excavation to depths of 60 feet, and crane- or Kelly bar-mounted equipment for excavation to depths of 100 feet or more. At this site, excavation for removal of impacted soils could extend to a depth of at least 24 feet to reach the deepest observed soil impacts. A combination of conventional hydraulic excavation equipment and staged, shored excavations would be used to accomplish the excavation work and are therefore carried forward for the development of the alternatives. The excavation of soils below the groundwater table is feasible but additional costs will be incurred due to measures needed to maintain a stable excavation area and to de-water the excavation area and the excavated soils prior to off-site transport and disposal.

Control of odors and VOC emissions will be a critical aspect of each excavation scenario. Excavation and loading activities could be conducted using a temporary fabric structure (if specified during the design phase of the project), odor-controlling foam, temporary plastic covering, fabric-covered perimeter fencing, and direct load-out. Each of these controls have been effectively implemented for odor control during the execution of recent remedial actions at similar MGP sites.

Soil removal was retained for alternative development.

6.2.5 Ex-Situ Treatment and Disposal of Subsurface Soil

Ex-situ soil treatment processes conducted on excavated soil include biological, chemical, or thermal treatment. The effectiveness of these processes is variable and each requires a site-specific demonstration to calculate the degree of treatment, time, and land area required. If performed on site, these processes require an appropriate distance from residential areas. These considerations resulted in on-site treatment processes not being retained for alternative development.

Off-site treatment and disposal technologies for excavated soil include conventional landfilling (Subtitle D landfill), low-temperature thermal desorption (LTTD), and disposal in waste-to-energy facilities. Each of these technologies has its place as a potentially applicable approach for certain soils or solid debris, and may be advantageous under particular conditions. Therefore, these off-site treatment and disposal options were retained for alternative development in combination with soil removal.

6.3 Groundwater Technologies

6.3.1 Institutional Controls and Engineering Controls (IC/ECs)

The institutional controls for groundwater that may be applicable to alternatives for this site include an environmental easement for site and groundwater use, and a restriction on the construction and use of new groundwater extraction wells.

6.3.2 Groundwater Containment Technologies

Groundwater containment technologies include soil cover, low permeability caps such as asphalt parking lots, subsurface barriers such as steel sheet pile or soil/bentonite walls, and active process barriers such as biologically active zones that form treatment "walls" reducing off-site migration of residuals.

For areas that have subsurface impacts in the vadose zone, soil covers and impermeable surface caps could decrease infiltration through impacted soils in the vadose zone and therefore have a positive effect on groundwater quality.

Subsurface barriers were not retained due to the localized nature of the impacts in the subsurface soil and because the impacts are not likely to extend beyond the impacted parcels.

6.3.3 In-Situ Treatment

Monitored Natural Attenuation (MNA)

Groundwater MNA relies upon the natural degradation and mitigation processes that occur in the subsurface to remedy groundwater impacts over time. The natural attenuation processes include a variety of physical, chemical, or biological processes that, under favorable conditions, act without human intervention to reduce the mass, toxicity, mobility, volume, or concentration of COCs in soil or groundwater. These processes include biodegradation, dispersion, dilution, sorption, volatilization, and chemical or biological stabilization, transformation, or destruction of COCs.

A previous study of MNA at an MGP site has shown its effectiveness following source removal and with favorable subsurface conditions [Neuhauser, et al, 2009]. Implementation is a function of an evaluation of physical and chemical soil and groundwater characteristics including soil and groundwater chemistry, groundwater hydraulics, and biodegradation processes associated with microbial activity. Groundwater MNA was retained for alternative development because it is easy to implement and has a low cost.

ISS

As described in Section 6.2.3, ISS creates a solidified mass that substantially decreases the ability of groundwater to contact the impacted soil and effectively immobilizes COCs in the solidified soil mass. This technology was retained to treat impacted media in the saturated zone due to its effectiveness and implementability.

ISCO

The use of ISCO involves the injection of Fenton's Reagent (a solution of hydrogen peroxide and an iron catalyst), or similar chemical oxidant, across the area of COC impacts, generally using temporary injection wells or modified direct push rods. The pattern and spacing depends on the site-specific radii of influence and other subsurface properties. ISCO is generally much more effective at COC destruction in the saturated zone than the vadose zone. However, given that ISCO has limited effectiveness in highly impacted and fine-grained soils (Section 6.2.3), this technology was not retained for evaluation.

Enhanced In-Situ Bioremediation

Enhanced biological treatment of groundwater may use aerobic or anaerobic microbial degradation of COCs. These are active management processes in which natural groundwater conditions are modified in order to facilitate bioremediation of the COCs to innocuous end-products. Engineered saturated zone bioremediation processes are designed to treat the dissolved constituents of the groundwater plume by ensuring the existence of a bioactive zone sufficient to degrade the constituents before they reach an environmental receptor. Aerobic biological treatment is the most applicable to MGP sites. In this process, oxygen-releasing compounds or direct air/oxygen injection is used in wells to deliver oxygen to the affected groundwater over the required time period to achieve the desired amount of oxygen. Enhancements such as increasing the dissolved oxygen content in the subsurface have been shown to be effective at MGP sites [Levinson, 2009]. These technologies are used to treat dissolved COCs in groundwater.

This technology is potentially effective for groundwater with moderate concentrations of COCs. However, for the Canastota Former MGP site, impacted groundwater containing COCs are generally concentrated around soil containing NAPL with high concentrations of COCs. Groundwater bioremediation will not address free-phase NAPL effectively, so the technology is not retained.

Air Sparging

Air sparging/soil vapor extraction is the injection of pressurized air into the subsurface below the water table to induce volatilization of dissolved phase COCs. The volatilized compounds are then removed by active vapor extraction wells. This technology is applicable to sites such as gasoline spills where VOCs are predominant. Because MGP-impacted groundwater contains PAHs that are not readily volatilized by air sparging, this technology is not being retained for alternative development.

6.3.4 Source Removal and Ex-Situ Treatment for Addressing Groundwater

General technology types within the source removal GRA include excavation, NAPL recovery, and enhanced recovery technologies. Additionally, once the groundwater is extracted, a number of options exist for treatment of the impacted water.

Excavation/Extraction/Ex-situ Treatment

As discussed in Section 6.2.4, removal of soils containing NAPL in the soil matrix would remove a potential source of on-going groundwater impacts. Therefore, as this method is focused on reducing impacted soil, it also helps address groundwater impacts. Generally, soil excavation below the water table requires dewatering, so the groundwater in the vicinity of the excavation is extracted and treated ex-situ in a temporary, on-site water treatment facility or transported for disposal.

It would be feasible to extract impacted groundwater for on-site treatment at this site. On-site treatment technology options for extracted groundwater may include air stripping and/or granular activated carbon (GAC) filtration. However, although the MGP COCs are amenable to biological treatment, the concentrations in groundwater are typically too low for biological treatment to be effective without the addition of large amounts of co-substrate to maintain a viable biomass. Extracted groundwater would be appropriate for off-site disposal at a publicly owned treatment works (POTW), though pretreatment would likely be required to meet the acceptance criteria provided by the POTW.

Although the anticipated recharge and extraction rates would be low due to the silt/clay content of the soils, groundwater extraction would nevertheless result in a large volume of groundwater with low concentrations of COCs. Therefore, mass removal rates relative to the recovery effort would be very low. As such, a more efficient means to extract the source material mass and reduce the on-going source of groundwater impacts would be to remove NAPL from the subsurface.

Groundwater extraction and treatment without excavation was not retained as a groundwater technology due to the long-term duration, and energy-intensive nature of this approach for the low-solubility COCs at the site. However, since excavation-related dewatering during construction may be required, the ex-situ pre-treatment technologies were retained for further consideration in development of alternatives.

NAPL Recovery

NAPL recovery can reduce the mass of NAPL in the subsurface and may also reduce the mobility of residual NAPL by recovering the flowable fraction. Typical recovery systems include specially constructed wells and/or recovery trenches. Collection may be passive or may require an active pumping system. Several NAPL pumping systems are available, including low-flow NAPL pumps that, for many systems, allow for the greatest NAPL recovery [EPRI, 2000]. Recovery of viscous and weathered NAPL may be difficult, and low rates of recovery may indicate that there is not a substantial flowable NAPL fraction.

At the site, flowable NAPL has not been observed and therefore is not accumulating in the monitoring wells. Without treatment, NAPL will not flow as a separate phase and would likely be extremely difficult to mobilize. Because flowable NAPL has not been observed in the RI soil borings, wells, or test pits, NAPL recovery using wells or trenches is not retained for alternative development.

Enhanced Recovery Technologies

As mentioned above, NAPL in groundwater is not expected to migrate without treatment designed to enhance its recovery. Adding heat to the subsurface through steam, hot water, or electro-resistive heating are technologies that may be used to enhance tar or NAPL recovery. However, these technologies are energy intensive and have a risk of mobilizing source materials in an uncontrolled fashion. This could spread impacts to previously unimpacted areas and make treatment more difficult, particularly if the impacts migrate downward in the aquifer.

Similarly, chemical enhancements such as surfactants or co-solvents or physical enhancements such as acoustic vibrations could also mobilize contamination, but recovery may be difficult and only partially effective. However, a substantial risk exists for uncontrolled migration of impacts to deeper within the aquifer. Therefore, the most efficient, safe and direct means to remove the NAPL is to excavate soils containing the source material. For these reasons, enhanced recovery technologies were not retained for alternative development.

6.4 Technology Screening Results

The technology options retained following the technology screening and evaluation are summarized below:

Technology Option	*Media*
No Action	Soil and Groundwater
Institutional Controls ▪ Site Management Plans ▪ Environmental Easements ▪ Groundwater Use Prohibitions	 ▪ Soil and Groundwater ▪ Soil and Groundwater ▪ Groundwater
In-Situ Treatment ▪ In-Situ Solidification ▪ Monitored Natural Attenuation	 ▪ Soil and Groundwater ▪ Groundwater
Removal and Ex-Situ Treatment ▪ Excavation with Off-Site Disposal or Treatment	 ▪ Soil

7. Development and Analysis of Alternatives

In this section, the remedial alternatives for the site are developed and evaluated, based on the nature and extent of impacts and the applicable technologies. A comparison of alternatives is presented at the conclusion of this section. A summary of how the alternatives address the RAOs is provided in Table 7-1, and a summary and comparison of the remedial alternatives is provided in Table 7-2.

7.1 Development of Alternatives for Additional Remedial Actions

A range of alternatives were developed for this site, based on the current and assumed future land use, RAOs, and GRAs identified in Section 5 and the applicable technologies identified in Section 6. A total of four alternatives were developed and retained for detailed analysis. The alternatives are summarized as follows:

Alternative 1: No Action

The No Action alternative is used as a baseline condition for comparison to other alternatives. It involves no IC/ECs, monitoring, or active remediation. There is no cost associated with this baseline alternative.

Alternative 2: Shallow Soil Excavation and ISS of Deeper Impacts

This alternative addresses deeper impacts using ISS. A 4- to 6-foot-deep pre-excavation in the areas of ISS will be required to contain spoils during the ISS process and to provide a minimum of 4 feet of granular soil below the final grades. The footprint of the proposed ISS (blue outlines) and associated pre-excavation (red outlines) are depicted on Figure 6, and the preliminary depth of ISS is 6 to 15 feet. The final locations and depths of the ISS remedy will be selected during the detailed design phase.

The following items describe a general sequence of the work associated with the ISS alternative:

- Erect a temporary fence, construct a stabilized construction entrance, and install erosion controls and other engineering controls associated with the work.
- Perform community air monitoring program (CAMP) monitoring for the duration of the intrusive work.
- Decommission existing monitoring wells within the area.
- Mobilize temporary facilities and construction equipment, including temporary grout batch plant and material storage silos required for the ISS operation.
- Temporarily or permanently relocate the existing overhead utilities and fueling station.
- Remove and dispose of existing surface cover (e.g., asphalt pavement, concrete slabs, existing vegetation).

- Install excavation support and movement monitoring system for existing buildings.
- Pre-excavate soils, including shallower areas up to 8 feet deep, and 6 feet deep in areas to be underlain by ISS. Excavated material may be segregated for off-site disposal and/or on-site reuse, depending on chemical and physical properties.
- Dewater the excavation area if required, treat the water on site, and dispose of the treated effluent.
- Demolish, excavate and remove the following historic MGP structures and the associated impacted soil:
  - Tar Well/Tar Separator
  - Hot Well
- Transport and dispose of debris and soil and at an off-site disposal and/or thermal treatment facility.
- Perform bulk ISS in areas where the remaining soil exceeds the Commercial Use SCOs, down to a depth of about 15 feet below the existing site grades.
- Grade and remove ISS spoils to provide a minimum of 4 feet between the final grades and the top of the ISS mass.
- Install a demarcation layer on top of the ISS mass.
- Place and compact soil backfill meeting the SCOs specified in 6 NYCRR Part 375-6.7(d) and DER-10 Appendix 5 for Commercial Use.
- Remove temporary fencing and other temporary engineering controls.
- Restore existing site cover and temporarily-relocated utilities or structures.
- MNA for groundwater.
- IC/ECs implemented site-wide by an SMP (including a groundwater monitoring program, site and groundwater use restrictions, and an environmental easement).

A Pre-Design Investigation (PDI) would be performed to further refine the horizontal and vertical extents of the impacts and the ISS remedy, particularly in the area of the existing gas holder and the salt storage unit.

A Monitoring Plan (included in the SMP) would be developed for the site to assess the performance of the remedy. Periodic Review Reports would be prepared in accordance with Part 375-1.8(h)(3).

Alternative 3: Excavation of Soils Exceeding Commercial SCOs and Subsurface Structure Removal

This remedial alternative involves excavating the impacted soil area depicted in the red outline on Figure 6. It provides for protection of human health and the environment, with short-term impacts and remedial action cost higher than Alternatives 1 and 2 (No Action, and ISS with Subsurface Excavation), but not as high as Alternative 4 (Excavation of Soils Exceeding Unrestricted SCOs).

The potential for future land use would not substantially increase. This alternative would therefore provide similar protection to the ISS alternative but would be more disruptive to the community in the short term.

This remedial alternative would involve excavation of the impacted soil area shown on Figure 6, and includes the following sequential actions:

- Erect a temporary fence, construct a stabilized construction entrance, and install erosion controls and other engineering controls associated with the work.
- Perform CAMP monitoring for the duration of the intrusive work.
- Decommission existing monitoring wells within the area.
- Mobilize temporary facilities and construction equipment.
- Demolish all, or a large portion of, the existing DPW garage building.
- Permanently relocate the existing salt storage unit.
- Permanently relocate the existing sanitary sewer line located on the south side of the site and abandon the existing sanitary sewer line.
- Temporarily or permanently relocate the existing overhead utilities and fueling station.
- Remove and dispose of existing surface cover (e.g., asphalt pavement, concrete slabs, existing vegetation).
- Install excavation support.
- Unwater (i.e., initial dewatering of the excavation) the soil within the excavation support area(s).
- Install, operate, and maintain dewatering system outside of the excavation area to intercept ground water flow and reduce seepage pressures.
- Excavate shallow soils. Excavated material may be segregated for off-site disposal and/or on-site reuse, depending on chemical and physical properties.
- Install internal or external bracing to complete the excavation support system.
- Demolish, excavate and remove the following historic MGP structures and the associated impacted soil:
    - Small Gas Holder
    - Tar Well/Tar Separator
    - Hot Well
- Excavate soils to the desired depth.
- Continue to dewater the excavation area and treat the water on site.

- Transport and dispose of debris and soil and at an off-site disposal and/or thermal treatment facility.
- Place and compact soil backfill meeting the SCOs specified in 6 NYCRR Part 375-6.7(d) and DER-10 Appendix 5 for Commercial Use to the required depth below the excavation support bracing.
- Discontinue dewatering, and remove dewatering and water treatment systems once backfill has been installed to an elevation above the normal groundwater level.
- Remove the bracing and backfill to final subgrade elevation.
- Remove the remainder of the excavation support system or abandon in place.
- Remove temporary fencing and other temporary engineering controls.
- Restore existing site cover, temporarily-relocated utilities or structures.
- Rebuild DPW garage.
- IC/ECs implemented site-wide by an SMP (including site and groundwater use restrictions and an environmental easement agreement).

Because of the completeness of the removal, NAPL recovery or in-situ treatment would not be required.

The following considerations would apply to this alternative:

- During the pre-design investigation phase, the excavation areas would be delineated and data would be used to make an estimation of the volumes of soil eligible to be disposed of at a landfill versus those that will require treatment prior to disposal.
- Odor, vapor, and dust control would be accomplished by excavation of NAPL-containing soil in conjunction with the use of foam and plastic sheeting.
- The water table is typically within 5 feet of existing grades. The support of excavation will go deep enough to penetrate the till layer to facilitate adequate dewatering. Any excavation supports will be designed to resist groundwater pressures and localized dewatering will be implemented as necessary.
- The excavated materials will be loaded into trucks and covered for transport to permitted off-site disposal facilities.

Alternative 4 – Soil Removal of Soil Exceeding Unrestricted Use SCOs and Subsurface Structure Removal

This alternative, required by DER-10 for comparison purposes, uses excavation and off-site treatment/disposal to remove soils above Unrestricted Use SCOs from the site and the neighboring affected properties. It is not a practicable remedy and is provided in this study for comparative purposes only.

Similar to Alternative 3, this remedial alternative involves excavation and off-site treatment and disposal to address site impacts. However, this alternative would remove soils from the site and neighboring affected parcels that exceed Unrestricted Use SCOs, encompassing the area depicted in the teal-colored outline on Figure 6. This alternative requires the removal of the MGP foundations followed by the removal of soil to Unrestricted Use SCOs. This alternative provides the highest protection of human health and the environment, but because the widespread removal of buried concrete foundation structures, debris and large amount of soil excavation, it has extremely high short-term impacts and remedial action costs. The land use potential would not be substantially increased. This alternative would therefore provide similar protection to the ISS alternative (Alternative 2) and would be more disruptive to the community in the short term.

7.2 Detailed Analysis of Alternatives

The following sections present descriptions of each of the remedial alternatives and the results of the evaluation of the alternatives with regard to the following eight criteria defined by DER-10:

1. Overall protection of human health and the environment
2. Conformance with SCGs
3. Long-term effectiveness and permanence
4. Reduction of toxicity, mobility, or volume of COCs through treatment
5. Short-term impacts and effectiveness of controls
6. Implementability
7. Cost effectiveness
8. Land Use

When performing this evaluation, the first two evaluation criteria are threshold criteria and must be met for an alternative to be considered for selection. The next six evaluation criteria are balancing criteria used to compare the positive and negative aspects of each of the remedial alternatives, contingent on whether the alternative satisfies the threshold criteria.

A ninth criterion, Community Acceptance, is considered after a decision document has been subject to public comment. This modifying criterion is evaluated after any public comments on the remedy have been received, prior to NYSDEC's final approval of the remedy.

In accordance with the NYSDEC Guidance Document DER-31 – Green Remediation, aspects of environmental sustainability were evaluated as part of the detailed analysis of alternatives. These aspects were included in the considerations of the short-term impacts of each alternative.

Estimated costs are presented for the proposed remedies. These include capital and operations, maintenance, and monitoring (OM&M) costs. OM&M costs are associated with groundwater monitoring for this site and are presented as present worth costs calculated based on a maximum period of 30 years with a discount rate of 5 percent. This value was selected based on recommendations by the NYSDEC. Costs have been prepared to present a range that may vary between +50 % and -30 % from actual costs.

7.2.1 Alternative 1: No Action

The No Action Alternative is used as a baseline condition for comparison to other alternatives. It involves no monitoring, active remediation, or IC/ECs. There is no cost associated with this baseline alternative. Because it would not address the surface or subsurface impacts present at the site, the No Action Alternative would not achieve the threshold criterion of conformance with SCGs required by DER-10. It would have low long-term effectiveness and permanence, and would not reduce mobility, toxicity, or volume. The overall protection of human health and the environment would not be achieved under the No Action Alternative, particularly for a future construction worker risk scenario. While No Action would have no negative short-term impacts, and would be implementable and cost effective, it would not meet the RAOs for subsurface soil to the extent practicable and is therefore not a viable alternative.

7.2.2 Alternative 2: Shallow Excavation and ISS of Subsurface Soil, including IC/ECs and MNA Program

Overall Protection of Human Health and the Environment

An ISS alternative provides high protection to human health and the environment. The potential for contact with COCs in subsurface soils would be reduced by 1) the excavation and removal of the shallow soils to a depth of up to 8 feet, 2) the solidification of deeper impacts to a depth of approximately 15 feet, and 3) placement of clean fill above the solidified mass to provide pavement subgrade or fill for landscaped areas. Solidification of source material would substantially reduce groundwater impacts, and wells would be installed outside of the solidified mass to monitor for the presence of NAPL (and recover NAPL, as needed) in the non-solidified areas.

Conformance with SCGs

The ISS alternative would comply with the applicable soil standards, criteria, and guidance (SCGs), but complete removal of SCG groundwater exceedances would not be achieved. Achievement of groundwater SCGs would be monitored by implementing NAPL gauging and recovery in areas outside of the solidified mass to the extent practicable. Table 7-1 provides a summary of how this alternative addresses the RAOs.

Regardless of the actions taken to improve groundwater quality, continuing sources of MGP residuals may contribute to exceedances of the NYSDEC Ambient Groundwater Water Quality Standards outside of the solidified mass. The response action objectives (RAOs) would be met by significantly reducing the potential migration and exposure pathways by the institutional controls and engineering controls (IC/ECs) and implementing an in-situ groundwater monitoring or treatment program and monitored natural attenuation (MNA).

Design development for the ISS remedy and the associated performance specifications will be developed in general accordance with the following documents:

- *Interstate Technology & Regulatory Council (ITRC); Technical/Regulatory Guidance; Development of Performance Specifications for Solidification/Stabilization; July 2011.*
- *NYSDEC ISS QA/QC Procedures Document.*

Long-term Effectiveness and Permanence

Solidification of source material and soil in combination with the ICs/ECs would greatly reduce the potential soil exposure pathways and would significantly decrease the leaching of soil-bound COCs into the dissolved phase groundwater impacts. Sources contributing to the exceedances of the NYSDEC Ambient Groundwater Quality Standards may be present beneath or outside of the solidified mass, although evidence of significant source material deeper than 15 feet was not observed during the RI.

Reduction of Mobility, Toxicity, or Volume Through Treatment

This alterative will result in a substantial reduction of the mobility, toxicity and volume by removing the shallow soils and solidifying the source material and adjacent soil. NAPL MNA, and recovery as needed, outside of the solidified mass will further decrease the mass and concentrations of COCs.

Short-term Impacts and Effectiveness of Controls

During the implementation of the proposed remedy, measures would be taken to monitor and reduce the potential for nuisance odors during the shallow excavation and solidification actions. The bulk excavation of MGP source material is not required with this alternative, and therefore, would reduce the potential for and duration of nuisance odors. Dust and odor control can be performed by spraying water on dry soils and applying odor control foam and/or plastic sheeting to impacted soils. Aside from the typical noise generated from standard construction equipment, no other significant sources of noise are expected, and the Contractor will be required to follow the applicable local codes and/or noise ordinances. Truck traffic from the operations would be significantly reduced, but some truck traffic would be necessary for mobilizing and demobilizing heavy construction equipment, material deliveries, removing and disposing of shallow excavated material and ISS spoils, and importing of a limited amount of backfill material onto the site.

Protection of Workers. Workers would be protected during implementation of this alternative as direct contact with impacted material will be minimized by use of heavy equipment to perform the excavation and solidification activities. Because most of the impacted soil is being solidified in place, the potential for exposure is significantly less than the exposure potential during excavation. Workers involved in the remedial and operation, maintenance, and monitoring (OM&M) activities will wear the appropriate personal protective equipment (PPE) as required in the site-specific health and safety plan.

Environmental Impacts. The potential for negative environmental impacts from this alternative is low. Impacts during the excavation and solidification operations will be addressed by use of spill prevention and control measures. Impacts from trucking and disposal or trucking and thermal treatment will include the use of fossil fuels and the generation of greenhouse gasses but will be significantly reduced by ISS as detailed above.

Time Until Response Objectives are Achieved. It is anticipated that mobilization, excavation, solidification and site restoration work will take approximately 9 months to complete. This alternative provides for a significant reduction in the concentrations of COCs in groundwater, starting approximately 1 year after the remedial action. We expect that the response objectives for groundwater will be achieved to the extent practicable over approximately 30 years.

Green Remediation Considerations: This alternative would have the lowest required use of fossil fuels and disposal facilities. Resource utilization is also lower relative to the other alternatives as the result of the reduction in volume of clean soils required to be brought onto the site for backfill and cover.

Implementability

Technical Feasibility. ISS is a familiar and proven environmental remediation technique and is technically feasible using conventional equipment. Auger mixing can be performed to depths of approximately 60 feet and bucket mixing can be performed to depths of approximately 20 feet. These two methods can be performed in parallel.

Administrative Feasibility. This alternative is administratively feasible, though inconvenient as it will require the relocation of the DPW personnel and services for a time greater than the duration of construction.

Availability of Services and Materials. The services and materials required for this alternative are readily available. The use of ISS technology and the number of successful ISS projects associated with environmental remediation has grown substantially in recent years. Multiple contractors that routinely work on NYSDEC MGP remediation projects can self-perform the ISS work or have close working relationships with specialty subcontractors.

Cost Effectiveness

ISS is a green and sustainable solution that incorporates both environmental and social aspects of remediation. ISS would reduce the overall project carbon footprint through a significant reduction of truck traffic required for the disposal of excavated material and import of clean backfill. It would reduce the disruption to the public by reducing the noise and vibration associated with sheet pile installation and extraction as well as decreasing the potential for nuisance odors associated with the bulk excavation of source material.

This alternative has a high cost-effectiveness because construction time, transportation and disposal, and dewatering costs are minimized.

The rounded projected costs for this alternative are as follows:

Capital Cost	$5.5 million	
OM&M Cost	$0.6 million	(including present worth of groundwater management for 30 years)
Contingency	$1.3 million	(A 30% allowance for undefined costs and conditions)
Total	$7.4 million	

Details of the cost estimate are provided in Appendix C.

Land Use

The installation of ISS in this area would not preclude future development because a 4- to 6-foot-thick zone of granular backfill will be installed above the solidified mass to facilitate future shallow excavations for utilities or other lightly-loaded structures. The ISS will be designed to have a compressive strength that permits excavation with mechanical means. If a new structure is proposed for this area, the ISS mass could be used as a component of the foundation system depending on the size and loading conditions associated with the proposed structure.

The land use for the ISS alternative would allow commercial or industrial use.

7.2.3 Alternative 3: Excavation of Soils Exceeding Commercial SCOs and Subsurface Structure Removal

Overall Protection of Human Health and the Environment

This remedial alternative is protective of human health and the environment. A high level of overall protection would be achieved by the complete removal action defined by this alternative.

Conformance with SCGs

SCGs for soils will be achieved by the removal of source materials and soils exceeding Part 375 Commercial levels. It is anticipated that this remedy would also achieve groundwater RAOs within a short time period by removing the source material and through natural attenuation. Table 7-1 provides a summary of how this alternative addresses the RAOs.

Long-term Effectiveness and Permanence

This remedy relies primarily on removal actions that will be effective and permanent, and will eliminate direct exposure potential upon removal.

Reduction of Mobility, Toxicity, or Volume Through Treatment

This remedial alternative will result in rapid substantial reduction of mobility, toxicity, and volume of COCs through the removal action.

Short-term Impacts and Effectiveness

The demolition and reconstruction of the DPW buildings and associated appurtenances, extensive and deep excavation, and backfilling in the soil removal area would have greater negative short-term impacts in terms of disrupting local residences and commercial activities in the area, increasing the duration of potential exposure of workers to COCs, and increased greenhouse gas emissions due to the large volume of material required for transport and off-site disposal or treatment.

Protection of Community. While measures would be taken to monitor and reduce the potential for nuisance odors and noise during the excavation, the deep excavation alternative has a greater potential for and a longer duration of disruption. During the implementation of this alternative, measures would be taken to monitor and reduce the potential for air emissions during source removal actions and transportation off site. Large quantities of odor-control foam and plastic sheeting would be used during the excavation activities. Excavation activities may be performed inside of a temporary fabric structure.

Truck traffic from the operations would be a long-lasting and have a very significant impact. Truck traffic would include mobilization and demobilization of heavy construction equipment, trucking of impacted material from the site, and trucking of backfill material onto the site.

Protection of Workers. Workers would be protected during implementation of this alternative as direct contact with impacted material will be reduced by use of heavy equipment to perform the excavation and loading activities. Workers involved in the remedial activities will wear the appropriate PPE as required in a site-specific health and safety plan. However, due to longer duration of construction activities and excavation of impacted material above Commercial SCOs to 15 feet deep, the potential of workers to come into contact with COCs increases when compared to the ISS alternative.

Environmental Impacts. The potential for negative environmental impacts for this alternative would be high. Potential releases during the removal of MGP source material will be addressed by the use of spill prevention and air emission control measures. Substantial impacts from trucking and disposal or LTTD of soil will include the generation of greenhouse gasses. The deep excavation would result in a total of approximately 2,640 one-way truckloads to remove impacted soil and deliver backfill soil, as compared to 1,160 truckloads for the ISS alternative.

Time Until Response Objectives are Achieved. The SCOs would be met upon completion of the removal, which is estimated to take a total of at least 12 months to complete, including the demolition of buildings and the re-routing of the critical utilities. This alternative provides for a significant reduction in the concentrations of COCs in groundwater, starting approximately 1.5 years after the remedial action. We expect that the response objectives for groundwater will be achieved to the extent practicable over approximately 30 years.

Green Remediation Considerations: This alternative would have the second-highest required use of fossil fuels and disposal facilities for the excavation. Other resource utilization would include the clean soils brought onto the site for backfill and cover.

Implementability

Technical Feasibility. Removal by excavation is technically feasible using conventional excavation equipment. Excavation, transportation, and disposal of impacted soils are conventional remedial techniques. Due to the large amount of excavation for this option, the feasibility may be limited by the capacity of the LTTD facilities.

Administrative Feasibility. This alternative is administratively feasible, though inconvenient as it will require the relocation of the DPW personnel and services during remedial construction and reconstruction of the DPW facility.

Availability of Services and Materials. The services and materials required for this alternative are readily available. Multiple facilities may need to be identified for both treatment of excavated soil and provision of clean backfill material, acceptable to NYSDEC, due to the significant quantities of material involved. Excavation uses conventional construction equipment that is readily available.

Cost Effectiveness

This remedy would not be cost-effective, as the high costs would not have a commensurately high value in additional environmental protection or increase in actual land use additional to the current high value of land use.

The projected costs for this alternative are as follows:

Capital Cost	$8.5 million	
OM&M Cost	$0.6 million	(groundwater monitoring for 3 years after remediation)
Contingency	$2.0 million	(A 20% allowance for undefined costs and conditions)
Total	$11.1 million	

Details of the cost estimate are provided in Appendix C.

Land Use

This alternative would remediate the site to allow for would allow commercial or industrial use.

7.2.4 Alternative 4: Excavation of Soils Exceeding Unrestricted Use SCOs and Subsurface Structure Removal

Overall Protection of Human Health and the Environment

Alternative 4 meets all RAOs. This remedial alternative is protective of human health and the environment. A high level of overall protection would be achieved by the complete removal action defined by this alternative. Over an anticipated short time, the RAOs for groundwater would be met by the MNA as all potential source materials for impact to groundwater would be removed.

Conformance with SCGs

SCGs for soils will be achieved by the removal of soils exceeding Part 375 Unrestricted levels. It is anticipated that this complete removal action would also result in achieving groundwater RAOs within a short time period. Table 7-1 provides a summary of how this alternative addresses the RAOs.

Long-term Effectiveness and Permanence

This remedy relies primarily on removal actions that will be effective and permanent, and will eliminate direct exposure potential upon removal.

Reduction of Mobility, Toxicity, or Volume Through Treatment

This remedial alternative will result in rapid substantial reduction of mobility, toxicity, and volume of COCs through the removal action.

Short-term Impacts and Effectiveness

The primary short-term impacts of this alternative are associated with the complete redevelopment of the site, including demolition and reconstruction of the DPW buildings, relocation of the utilities, fuel station, sewer pump station and other appurtenant structures associated with the DPW and fire training, as well as the extensive and deep excavation of soil and the backfilling and site restoration activities. The greatest potential for exposure to dust and odor by the construction workers and the community members exists under this alternative; however, measures would be taken to manage these potential exposures, as discussed in Section 7.2.3.

Protection of Community. Truck traffic from the operations would be long-duration and have a severe impact. Truck traffic would include mobilization and demobilization of heavy construction equipment, trucking of impacted material from the site, and trucking of backfill material onto the site. During the implementation of this alternative, measures would be taken to monitor and reduce the potential for air emissions during the excavation and well installation actions. Excavation activities may be performed inside of a temporary fabric structure.

Protection of Workers. Workers would be protected during implementation of this alternative as direct contact with impacted material will be minimized by use of heavy equipment to perform the excavation and loading activities. Workers involved in the remedial activities would wear the appropriate PPE. Workers involved in the remedial and OM&M activities would wear the appropriate PPE.

Environmental Impacts. The potential for negative environmental impacts for this alternative would be high due to impacts from trucking and LTTD treatment of soil will include the generation of greenhouse gasses. The excavation would result in a total of approximately 4,900 one-way truckloads to remove impacted soil and deliver backfill soil, as compared to 1,160 truckloads for the ISS alternative.

Time Until Response Objectives are Achieved. The SCOs would be met upon completion of the removal, which is estimated to take about 14 months to complete, including the reconstruction of the natural gas regulator station and the re-routing gas, electric, stormwater lines in Franklin Street. Groundwater objectives would be met after a final attenuation period, estimated to have a duration of 1-5 years.

Green Remediation Considerations: This alternative would have the highest required use of fossil fuels and disposal facilities for the excavation. Other resource utilization would include the clean soils brought onto the site for backfill and cover.

Implementability

Technical Feasibility. Although costly, it is technically feasible to implement this alternative using conventional equipment. Excavation, transportation, and disposal of impacted soils are conventional remedial methods.

Administrative Feasibility. This alternative is administratively feasible provided that access agreements are obtained from the Village of Canastota and the adjacent property owners. This alternative is inconvenient as it will require the relocation of the DPW personnel and services for the duration of remedial construction and reconstruction of the DPW facility.

Availability of Services and Materials. The services and materials required for this alternative are readily available. Multiple facilities may need to be identified for both treatment of excavated soil and provision of clean backfill material, acceptable to the NYSDEC, due to the significant quantities of material involved. Excavation uses conventional construction equipment that is readily available.

Cost Effectiveness

This remedy would not be cost effective, as the extremely high costs would not have a commensurately high value in additional environmental protection or increase in actual land use. Each of the other alternatives would allow both current and potential future land uses (DPW facility).

The projected costs for this alternative are as follows:

Capital Cost $10.1 million

OM&M Cost	$0.6 million	(groundwater monitoring for 3 years after remediation)
Contingency	$2.2 million	(A 20% allowance for undefined costs and conditions)
Total	$12.9 million	

Details of the cost estimate are provided in Appendix C.

Land Use

This alternative would allow for any potential use of the site, though local zoning ordinances limit the property to industrial use.

7.3 Comparison of Alternatives

A comparative analysis was conducted in which the alternatives were compared to one another with regard to each of the eight analysis criteria. A summary of the comparative analysis is presented in Table 7-2. The following discussion provides a comparison of the substantive alternatives, without the No Action Alternative, which is not considered a viable alternative.

Overall Protection of Human Health and the Environment

Each of the substantive alternatives include common elements that would result in overall protection of human health and the environment. Each alternative would be protective of human health and the environment by eliminating potential exposure pathways or maintaining barriers to potential exposure pathways, either by removal or IC/ECs.

For each alternative, the SCGs for groundwater would be met either through removal or immobilization of source and impacted material.

With respect to this criterion, the alternatives are ranked as follows:

1. Alternative 4 would be the most protective, because it would involve the most complete removal of impacted materials (i.e., soil exceeding Unrestricted Use SCOs).
2. Alternative 3 would be the next most protective. It would have results similar to Alternative 4 but would involve only removal of soil exceeding Commercial Use SCOs.
3. Alternative 2 would rank as the next most protective because it would immobilize COCs in-situ.

Conformance with SCGs

Alternative 2 would provide conformance with the SCGs appropriate for the land uses, to the extent practicable. Alternatives 3 and 4 would provide additional conformance to SCGs (Commercial and Unrestricted, respectively), as they could result in meeting groundwater RAOs within a few years.

Long-term Effectiveness and Permanence

Each alternative would result in a substantial reduction of the source of impacts to groundwater. The ranking of the alternatives with respect to this criterion would be proportional to the amount of COCs removed and identical to the ranking indicated for Overall Protection of Human Health and Environment, above.

Reduction of Toxicity, Mobility, or Volume

Each alternative would reduce the volume and mobility of MGP impacts at the site. The ranking of the alternatives with respect to this criterion would be proportional to the amount of COCs removed and identical to the ranking indicated for Overall Protection of Human Health and Environment, above.

Short-term Impacts and Effectiveness

Each alternative would have some degree of short-term impacts, as they all involve excavation support, on-site water treatment, excavation and off-site transportation, treatment and disposal, and greenhouse gas emissions. The primary factor is the amount of excavation and associated backfill. The principal short-term impact to the community would be truck traffic, and additional excavation and backfill volume would result in additional truck traffic over a longer time period to complete the work. Their short-term effectiveness, as indicated by the time until response objectives are achieved, does not substantially differ for either alternative.

Metrics relevant to short-term impacts and effectiveness are provided in Table 7-3. With respect to this criterion, the alternatives are ranked as follows:

1. Alternative 2 would rank first because of minimal short-term impacts to the community.

2. Alternatives 3 would rank second and have significantly greater impacts relative to Alternative 2, but would be equally effective at achieving RAOs.

3. Alternative 4 would involve the greatest excavation quantities and depths, resulting in the greatest negative short-term impacts, and would be equally effective at achieving RAOs.

Implementability

With respect to this criterion, the alternatives are ranked as follows:

1. Alternative 2 is most implementable, because excavation to 6 to 8 feet is readily achievable, the disruption time is minimized, and water management and risks to infrastructure would be reasonable.

2. Alternative 3 is less implementable than Alternative 2 because of the depth of the excavations (up to 15 feet deep). The larger excavation at that depth will require a greater level of shoring, staging and coordination. Dewatering will also be a concern at these greater depths and will add to the complexity and uncertainty associated with this alternative.

3. Alternative 4 is the least implementable because of the depth (up to 24 feet deep) and extent of excavations. Shoring, staging, coordination, and dewatering concerns are even greater than under Alternative 3. Additionally, adjacent property owners are more likely to be directly affected.

Cost Effectiveness

The alternatives are ranked as follows with respect to cost effectiveness:

1. Alternative 2 is the most cost-effective as it provides for the best land use value and reduction in long-term liability for its estimated cost of approximately $7.4 million.

2. Alternatives 3 and 4 are less cost-effective ($11.1 million and $12.9 million, respectively), and they would not have a commensurately high value in additional environmental protection or increased land use potential.

8. Recommended Remedy

Upon consideration of the results of the RI, and on the evaluated alternatives and their respective attributes and limitations, the elements detailed in Alternative 2 emerged as the recommended remedy for the site. As summarized in the comparative analysis, Alternative 2 will achieve a substantial reduction in impacts, with more certainty than Alternative 1, and with less cost and negative impact while maintaining similar effectiveness to Alternatives 3 and 4, which involve deep excavation and much larger volumes of excavation, disposal, and backfill. Alternative 2 provides an emphasis on a balanced effectiveness and cost. This alternative is implementable with moderate short-term impacts, and meets the RAOs for the site, to the extent practicable.

The recommended remedy, Alternative 2, pre-ISS excavation of soil, ISS, and Implementation of IC/ECs and an MNA program, would involve excavation of an estimated 6,900 CY of soil (calculation shown in Appendix B), for an estimated cost of $7.4 million.

This remedial alternative includes the following sequential actions:

- Rerouting of sewer line, utilities, and fueling station.
- Decommissioning of monitoring wells in the excavation area.
- Excavation and disposal of subsurface structures including the tar well/separator.
- Excavation and disposal of approximately 6,900 CY of MGP-impacted soil from the impacted area to a maximum depth of 8 feet.
- ISS of impacted material from 6 feet to 15 feet deep.
- Placement of a demarcation layer above the ISS mass.
- Placement of clean fill to match the surrounding grade.
- Restoration of surface cover.
- Development of an MNA program, including installation of additional monitoring wells.
- Establishment of an SMP providing for IC/ECs.

The active site work, including the excavation and restoration of the property would have a duration of approximately 9 months.

It is not possible to predict with certainty the duration of groundwater monitoring. A 5-year initial groundwater monitoring program is recommended, after which time the program would be evaluated. The details of the groundwater remedial programs will be developed in the design phase of the project.

In accordance with DER-31 Green Remediation, this alternative would have a moderate environmental footprint, primarily associated with the transport and disposal of impacted soil. During the course of the remedial activities, steps would be taken to mitigate the environmental footprint and provide for sustainable practices, energy usage and materials. The details of these provisions will be developed in the design phase of the remedy.

The recommended remedy for the site represents a consistent approach appropriate for its current and future land use and fitting with the local community.

The next step is a NYSDEC issuance of a Proposed Remedial Action Plan (PRAP) for public comment followed by a Record of Decision (ROD). A design for the remedy including detailed drawings and specifications for remedial construction will follow the issuance of the PRAP and ROD. A Pre-Design Investigation will be implemented to define the basis for design.

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Tables

Table 4-1
Chemical-Specific Standards, Criteria, and Guidance
Canastota Former MGP Site

Media	Requirements	Citation	Description	SCG or TBC	Comment
Soil	NYSDEC Remedial Program SCOs	6 NYCRR Part 375 Subpart 375-6	Establishes SCOs based on residential, commercial, and industrial land use; protection of ecological resources; and protection of groundwater quality.	SCG	Specified screening-level goals may be applicable in determining site-specific soil objectives.
	NYSDEC Soil Cleanup Objectives (SCOs) for Inactive Hazardous Waste Sites	NYSDEC DER-10, May 2010	Establishes recommended soil cleanup objectives (SCOs), SCOs for protection of groundwater quality, and groundwater standards/criteria.	SCG	Specified screening-level goals may be applicable in determining site-specific soil objectives.
	NYSDEC Guidance for implementing SCOs	NYSDEC Policy Memorandum on Soil Cleanup Guidance CP-51, October 2010	Provides guidance on use of SCOs.	TBC	Guidance may be applicable to site-specific soil cleanup alternatives. Provides modification to SCOs for MGP sites.
Groundwater	NYSDEC Groundwater Objectives	6 NYCRR Part 700-706 NYSDEC, Division of Water, TOGS (1.1.1) - 6 NYCRR 703.5	Establishes guidance or standard values for groundwater quality objectives.	SCG	May be applicable in determining site-specific groundwater objectives.
Surface water	NYSDEC Surface Water Objectives	6 NYCRR Part 700-706 NYSDEC, Division of Water, TOGS (1.1.1) - 6 NYCRR 703.5	Establishes guidance or standard values for surface water quality objectives.	SCG	Not applicable to this site. There are no surface water features at the site.
Sediment	NYSDEC Sediment Quality Criteria Development Process	Technical Guidance for Screening Contaminated Sediments (NYSDEC, 1999). Evaluating Ecological Risk to Invertebrate Receptors From PAHs in Sediments at Hazardous Waste Sites (USEPA, 2009)	Describes process for developing sediment quality criteria in the State of New York.	TBC	Not applicable to this site. There are no sediments at the site.
	Bioavailability Methods	ASTM D-7363-07 Standard Test Method for Solid-Phase Micro Extraction and PAH Analysis	Describes an updated process for developing sediment quality criteria.	TBC	Not applicable to this site. There are no sediments at the site.
Soil Vapor	Indoor Air Quality Objectives	NYSDOH Soil Vapor Intrusion Guidance October 2006	Establishes methods and guidance regarding data acquisition, interpretation, and mitigation.	TBC	Building was evaluated for soil vapor concentrations during the RI. Sample results do not indicate a concern with regard to MGP-site-related vapor intrusion. [GEI 2014]

Notes:

SCG = Standards, Criteria, and Guidance
TBC = Other Criteria To Be Considered

Table 4-2
Action-Specific Standards, Criteria, and Guidance
Canastota Former MGP Site

Action	Requirements	Citation	Description	SCG or TBC	Comment
Water Treatment Discharge	NYSDEC Ambient Water Quality Standards and Guidance Values and Groundwater Effluent Limitations	Division of Water Technical and Operational Guidance Series (TOGS) 1.1.1	Compilation of ambient water quality standards and guidance values for toxic and non-conventional pollutants for use in NYSDEC programs (i.e., SPDES).	TBC	These standards and guidance values are applicable in establishing discharge limitations to surface waters.
	NYSDEC Industrial SPDES Permit Drafting Strategy for Surface Waters	TOGS 1.2.1	Guidance for developing effluent and monitoring limits for point source releases to surface water.	TBC	These standards and guidance values are applicable in establishing discharge limitations to surface waters.
	Clean Water Act	Section 401	Water Quality Certification.	SCG	Potentially applicable.
	SPDES	6 NYCRR Parts 750-01, 750-02	Requirements for obtaining a SPDES permit and requirements for operating in accordance with a SPDES permit.	SCG	Potentially applicable to constructing and operating a water treatment system for discharge to surface water.
	Wastewater Treatment Plant	TOGS 1.3.8	Limits on new or changed discharges to Publicly Owned Treatment Works (POTWs), strict requirements regarding bioaccumulative and persistent substances, plus other considerations.	TBC	Potentially applicable to constructing and operating a temporary water treatment system for discharge to POTWs.
Construction Stormwater	SPDES Permit Requirements	NYSDEC SPDES General Permit for Stormwater Discharge	Requirements to protect stormwater from construction impacts including preparation of a Stormwater Pollution Prevention Plan (SWPPP).	SCG	Potentially applicable. A permit itself is not needed, only that the substantive requirements are fulfilled.
In-Situ Treatment of Soils and Groundwater	Underground Injection Control Program	40 CFR Part 144	Includes requirements for injection of chemicals.	SCG	Potentially applicable (in-situ chemical oxidation).
	NYSDEC Ambient Water Quality Standards and Guidance Values	Division of Water Technical and Operational Guidance Series (TOGS) 2.1.2	Applicability of SPDES permits and groundwater effluent standards to the use of underground injection/recirculation as a remediation measure.	SCG	Potentially applicable.
Indoor Air	NYSDOH Background Air Levels	Guidance for Evaluating Soil Vapor Intrusion in the State of New York	Includes a database of background indoor air concentrations and description of decision-making process for remediation of indoor air impacts.	TBC	Potentially applicable; however, building was evaluated for soil vapor concentrations during the RI. Sample results do not indicate a concern with regard to vapor intrusion. [GEI 2014]
Waste Management	Solid Waste Management Facility	6 NYCRR 360	Includes solid waste management facility requirements.	SCG	Applicable if soil or NAPL are removed.
	Waste Transporter Permits	6 NYCRR 364	Regulates collection, transport, and delivery of regulated waste. Requires that wastes be transported by permitted waste haulers.	SCG	Applicable if soil or NAPL are removed.
		DER-10 3.3(e)	Disposal of drill cuttings.	SCG	Potentially applicable during the installation of new monitoring wells.
MGP-Impacted Soil and Sediment	Management of Soil and Sediment Impacted with Coal Tar from Manufactured Gas Plant Sites	NYSDEC TAGM 4060 and NYSDEC DER-4	This guidance outlines the criteria for MGP coal tar waste. Soils and sediment only exhibiting the toxicity characteristic for benzene (D018) may be conditionally excluded from the requirements of 6 NYCRR Parts 370-374 and 376 when they are destined for permanent thermal treatment.	SCG	Applicable for off-site treatment and disposal of soil.

Table 4-2
Action-Specific Standards, Criteria, and Guidance
Canastota Former MGP Site

Action	Requirements	Citation	Description	SCG or TBC	Comment
Hazardous Waste	**Federal:** *Resource Conservation and Recovery Act (RCRA) Subtitle C – Hazardous Waste Management*				
	Generation, Management, and Treatment of Hazardous Waste	40 CFR Parts 261-265	Outlines criteria for determining if a solid waste is a hazardous waste and establishes requirements for hazardous waste management.	SCG	Because of New York State policy for management of wastes from MGP sites, hazardous waste will not be generated as part of implementation of the remedial actions, except possibly NAPL. Potentially applicable.
	State: NYSDEC Division of Hazardous Substances Regulation				
	New York State Hazardous Waste Management Regulations	6 NYCRR Parts 370-376	Outlines criteria for determining if a solid waste is a hazardous waste and establishes a hazardous waste management program.	SCG	Because of New York State policy for management of wastes from MGP sites, hazardous waste will not be generated as part of implementation of the remedial actions, except possibly NAPL. Potentially applicable.
Off-Site Management of Non-Hazardous Waste	RCRA Subtitle D	42 U S C Section 6901 *et seq.*	State and local governments, in accordance with USEPA's guidance, are the primary planning, regulating, and implementing entities for the management of non-hazardous solid waste, such as household garbage and non-hazardous industrial solid waste.	SCG	Applicable if soil or NAPL are removed from site.
Air Emissions	*Clean Air Act (CAA)*				
	New Source Review (NSR) and Prevention of Significant Deterioration (PSD) Requirements	40 CFR Part 52	New sources or modifications which emit greater than the defined threshold for listed pollutants must perform ambient impact analysis and install controls which meet best available control technology (BACT).	SCG	Not applicable. No new sources will be generated.
	National Emission Standards for Hazardous Air Pollutants (NESHAPs)	40 CFR Part 61; 40 CFR Part 63	Source-specific regulations which establish emissions standards for hazardous air pollutants (HAPs).	SCG	Not applicable.
	New York State Air Pollution Control Regulations	6 NYCRR Parts 120, 200-203, 207, 211, 212, 219, Air Guide-1	Establishes emissions standards and permitting requirements for new sources of air pollutants and specific contaminants.	SCG	Requirements would be applicable to remediation alternatives that result in emissions of air contaminants, including particulate matter and volatile or semi-volatile COCs.
	New York State Ambient Air Quality Standards	6 NYCRR Part 257	Establishes state ambient air quality standards and guidelines for protection of public health.	SCG	May be applicable in evaluating air impacts during remediation activities. Establishes short-term exposure action limits for occupational exposure.
	Fugitive Dust Suppression and Particulate Monitoring	NYSDEC - DER-10, Appendix 1B	Fugitive dust suppression and particulate monitoring during source area remedial activities.	SCG	For implementation under a site health and safety plan and CAMP during remedial activities. Applicable to site disturbance activities.
Construction-Related Air Emissions	Community Air Monitoring Plan (CAMP)	NYSDEC - DER-10, Appendix 1A	Air Quality Requirements	SCG	Applicable to remedial site construction activities, well installation activities, or future construction.
Work Near Overhead Power Lines	Safety and Health Regulations for Construction	Occupational Safety and Health Administration (OSHA) 29 CFR Part 1926, Subpart K; Part 1926.550(a)(15)	Establishes minimum clearances and grounding requirements for work near electrical equipment and for the operation of cranes and derricks in the vicinity of electrical distribution and transmission lines.	SCG	The minimum required clearances will be maintained and equipment grounding will be established when work is performed in the vicinity of overhead power lines.
	Worker Protection - Safety and Health	New York State Department of Labor (NYSDOL) High-Voltage Proximity Act, Code Rule 57, Section 202-h	Establishes minimum clearances and grounding requirements for work near high-voltage power lines.	SCG	The minimum required clearances will be maintained and equipment grounding will be established when work is performed in the vicinity of overhead power lines.

Table 4-2
Action-Specific Standards, Criteria, and Guidance
Canastota Former MGP Site

Action	Requirements	Citation	Description	SCG or TBC	Comment
Institutional Controls	Institution of an Environmental Easement	NYSDEC Policy on Environmental Easements: Environmental Conservation Law (ECL) Article 71, Title 36 NYSDEC August 2015 update to policy and forms	NYSDEC has developed a standard form and procedure for establishing environmental easements.	SCG	Institutional controls will be established in accordance with NYSDEC policy.
Monitored Natural Attenuation (MNA)	Provides Specific Requirement for Implementation of MNA	*Use of MNA at Superfund, RCRA Corrective Action and UST Sites* (USEPA, 1997)	This guidance document establishes the technical basis for implementing MNA.	TBC	MNA will be implemented in accordance with USEPA guidance.
Site Management Plan (SMP)	Template document intended to expedite development and approval of a site-specific SMP by providing format and general content guidelines.	*Site Management Plan Template* (NYSDEC, August 2015)	NYSDEC has developed an SMP template for remedial projects performed under the management of the NYSDEC Division of Environmental Remediation.	SCG	An SMP will be utilized following remedial action, to address the means for implementing the Institutional Controls and Engineering Controls that will be required by an Environmental Easement for the site.
Land Disturbing Activities	Excavation of Impacted Soil	DER-10; Technical Guidance for Site Investigation and Remediation	Requirements for collection and analysis of compliance and documentation samples.	TBC	Applicable.
			Requirements for CAMP implementation.	TBC	Applicable.
	Backfill	DER-10; Technical Guidance for Site Investigation and Remediation	Requirements for procedures to document that imported backfill is not impacted by COC.	TBC	Applicable.

Table 4-3
Location-Specific Standards, Criteria, and Guidance
Canastota Former MGP Site

Location	Requirements	Citation	Description	SCG or TBC	Comment
Entire Site	Madison County	General Regulations	County transportation and site use regulations.	TBC	Requirements of County, Town, and Village would be applicable to all remediation alternatives, especially those requiring transportation.
	Town of Lennox	Redevelopment Plans	Zoning regulations	SCG	Any zoning or master plan for redevelopment would be considered when planning future land use at the site.
	Village of Canastota	General Ordinances	Village regulations regarding transportation, noise, zoning, building permits, etc.	TBC	Requirements of County, Town, and Village would be applicable to all remediation alternatives, especially those requiring transportation.
	New York State Department of Transportation	General Regulations	NYSDOT regulations regarding transport of materials	TBC	Requirements of NYSDOT would be applicable to most remediation alternatives.
Floodplains	Executive Order 11988 - Floodplain Management	40 CFR Part 6, Subpart A; 40 CFR Part 6.302	Activities taking place within floodplains must be done to avoid adverse impacts and preserve the beneficial values in floodplains.	SCG	Not applicable. The site is in Zone B of the FEMA Flood Insurance Map which indicates it is located in an area of minimal flooding.
	Floodplain Management Regulations	6 NYCRR Part 500	Establishes floodplain management requirements.	SCG	Not applicable. The site is in Zone B of the FEMA Flood Insurance Map which indicates it is located in an area of minimal flooding.
	100-year floodplain regulations	Federal Emergency Management Agency	Administers floodplain management requirements.	SCG	Not applicable. The site is in Zone B of the FEMA Flood Insurance Map which indicates it is located in an area of minimal flooding.
Wetlands/Waters of the U.S.	Executive Order 11990 - Protection of Wetlands	40 CFR Part 6, Subpart A	Activities taking place within wetlands must be done to avoid adverse impacts.	SCG	Not applicable. Wetlands are not present at the site.
	Dredging and Filling regulations	Clean Water Act, Section 404; Rivers and Harbors Act	Regulates the discharge of dredged or fill material into waters of the United States. Requires a permit from the ACOE.	SCG	Not applicable. Sediments are not present at the site.
	Wetlands Regulations	NYSDEC Freshwater Wetlands Act	Regulates use and development of freshwater wetlands.	SCG	Not applicable. Wetlands are not present at the site.
	Protection of Water Regulations	6 NYCRR Part 608	Protection of Water Permit/ Water Quality Certification.	SCG	Not applicable.
Critical Habitat	Endangered Species Act and Fish and Wildlife Coordination Act	16 USC 661; 16 USC 1531	Actions must be taken to conserve critical habitat in areas where there are endangered or threatened species.	SCG	Not applicable. A high-value habitat for wildlife is not present at the site.
Historic Preservation	New York State Department of Parks, Recreation, and Historic Preservation	Historic Preservation Act	Establishes requirements for the identification and preservation of historic and cultural resources.	SCG	Applicable to the management of historic or archeological artifacts identified on the site. A "No Findings" determination is required prior to excavation.

Notes:
SCG = Standards, Criteria, and Guidance
TBC = Other Criteria To Be Considered

Table 5-1
Estimated Volumes of Impacted Media
Canastota Former MGP Site

Medium or Material	Estimated Volume	
Soil exceeding Unrestricted SCOs	20,400	CY
Soil exceeding Commercial SCOs to depths of 15 feet	15,300	CY
Historic MGP Structures and associated impacted soil	1,000	CY
Volume of ISS Mass (from depths of 6 feet to 15 feet)	4,800	CY
Groundwater exceeding NYSDEC Ambient Water Quality Standards	840,000	gal

Table 6-1
Technology Screening and Evaluation
Canastota Former MGP Site

General Response Action	Remedial Technology Type	Technology Process Option	Effectiveness	Implementability	Site-Specific Applicability and Screening Evaluation	Relative Cost
No Action	No Action	No Action	Not effective for achieving RAOs for soil or groundwater in an acceptable timeframe.	Readily implementable	Retained for alternative development. No Action is included for comparison purposes in accordance with NYSDEC DER-10.	No Cost
Institutional Controls/ Engineering Controls (IC/ECs)	Institutional Controls	Environmental Easement/Deed Restriction	Effective in preventing exposures to soil and groundwater by construction/utility workers. Not effective in limiting subsurface migration of COCs, volume reduction, or treatment.	Readily implementable	Retained for alternative development, particularly as a common element of combined technologies, for restricting site use to commercial/industrial and preventing construction and use of groundwater wells.	Low capital and OM&M costs
		Local Groundwater Use Ordinance				
		Site Management Plan				
Containment	Surface Barriers	Soil Cover	Effective for decreasing infiltration of precipitation and preventing direct contact with impacted surface soil.	Readily implementable	Not retained. Can decrease infiltration of precipitation through impacted soils in the vadose zone and therefore have a positive effect on groundwater quality. However, a surface barrier will not meet RAOs.	N/A; not retained
		Low permeability surface cover				
	Vertical Barriers	Sheet piling, bentonite/cement slurry, HDPE sheeting, drilled grout/solidified earth column	Effective for preventing migration of NAPL in subsurface soils.	Implementable	Not retained. Groundwater impact is localized and not likely to extend beyond the impacted parcels. Would require an associated and sophisticated hydraulic control (such as groundwater extraction) to prevent uncontrolled mounding or run-around. Very long duration.	N/A; not retained
In-Situ Treatment	Natural Attenuation	Monitored Natural Attenuation (MNA)	Effective over time for meeting groundwater RAOs once sources of groundwater impacts have been addressed. If sources cannot be fully addressed, MNA is marginally effective to ineffective in providing a decreasing trend of groundwater COCs.	Implementable	Retained for alternative development in combination with source removal.	Low capital costs Moderate OM&M costs
	Immobilization	In-Situ Stabilization/ Solidification (ISS): Excavator Bucket Mixing, Auger Mixing, and Pressure/Jet Grouting	Effective for meeting groundwater RAOs. Physically binds or encloses a COC mass and/or induces a chemical reaction between the stabilizing agent and the COCs to reduce their mobility within the subsurface and to decrease permeability of the mass so that groundwater does not contact the COCs. Pressure/Jet Grouting method may be less effective due to unpredictability in extent of ISS monolith.	Proven and implementable	Excavator bucket and auger mixing method retained for alternative development. Pressure/Jet grouting method not retained due to unpredictability in effective implementation, except in locations where mixing cannot be performed.	High capital costs Costs of ISS for saturated soils can be less than excavation/off-site disposal

Table 6-1
Technology Screening and Evaluation
Canastota Former MGP Site

General Response Action	Remedial Technology Type	Technology Process Option	Effectiveness	Implementability	Site-Specific Applicability and Screening Evaluation	Relative Cost
In-Situ Treatment (cont'd)	Transformation	In-Situ Chemical Oxidation (ISCO)	Effective for conductive soils without free product or high concentrations of contamination. It is not effective for highly impacted soils.	Implementable	Not retained. Site conditions inhibit effectiveness.	N/A; not retained
		Enhanced In-Situ Bioremediation	Inhibited by presence of fine-grained soils and highly impacted soils.			
	Organic Treatment	Air Sparging	Applicable where VOCs are predominant. Not effective for MGP-impacted groundwater because PAHs are not readily volatilized by air sparging.	Implementable	Not retained. Ineffective for MGP-impacted groundwater.	N/A; not retained
Removal	Excavation	Conventional excavation of soil containing source material or COCs/shored excavation	Effective at meeting soil RAOs and addressing groundwater RAOs through the removal of source material.	Proven and readily implemented for accessible soil	Retained for alternative development.	High capital costs
		Slurry Trench Excavation	Effective, but generally used for excavations deeper than the typical reach of an excavator, with flowing sand and artesian conditions. Requires additional equipment and more extensive dewatering and earth support structures.		Not retained. MGP impacts were not observed deeper than 24 feet. Subsurface soils containing COCs are within the typical reach of conventional and long-stick excavators.	N/A; not retained
Treatment and Disposal	Above-Ground Groundwater Treatment	Air-stripping, granular activated carbon, Chemical/UV Oxidation, discharge to POTW	Groundwater extraction would result in treatment of a very high volume of groundwater with low concentration of COCs. Without source removal, treating large amounts of groundwater is not effective.	Implementable	Not retained for alternative development as a remedial technology process, but may be used on construction water resulting from implementation of a source removal remedy.	N/A; not retained
	NAPL recovery	Wells	Not highly effective for achieving RAOs for soil or groundwater based on site conditions. Flowable NAPL has not been observed at the site and is not accumulating in monitoring wells.	Implementable	Not retained. Mobilizing NAPL may not be possible.	N/A; not retained
		Recovery Trenches				
	Enhanced Recovery	Thermal mobilization	Enhanced recovery methods have varying levels of effectiveness and generally cannot be easily controlled. Risk of contamination spreading to previously unimpacted areas is high.	Implementable	Not retained. Controlling movement of contaminants difficult.	N/A; not retained
		Chemical mobilization				
		Acoustic vibrations				

Table 6-1
Technology Screening and Evaluation
Canastota Former MGP Site

General Response Action	Remedial Technology Type	Technology Process Option	Effectiveness	Implementability	Site-Specific Applicability and Screening Evaluation	Relative Cost
Treatment and Disposal (cont'd)	Off-site treatment/ disposal	Off-site Landfill	Off-site disposal and treatment are highly effective for achieving soil RAOs, and groundwater RAOs over time.	Implementable	Retained for alternative development. A widely used conventional technology.	Moderate capital costs
		Low Temperature Thermal Desorption (LTTD)		Implementable	Retained for alternative development. A widely used conventional technology.	Moderate capital costs
		Waste-to-Energy		Implementable at limited capacity	Retained for alternative development. Potentially applicable for impacted site debris that is too large for LTTD. Capacity of facilities is limited and may not be applicable for bulk soil.	Moderate capital costs
		Chemical Treatment	Soil washing and chemical treatment by addition of oxidants is not generally effective for MGP-impacted soils.	Implementable	Not retained. Not applicable for MGP-impacted soils.	N/A; not retained
		Biological Treatment	Landfarming or soil windrow tilling is generally unavailable/ineffective for MGP-impacted soils.	Not implementable; facilities unavailable	Not retained. No active facilities are available for MGP-impacted soils.	N/A; not retained
	On-site treatment/ disposal	On-site Landfill	Effective, but impacted soil will remain on site (in a controlled location).	Implementable	Not retained. Not likely acceptable to current property owner and surrounding community.	N/A; not retained
		LTTD	On-site treatment highly effective for achieving soil RAOs, and groundwater RAOs over time.	Implementable	Not retained. Not likely acceptable to current property owner and surrounding community.	N/A; not retained
		Incineration		Implementable	Not retained. Not likely acceptable to current property owner and surrounding community.	N/A; not retained
		Chemical Treatment	Soil washing and chemical treatment by addition of oxidants is generally not effective for MGP-impacted soils.	Implementable	Not retained. Not applicable to MGP-impacted soils.	N/A; not retained
		Biological Treatment	Landfarming or soil windrow tilling to enhance biological treatment of MGP-impacted soils is generally not effective.	Implementable	Not retained. Not likely acceptable to current property owner and surrounding community.	N/A; not retained

Table 7-1
RAOs Addressed by Alternatives
Canastota Former MGP Site

Applicable Medium	RAOs	Remedial Alternative Alternative 1 No Action	Alternative 2 ISS of Subsurface Soil with Shallow Excavation, including MNA and IC/ECs	Alternative 3 Excavation of Soils Exceeding Commercial SCOs and Subsurface Structure Removal	Alternative 4 Excavation of Soils Exceeding Unrestricted Use SCOs and Subsurface Structure Removal
Soil	Prevent ingestion/direct contact with soil with COC levels exceeding the applicable SCOs Prevent inhalation of or exposure to COCs volatilizing from soil Prevent migration of COCs that would result in groundwater, surface water, or sediment impacts Prevent impacts to biota from ingestion/direct contact with soil causing toxicity	Not addressed	Addressed by this action	Addressed by this action	Addressed by this action
Groundwater	Prevent ingestion of groundwater with COC levels exceeding drinking water standards Prevent contact with, or inhalation of, volatiles from impacted groundwater Prevent the discharge of COCs to surface water or sediment Remove the source of ground or surface water impacts, to the extent practicable Restore groundwater aquifer to ambient groundwater quality criteria, to the extent practicable	Not addressed	Addressed by SMP with groundwater use restrictions	Addressed by this action	Addressed by this action

Table 7-2
Comparative Ranking of Alternatives
Canastota Former MGP Site

Alternative	Description	Threshold Criteria		Balancing Criteria						
		Overall Protection of Human Health and the Environment	Compliance with SCGs	Long-Term Effectiveness and Permanence	Reduction of Toxicity, Mobility, or Volume	Short-Term Effectiveness	Implement-ability	Total Cost (FS accuracy +50% / - 30%)	Cost Effectiveness	Land Use
1	No Action	Not Protective	Not Compliant	Not Effective	No Reduction	Not Effective	No Action	No Cost	No Cost	Not Supportive
2	ISS of Subsurface Soil with Shallow Excavation, including MNA and IC/Ecs	3rd	3rd	3rd	3rd	1st	1st	$7,400,000	1st	1st
3	Excavation of Soils Exceeding Commercial SCOs and Subsurface Structure Removal	2nd	2nd	2nd	2nd	2nd	2nd	$11,000,000	2nd	1st
4	Excavation of Soils Exceeding Unrestricted Use SCOs and Subsurface Structure Removal	1st	1st	1st	1st	3rd	3rd	$12,900,000	3rd	1st

Comparative Ranking:

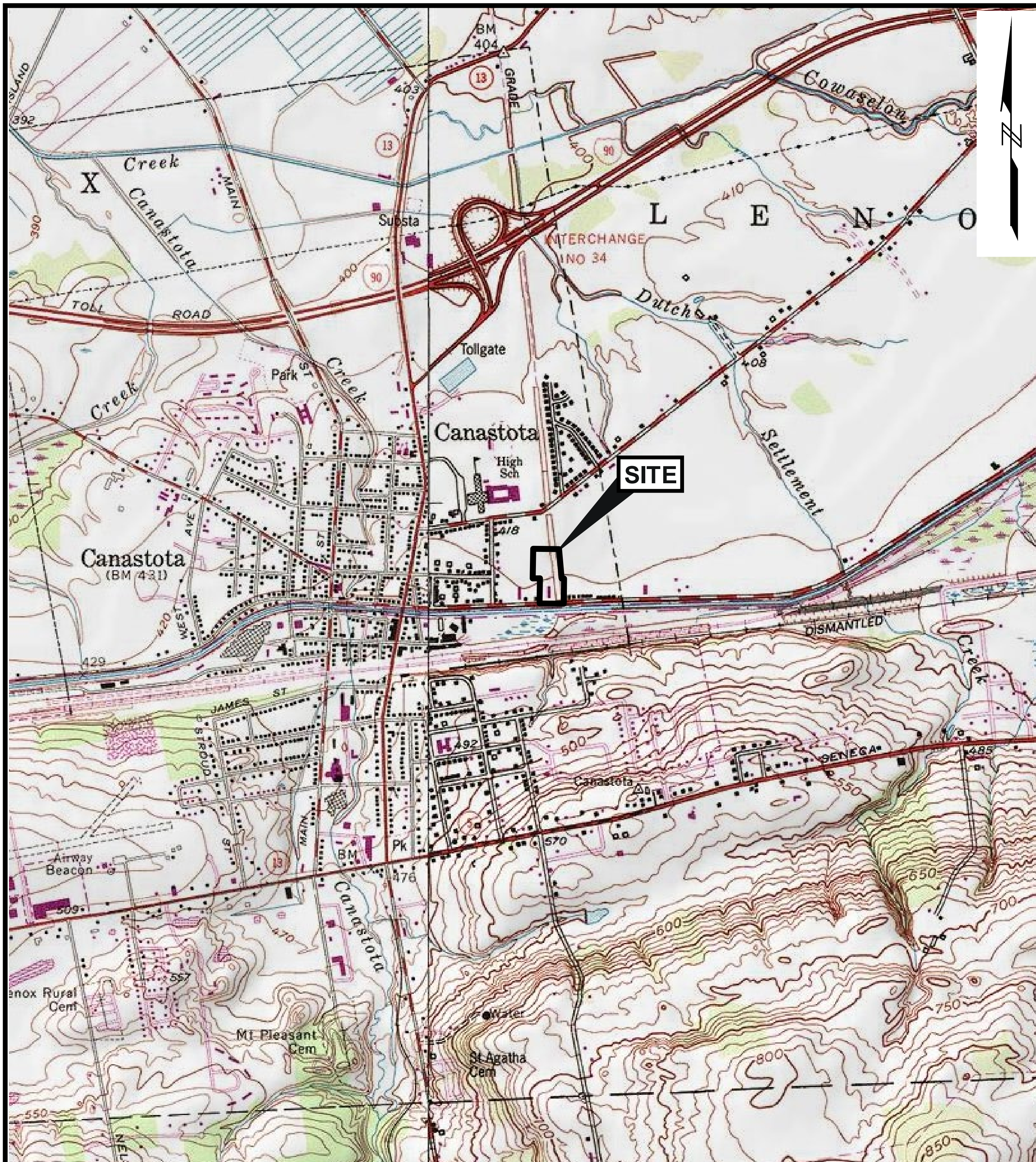
1st - Ranked First, Best
2nd - Ranked Second
3rd - Ranked Third
Duplicate ranks indicate equivalent ranking.

Table 7-3
Metrics Relevant to Short-Term Impacts
Canastota Former MGP Site

Alternative	Description	Descriptors of Short-Term Impacts and Effectiveness of Controls				
		Duration of Construction	Volume Soil Excavated (CY)	Volume of Soils Treated by ISS (CY)	Volume Backfilled (CY)	Total Truck Trips Required
1	No Action	None	None	None	None	None
2	ISS of Subsurface Soil with Shallow Excavation, including MNA and IC/ECs	9	7,000	4,800	8,100	1,160
3	Excavation of Soils Exceeding Commercial SCOs and Subsurface Structure Removal	12	14,900	0	19,400	2,640
4	Excavation of Soils Exceeding Unrestricted Use SCOs and Subsurface Structure Removal	14	27,700	0	36,000	4,900

Notes:
Under Alternative 2, assumes 20% bulking of ISS soils equates to 20% less backfill needed.
CY - in-place cubic yards

Figures



SOURCE:
Map created with TOPO! ® ©2001 National Geographic
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SCALE, FEET

Feasibility Study
Canastota Non-owned Former MGP Site
Canastota, New York

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SITE LOCATION MAP

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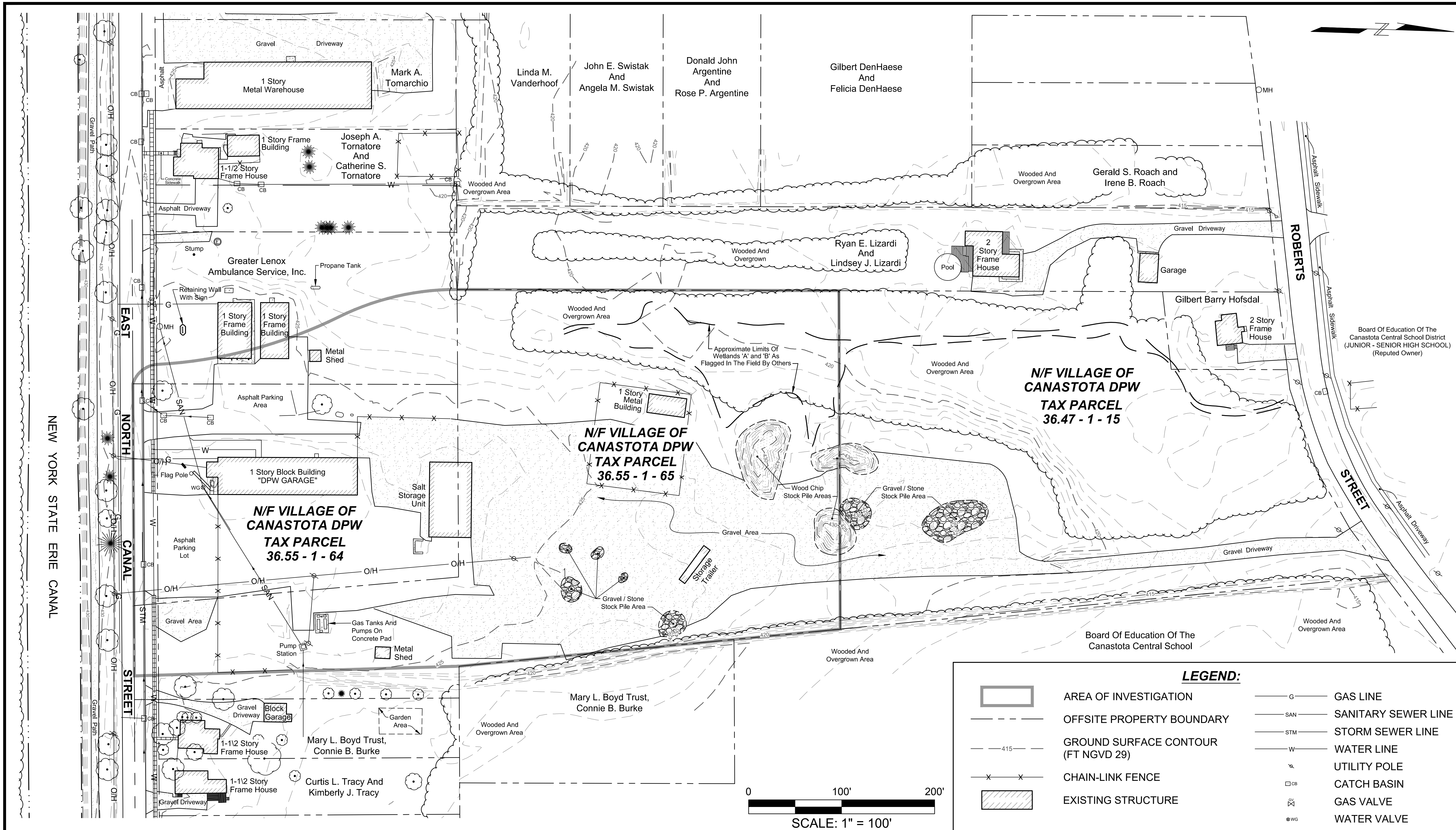

SOURCES:

1. PLAN BASED ON SURVEY MAPS SHEETS 1 AND 2: *LANDS OF VILLAGE OF CANASTOTA, NORTHEAST CANAL STREET AND ROBERTS STREET, BEING PART OF LOT # 86 OF THE CANASTOTA TRACT, VILLAGE OF CANASTOTA - MADISON COUNTY, STATE OF NEW YORK,* PREPARED BY DELTA ENGINEERS, ARCHITECTS & LAND SURVEYORS, 4873 NEW YORK STATE ROUTE #5, VERNON, NY, SCALE: 1" = 30, DATE: 2/10/2010, LAST REVISED JANUARY 20, 2011.
2. 1911 SANBORN FIRE INSURANCE MAP.

NOTES:

1. HORIZONTAL DATUM: NEW YORK STATE PLANE COORDINATE SYSTEM, CENTRAL ZONE, (NAD 83).
2. VERTICAL DATUM: NATIONAL GEODETIC VERTICAL DATUM OF 1929 (NGVD 29).
3. LOCATIONS OF SOME HISTORIC FEATURES ADJUSTED BASED ON FIELD OBSERVATIONS.

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CURRENT SITE LAYOUT

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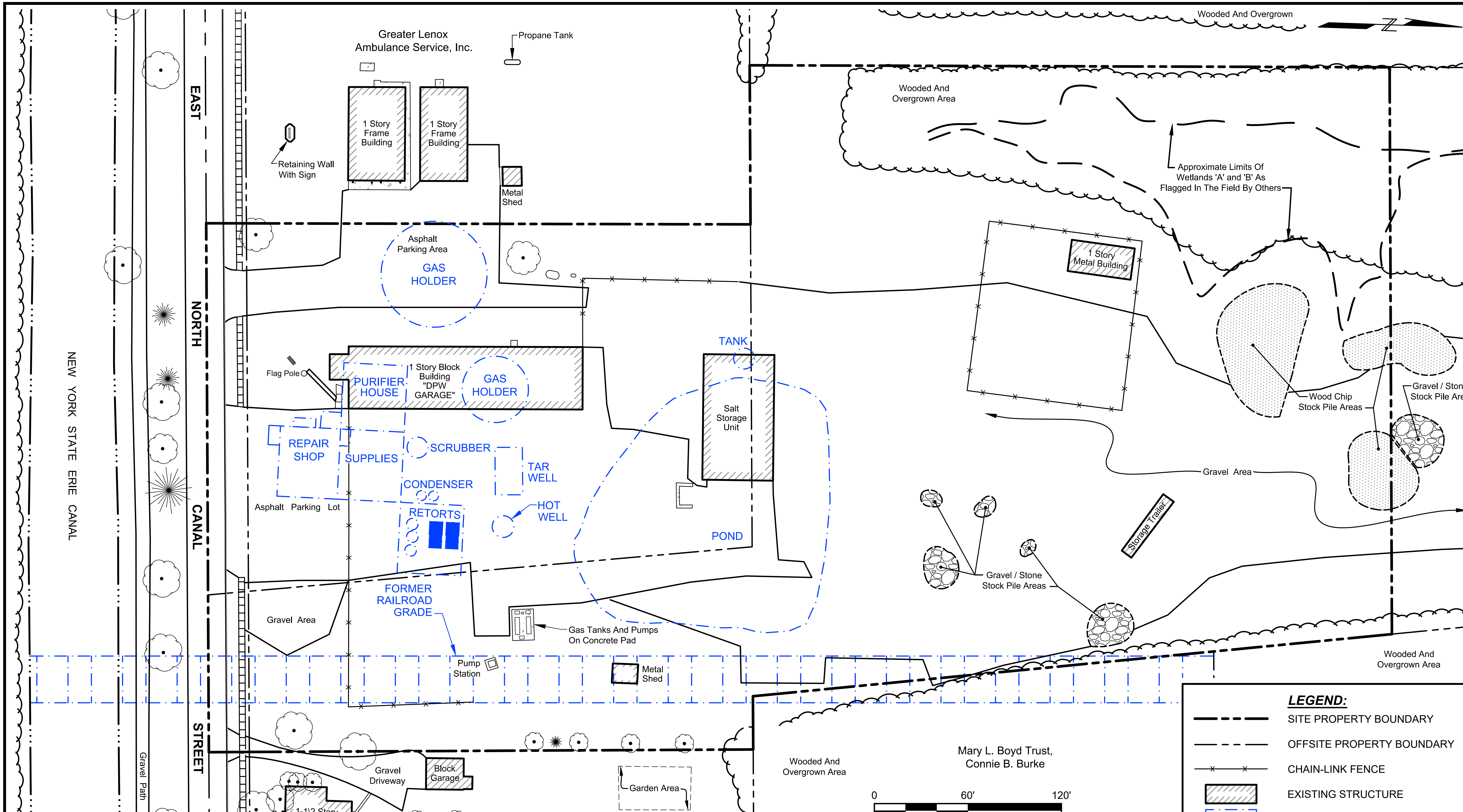

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3. LOCATIONS OF SOME HISTORIC FEATURES ADJUSTED BASED ON FIELD OBSERVATIONS.

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HISTORICAL SITE FEATURES

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SOURCES:

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2. 1911 SANBORN FIRE INSURANCE MAP.

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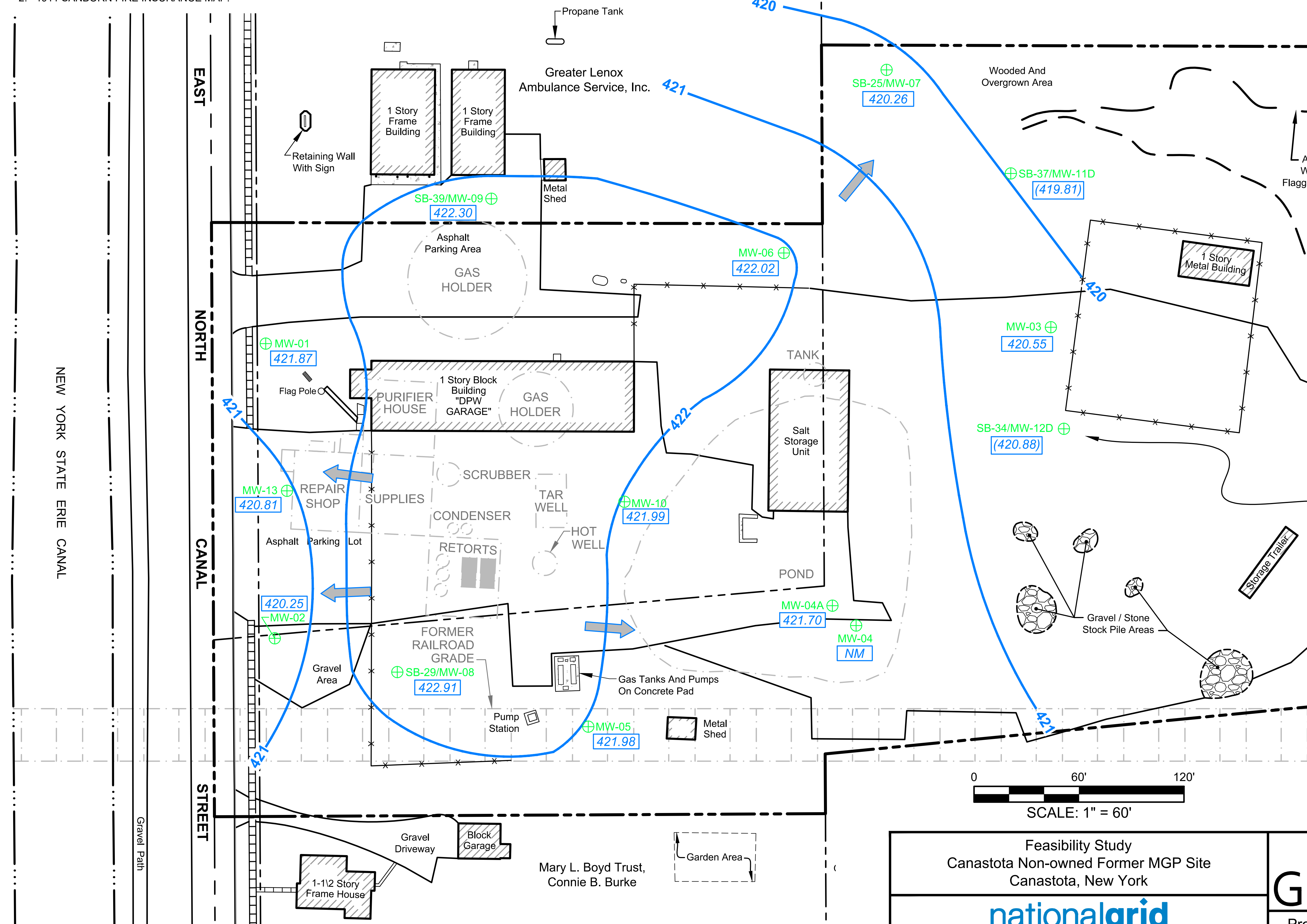

LEGEND:

- SITE PROPERTY BOUNDARY
- OFFSITE PROPERTY BOUNDARY
- CHAIN-LINK FENCE
- EXISTING STRUCTURE
- HISTORIC STRUCTURE
- MW-01 MONITORING WELL
- 419.02 GROUNDWATER ELEVATION (FEET)
- NM ELEVATION NOT MEASURED
- 419 GROUNDWATER ELEVATION CONTOUR (FEET)
- GENERALIZED GROUNDWATER FLOW DIRECTION

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GROUNDWATER CONTOUR MAP (SEPTEMBER 25, 2014)

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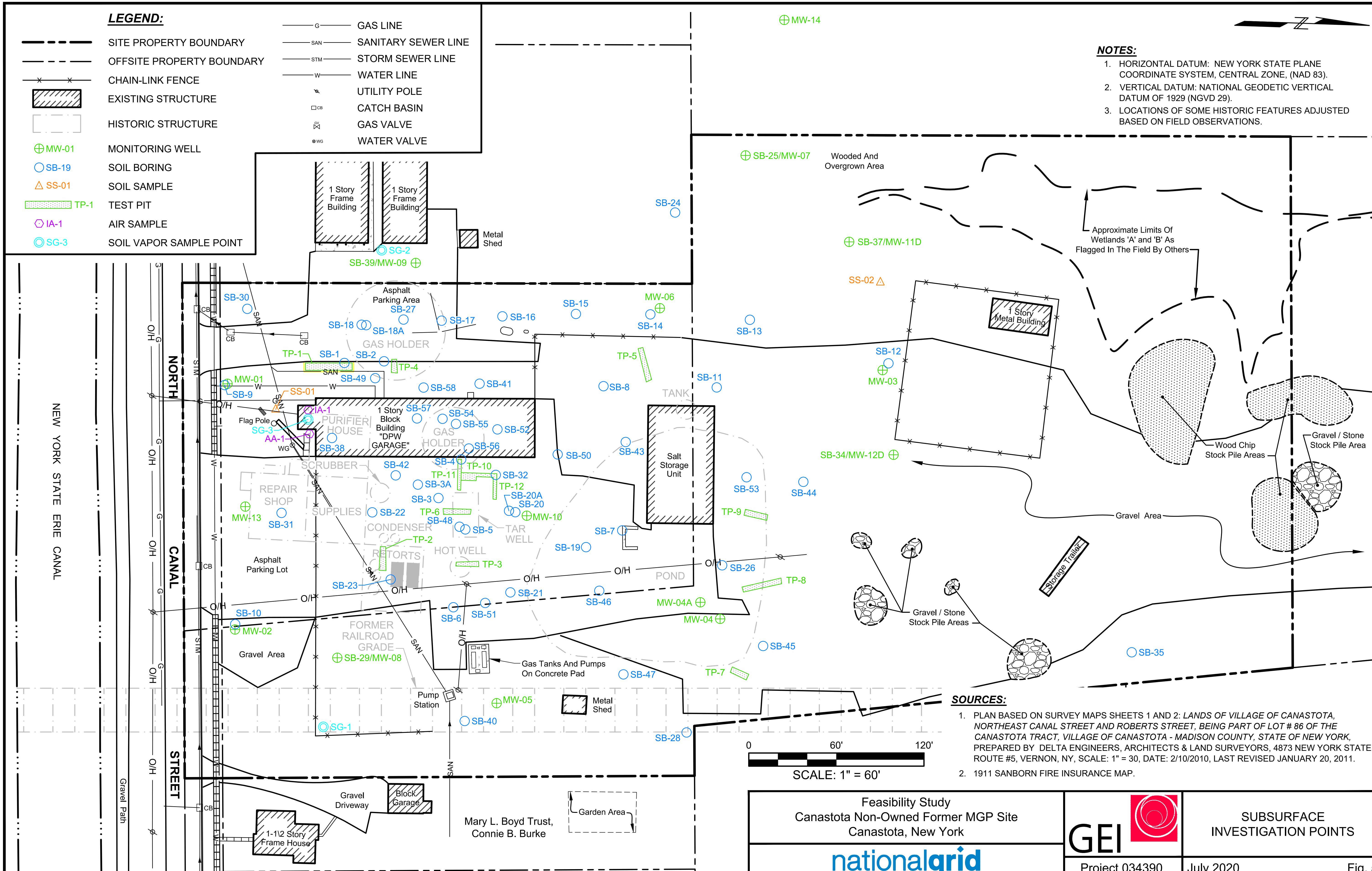

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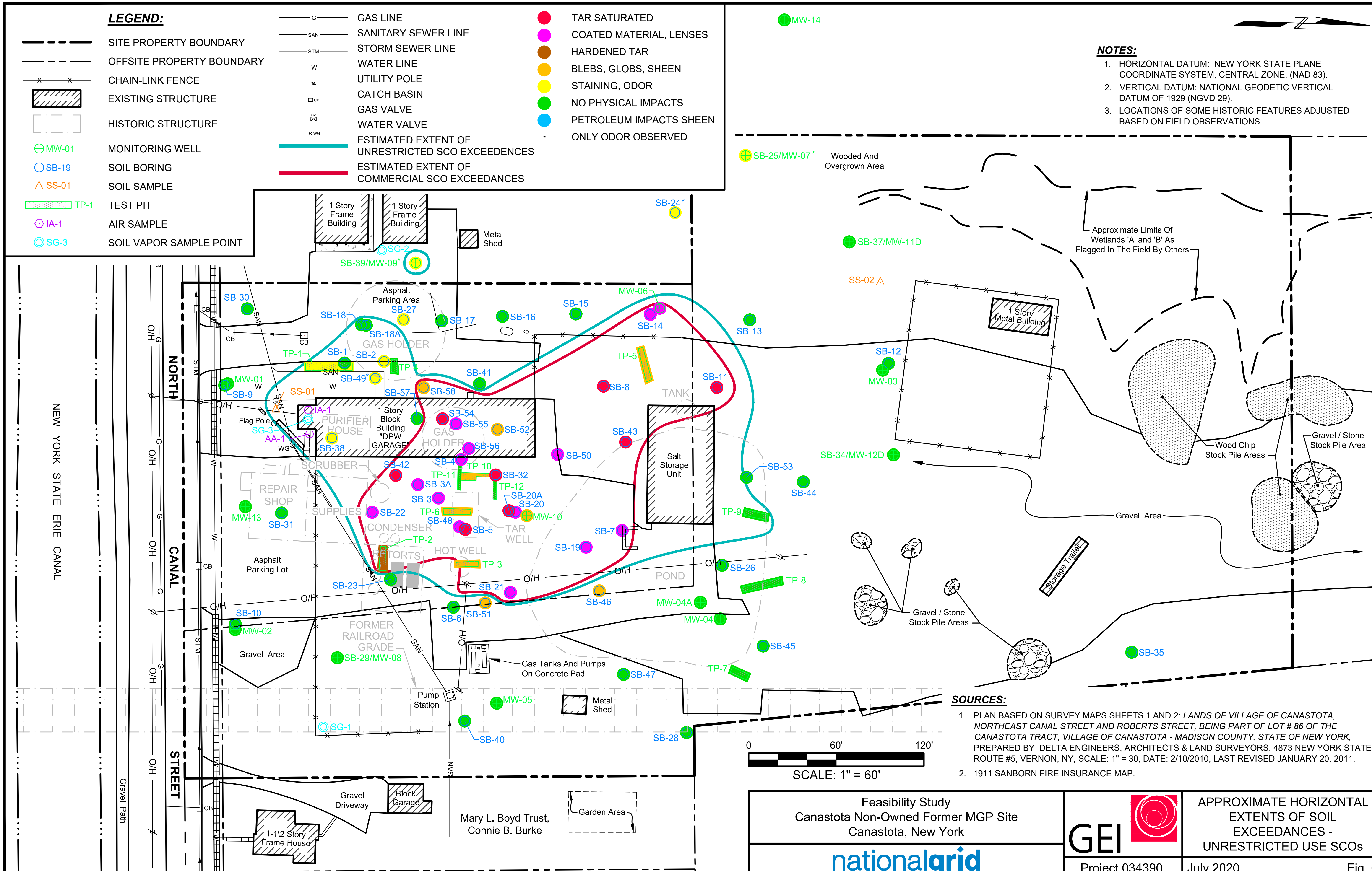

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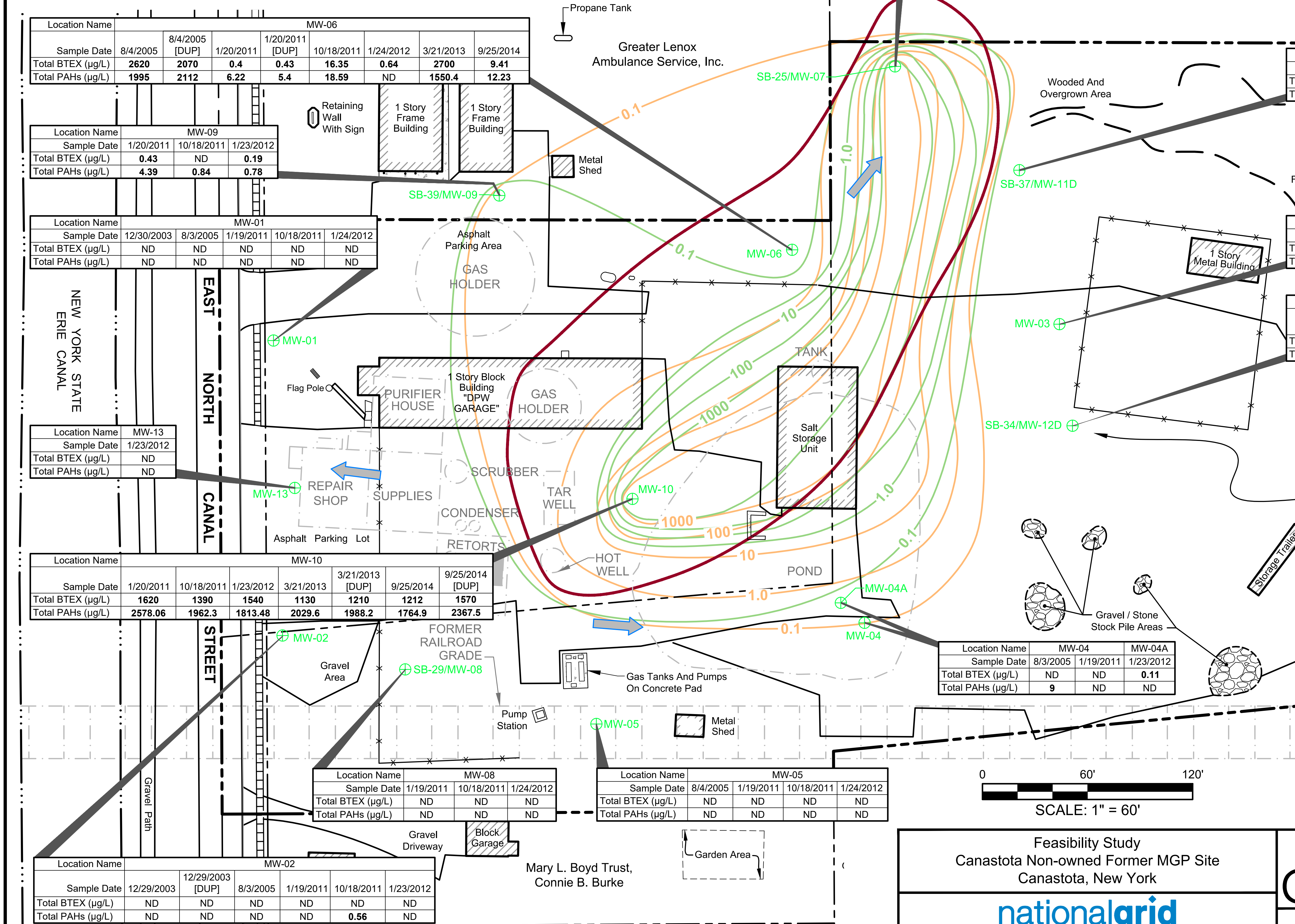

Location Name	MW-14
Sample Date	9/25/2014
Total BTEX (µg/L)	ND
Total PAHs (µg/L)	ND

Location Name	MW-07					
Sample Date	1/20/2011	10/19/2011	1/23/2012	1/23/2012 [DUP]	3/21/2013	9/25/2014
Total BTEX (µg/L)	**0.44**	**6030**	**4570**	**5380**	**2205**	**8190**
Total PAHs (µg/L)	**3.73**	**3655.6**	**1026.4**	**1643.8**	**445.06**	**1972.3**

Location Name	MW-06							
Sample Date	8/4/2005	8/4/2005 [DUP]	1/20/2011	1/20/2011 [DUP]	10/18/2011	1/24/2012	3/21/2013	9/25/2014
Total BTEX (µg/L)	**2620**	**2070**	**0.4**	**0.43**	**16.35**	**0.64**	**2700**	**9.41**
Total PAHs (µg/L)	**1995**	**2112**	**6.22**	**5.4**	**18.59**	ND	**1550.4**	**12.23**

Location Name	MW-09		
Sample Date	1/20/2011	10/18/2011	1/23/2012
Total BTEX (µg/L)	**0.43**	ND	**0.19**
Total PAHs (µg/L)	**4.39**	**0.84**	**0.78**

Location Name	MW-11D		
Sample Date	1/20/2011	10/19/2011	1/23/2012
Total BTEX (µg/L)	ND	ND	ND
Total PAHs (µg/L)	ND	ND	ND

Location Name	MW-01				
Sample Date	12/30/2003	8/3/2005	1/19/2011	10/18/2011	1/24/2012
Total BTEX (µg/L)	ND	ND	ND	ND	ND
Total PAHs (µg/L)	ND	ND	ND	ND	ND

Location Name	MW-03				
Sample Date	12/30/2003	8/3/2005	1/19/2011	10/19/2011	1/24/2012
Total BTEX (µg/L)	ND	ND	ND	ND	ND
Total PAHs (µg/L)	ND	ND	ND	ND	ND

Location Name	MW-12D			
Sample Date	1/19/2011	10/19/2011	10/19/2011 [DUP]	1/24/2012
Total BTEX (µg/L)	ND	ND	ND	ND
Total PAHs (µg/L)	ND	ND	ND	ND

Location Name	MW-13
Sample Date	1/23/2012
Total BTEX (µg/L)	ND
Total PAHs (µg/L)	ND

Location Name	MW-10						
Sample Date	1/20/2011	10/18/2011	1/23/2012	3/21/2013	3/21/2013 [DUP]	9/25/2014	9/25/2014 [DUP]
Total BTEX (µg/L)	**1620**	**1390**	**1540**	**1130**	**1210**	**1212**	**1570**
Total PAHs (µg/L)	**2578.06**	**1962.3**	**1813.48**	**2029.6**	**1988.2**	**1764.9**	**2367.5**

Location Name	MW-04		MW-04A
Sample Date	8/3/2005	1/19/2011	1/23/2012
Total BTEX (µg/L)	ND	ND	**0.11**
Total PAHs (µg/L)	**9**	ND	ND

Location Name	MW-08		
Sample Date	1/19/2011	10/18/2011	1/24/2012
Total BTEX (µg/L)	ND	ND	ND
Total PAHs (µg/L)	ND	ND	ND

Location Name	MW-05			
Sample Date	8/4/2005	1/19/2011	10/18/2011	1/24/2012
Total BTEX (µg/L)	ND	ND	ND	ND
Total PAHs (µg/L)	ND	ND	ND	ND

Location Name	MW-02					
Sample Date	12/29/2003	12/29/2003 [DUP]	8/3/2005	1/19/2011	10/18/2011	1/23/2012
Total BTEX (µg/L)	ND	ND	ND	ND	ND	ND
Total PAHs (µg/L)	ND	ND	ND	ND	**0.56**	ND

LEGEND:

	SITE PROPERTY BOUNDARY
	OFFSITE PROPERTY BOUNDARY
	CHAIN-LINK FENCE
	EXISTING STRUCTURE
	HISTORIC STRUCTURE
MW-01	MONITORING WELL
	ESTIMATED EXTENT OF NYSDEC AMBIENT WATER QUALITY STANDARDS EXCEEDANCES
	GENERALIZED GROUNDWATER FLOW DIRECTION
ND	NOT DETECTED
BTEX	BENZENE, TOLUENE, ETHYLBENZENE, XYLENES
PAHs	POLYCYCLIC AROMATIC HYDROCARBONS
µg/L	MICROGRAMS PER LITER
0.11	BOLD INDICATES DETECTED COMPOUNDS
0.1	TOTAL BTEX ISOCONCENTRATION (µg/L) (JANUARY 2012)
0.1	TOTAL PAHs ISOCONCENTRATION (µg/L) (JANUARY 2012)

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Canastota, New York

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APPROXIMATE EXTENT OF NYSDEC AMBIENT WATER QUALITY STANDARDS EXCEEDANCES

Project 034390 | July 2020 | Fig. 7

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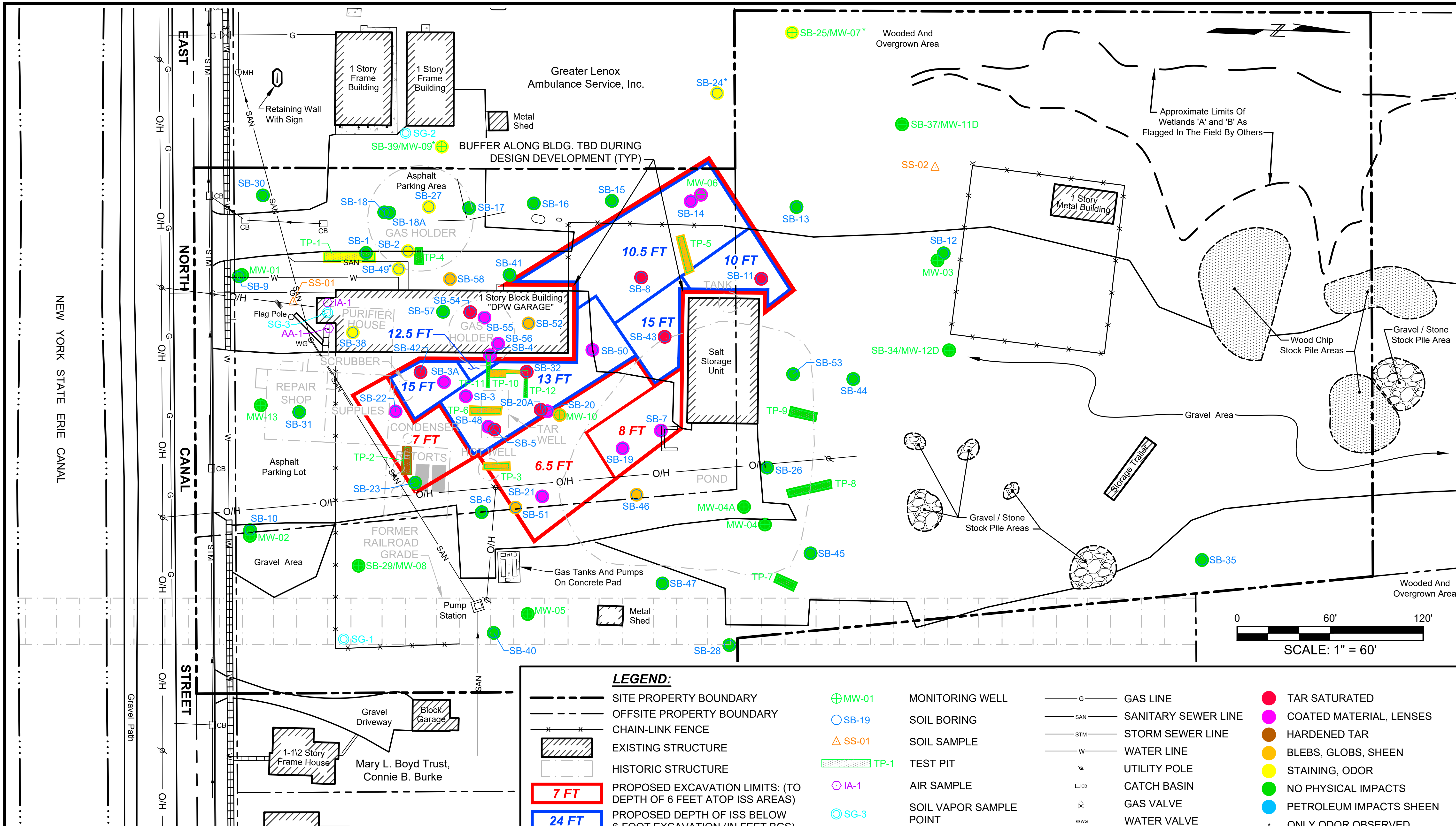

LEGEND:

SITE PROPERTY BOUNDARY	MW-01	MONITORING WELL	G	GAS LINE	TAR SATURATED
OFFSITE PROPERTY BOUNDARY	SB-19	SOIL BORING	SAN	SANITARY SEWER LINE	COATED MATERIAL, LENSES
CHAIN-LINK FENCE	SS-01	SOIL SAMPLE	STM	STORM SEWER LINE	HARDENED TAR
EXISTING STRUCTURE	TP-1	TEST PIT	W	WATER LINE	BLEBS, GLOBS, SHEEN
HISTORIC STRUCTURE	IA-1	AIR SAMPLE		UTILITY POLE	STAINING, ODOR
7 FT — PROPOSED EXCAVATION LIMITS: (TO DEPTH OF 6 FEET ATOP ISS AREAS)	SG-3	SOIL VAPOR SAMPLE POINT	CB	CATCH BASIN	NO PHYSICAL IMPACTS
24 FT — PROPOSED DEPTH OF ISS BELOW 6-FOOT EXCAVATION (IN FEET BGS)				GAS VALVE	PETROLEUM IMPACTS SHEEN
			WG	WATER VALVE	ONLY ODOR OBSERVED

SOURCES:

1. PLAN BASED ON SURVEY MAPS SHEETS 1 AND 2: *LANDS OF VILLAGE OF CANASTOTA, NORTHEAST CANAL STREET AND ROBERTS STREET, BEING PART OF LOT # 86 OF THE CANASTOTA TRACT, VILLAGE OF CANASTOTA - MADISON COUNTY, STATE OF NEW YORK*, PREPARED BY DELTA ENGINEERS, ARCHITECTS & LAND SURVEYORS, 4873 NEW YORK STATE ROUTE #5, VERNON, NY, SCALE: 1" = 30, DATE: 2/10/2010, LAST REVISED JANUARY 20, 2011.
2. 1911 SANBORN FIRE INSURANCE MAP.

NOTES:

1. HORIZONTAL DATUM: NEW YORK STATE PLANE COORDINATE SYSTEM, CENTRAL ZONE, (NAD 83).
2. VERTICAL DATUM: NATIONAL GEODETIC VERTICAL DATUM OF 1929 (NGVD 29).
3. LOCATIONS OF SOME HISTORIC FEATURES ADJUSTED BASED ON FIELD OBSERVATIONS.

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ALTERNATIVE 2 - SOIL REMOVAL TO 6FT DEEP & ISS DEEPER IMPACTS

Project 034390 | July 2020 | Fig. 8

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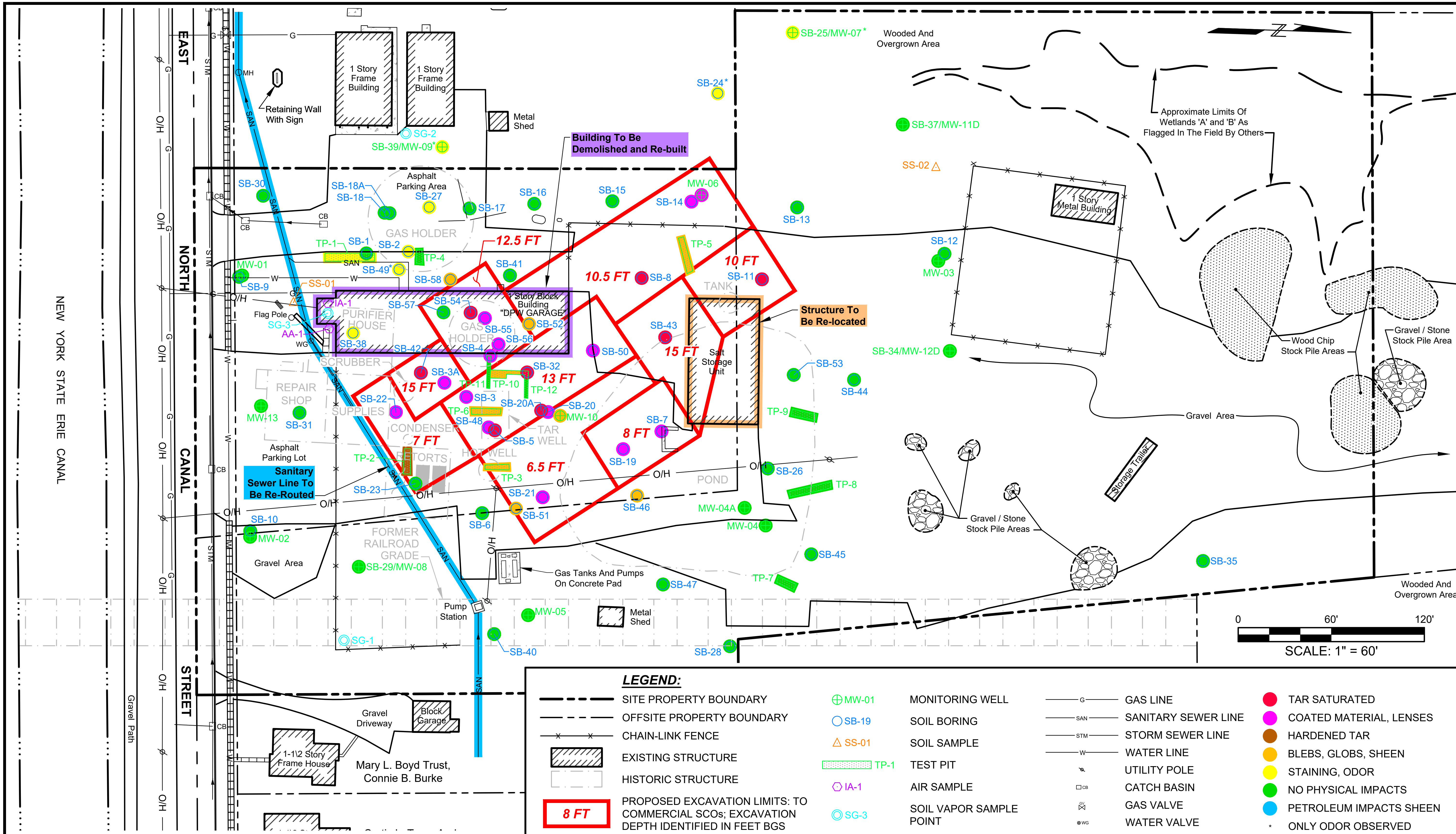

LEGEND:

	SITE PROPERTY BOUNDARY
	OFFSITE PROPERTY BOUNDARY
	CHAIN-LINK FENCE
	EXISTING STRUCTURE
	HISTORIC STRUCTURE
8 FT	PROPOSED EXCAVATION LIMITS: TO COMMERCIAL SCOs; EXCAVATION DEPTH IDENTIFIED IN FEET BGS
MW-01	MONITORING WELL
SB-19	SOIL BORING
SS-01	SOIL SAMPLE
TP-1	TEST PIT
IA-1	AIR SAMPLE
SG-3	SOIL VAPOR SAMPLE POINT
G	GAS LINE
SAN	SANITARY SEWER LINE
STM	STORM SEWER LINE
W	WATER LINE
	UTILITY POLE
CB	CATCH BASIN
	GAS VALVE
WG	WATER VALVE
	TAR SATURATED
	COATED MATERIAL, LENSES
	HARDENED TAR
	BLEBS, GLOBS, SHEEN
	STAINING, ODOR
	NO PHYSICAL IMPACTS
	PETROLEUM IMPACTS SHEEN
	ONLY ODOR OBSERVED

SOURCES:

1. PLAN BASED ON SURVEY MAPS SHEETS 1 AND 2: *LANDS OF VILLAGE OF CANASTOTA, NORTHEAST CANAL STREET AND ROBERTS STREET, BEING PART OF LOT # 86 OF THE CANASTOTA TRACT, VILLAGE OF CANASTOTA - MADISON COUNTY, STATE OF NEW YORK*, PREPARED BY DELTA ENGINEERS, ARCHITECTS & LAND SURVEYORS, 4873 NEW YORK STATE ROUTE #5, VERNON, NY, SCALE: 1" = 30, DATE: 2/10/2010, LAST REVISED JANUARY 20, 2011.
2. 1911 SANBORN FIRE INSURANCE MAP.

NOTES:

1. HORIZONTAL DATUM: NEW YORK STATE PLANE COORDINATE SYSTEM, CENTRAL ZONE, (NAD 83).
2. VERTICAL DATUM: NATIONAL GEODETIC VERTICAL DATUM OF 1929 (NGVD 29).
3. LOCATIONS OF SOME HISTORIC FEATURES ADJUSTED BASED ON FIELD OBSERVATIONS.

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ALTERNATIVE 3 - SOIL REMOVAL (COMMERCIAL USE)

Project 034390 | July 2020 | Fig. 9

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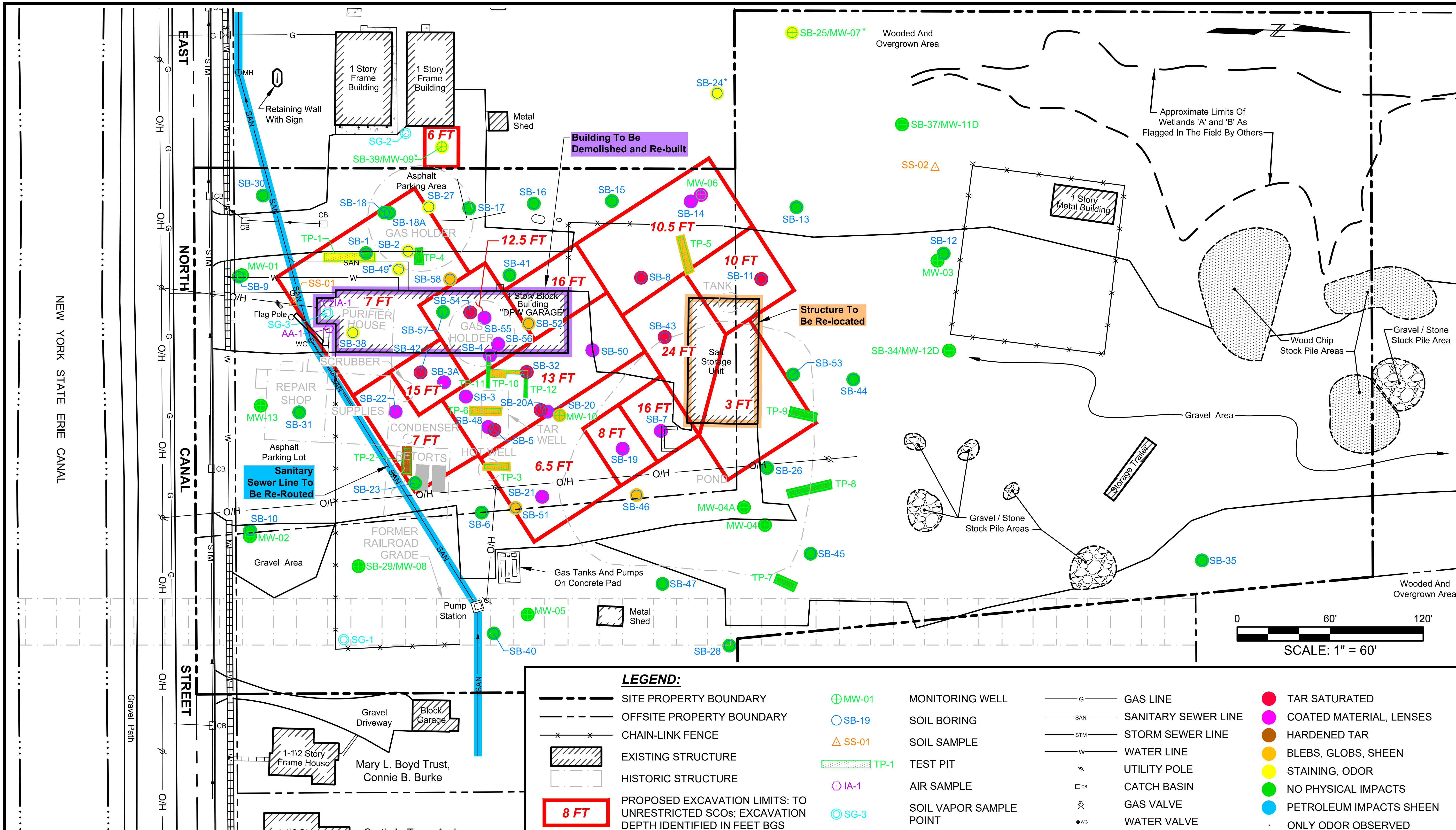

SOURCES:

1. PLAN BASED ON SURVEY MAPS SHEETS 1 AND 2: *LANDS OF VILLAGE OF CANASTOTA, NORTHEAST CANAL STREET AND ROBERTS STREET, BEING PART OF LOT # 86 OF THE CANASTOTA TRACT, VILLAGE OF CANASTOTA - MADISON COUNTY, STATE OF NEW YORK,* PREPARED BY DELTA ENGINEERS, ARCHITECTS & LAND SURVEYORS, 4873 NEW YORK STATE ROUTE #5, VERNON, NY, SCALE: 1" = 30, DATE: 2/10/2010, LAST REVISED JANUARY 20, 2011.
2. 1911 SANBORN FIRE INSURANCE MAP.

NOTES:

1. HORIZONTAL DATUM: NEW YORK STATE PLANE COORDINATE SYSTEM, CENTRAL ZONE, (NAD 83).
2. VERTICAL DATUM: NATIONAL GEODETIC VERTICAL DATUM OF 1929 (NGVD 29).
3. LOCATIONS OF SOME HISTORIC FEATURES ADJUSTED BASED ON FIELD OBSERVATIONS.

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ALTERNATIVE 4 -
SOIL REMOVAL
(UNRESTRICTED USE)

Project 034390 | July 2020 | Fig. 10

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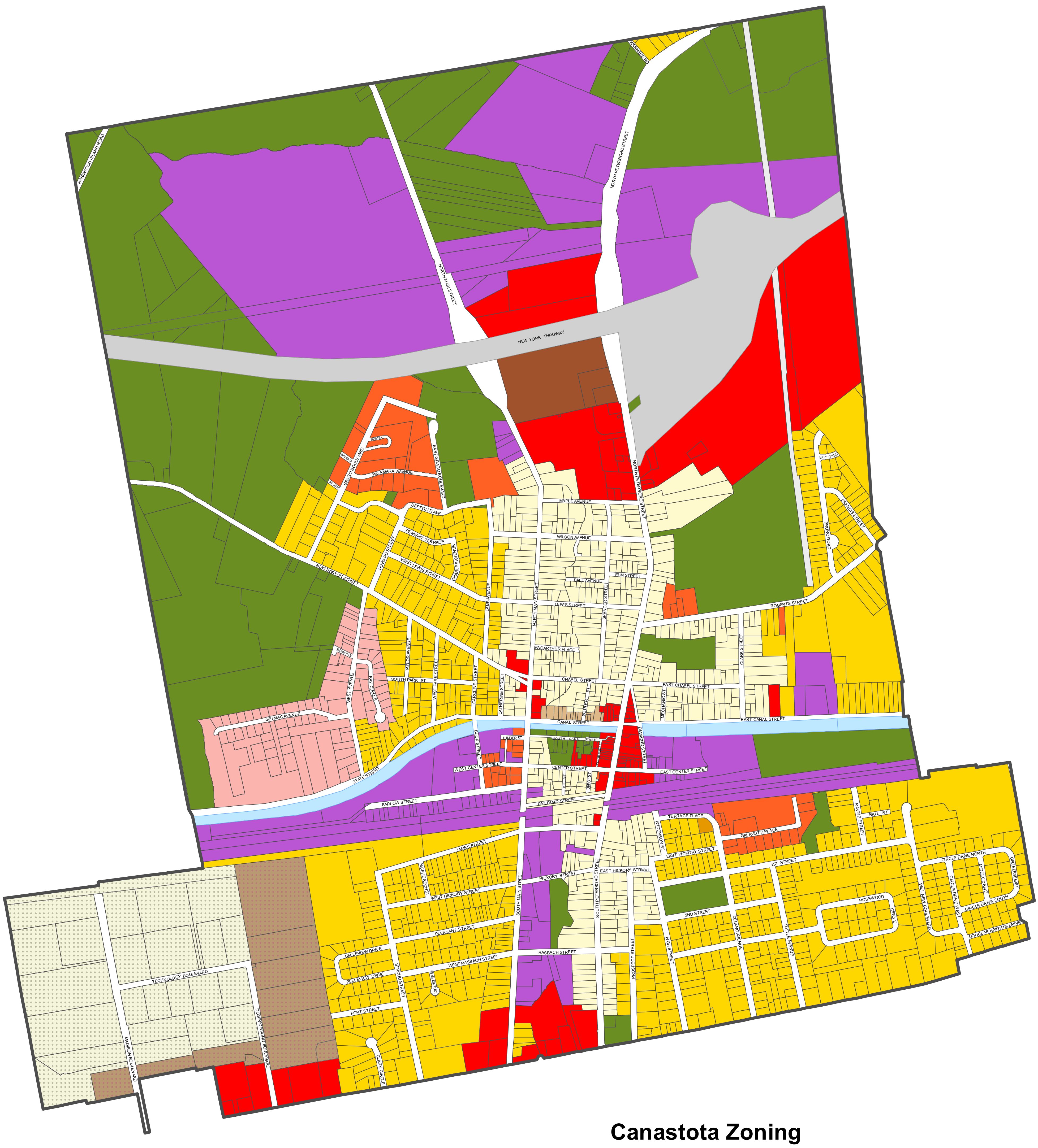
Appendix A

Zoning and Property Use Information

Village of Canastota Zoning



Canastota Zoning

- Village Boundary
- Erie Canal
- National Grid Land
- NY Thruway Land

- AG — Agricultural District
- CM — Commercial District
- HP — Historic Preservation District
- IN — Industrial District
- INP-A — Industrial Park Development District A
- INP-B — Industrial Park Development District B
- MH — Mobile Home District
- PD — Planned Development District
- R1 — Residential 1 District
- R2 — Residential 2 District
- RM — Multiple Resident District

N

0 0.125 0.25 0.5 Miles

MVGIS
Utica, NY

November 2017

Appendix B

Remedial Alternative Volume Estimates

Soil Exceeding Unrestricted SCOs	Area (ft^2)	Avg. Depth (ft)	Total Volume (yd^3)
Overall Area	52945	9.5	18629
Deeper impacts around SB43	2592	14.5	1392
Deeper impacts around SB-52	1664	6.5	401
Total			20421

Notes

1. Depths range from 3 feet deep to 24 feet deep. See Figure 10 for detailed portrayal of depths of soil exceeding Unrestricted SCOs.
2. See Figure 6 for boundary of impacted soil area.

Soils Exceeding Commercial SCOs	Area (ft^2)	Avg. Depth (ft)	Volume (yd^3)
Overall Area	31720	13	15272

Notes

1. Depths range from 6.5 feet deep to 15 feet deep. See Figure 9 for detailed portrayal of depths of soil exceeding Commercial SCOs.
2. See Figure 6 for boundary of impacted soil area.

ISS Alternative	Area (ft^2)	Depth (ft)	Volume (yd^3)
Soil to be Excavated	26532	6 to 8	6890
Soil to be Treated using ISS	16272	4 to 15	4774
ISS swell	16272	2	1205
Inaccessible Impacted Soil (beneath buildings)	5188	10.5 to 15	3609

Notes

1. Depths to be treated using ISS range from 6 feet deep to 15 feet deep. See Figure 8 for detailed portrayal of depths of soil to be excavated and to be treated using ISS.
2. See Figure 6 for boundary of impacted soil area.

Impacted Groundwater	Quantity	Unit
Soil Impacted Area	28836	ft^2
Downgradient Area	19728	ft^2
Total	48564	ft^2
Average Depth of Impacts Below Water Table	9	ft
Soil Porosity	25%	%
Cubic feet to gallon conversion	7.48	-
Volume of impacted groundwater	839949	gal

Notes

1. See Figure 7 for boundary of impacted groundwater area.

Appendix C

Remedial Alternative Cost Estimates

NATIONAL GRID – CANASTOTA
Appendix C. PRELIMINARY ENGINEER’S ESTIMATE - Alternative 2 In Situ Solidification
11/5/2020

DIRECT CAPITAL COSTS					
Item	**Task**	**Quantity**	**Unit**	**Unit Cost**	**Total Cost**
1	Pre-Design Investigation	1	Lump Sum	$ 225,000	$ 225,000
2	Temporary re-location of DPW building personnel, equipment, and services	11.0	Month	$ 15,000	$ 165,000
3	Site Controls	1	Lump Sum	$ 20,000	$ 20,000
4	CAMP	8.0	Month	$ 16,000	$ 128,000
5	Surveying	1	Lump Sum	$ 50,000	$ 50,000
6	Odor and Dust Suppressant	8.0	Month	$ 21,000	$ 168,000
7	Relocation of Utilities/Fueling Station	1	Lump Sum	$ 65,000	$ 65,000
8	Well Decommissioning	2	Well	$ 2,500	$ 5,000
9	Dewatering Equipment Mobilization	1	Lump Sum	$ 250,000	$ 250,000
10	Dewatering Treatment OM&M	6.5	Month	$ 30,000	$ 195,000
11	Dewatering Equipment Demobilization	1	Lump Sum	$ 50,000	$ 50,000
12	Foundation Underpinning	1	Lump Sum	$ 150,000	$ 150,000
13	Excavation Support	9813	Square Foot	$ 90	$ 883,170
14	Overburden Excavation (0-4.5')	4864	Cubic Yard	$ 20	$ 97,280
15	Excavation of Tar Well/Tar Separator	150	Cubic Yard	$ 35	$ 5,250
16	T&D of Gas Holder, Tar Well/Tar Separator, etc	240	Ton	$ 95	$ 22,800
17	Impacted Material Excavation (4.5'-max 8')	2025	Cubic Yard	$ 20	$ 40,500
18	Bucket Mix ISS (6'-24')	4774	Cubic Yard	$ 100	$ 477,400
19	Soil-Drying Agent for ESMI T&D	65	Ton	$ 200	$ 12,960
20	Transport/Thermal Treatment of Soil	1361	Ton	$ 95	$ 129,276
21	Transport of Soil to Landfill	10490	Ton	$ 55	$ 576,963
22	Imported Backfill	6592	Cubic Yard	$ 35	$ 230,720
23	Restore site cover	26532	Square Foot	$ 11	$ 291,852
24	Contractor Project Support	9.0	Month	$ 28,000	$ 252,000
25	Remediation Mobilization/Demobilization	15%	% of Costs	$ 4,491,171	$ 673,676
26	Engineering Design/Support	15%	% of Costs	$ 4,491,171	$ 673,676
27	Construction Management	15%	% of Costs	$ 4,491,171	$ 673,676
28	Performance and Payment Bonds	3%	% of Costs	$ 4,491,171	$ 134,735
29	Contingency	20%	% of Costs	$ 4,491,171	$ 898,234
	TOTAL DIRECT CAPITAL COSTS				**$ 7,545,168**

SHORT-TERM O&M					
Item	**Task**	**Quantity**	**Unit**	**Rounded**	**Total NPV Cost**
30	Semi-Annual GW Monitoring Net Present Value	5	Year	$ 27,000	$123,652.09
	TOTAL SHORT-TERM O&M NPV COSTS				**$ 123,652**

LONG-TERM O&M					
Item	**Task**	**Quantity**	**Unit**	**Rounded**	**Total NPV Cost**
31	Inspection and maintenance of Engineering and Institutional Controls Net Present Value	30	Year	$ 14,000	$274,406.18
	TOTAL LONG-TERM O&M NPV COSTS				**$ 274,406**

TOTAL COSTS		
Item	**Task**	**Total Cost**
1	TOTAL DIRECT CAPITAL COSTS	$ 7,545,168
2	TOTAL SHORT-TERM O&M NPV COSTS	$ 123,652
3	TOTAL LONG-TERM O&M NPV COSTS	$ 274,406
	GRAND TOTAL	**$ 7,943,226**

Notes
1. Lump Sum costs are based either on previous GEI project experience or RS Means. OM&M costs are based on previous GEI experience.
2. The project will require excavation support.
3. It is assumed that soil excavated from the overburden (0-4.5 feet bgs) will be disposed of in a landfill. An additional 10% of ISS volume was added for spoil disposal.
4. It is assumed that 40% of deeper excavated soils (4.5 to up to 8 feet bgs) will be require thermal desorption and the remaining 60% can be transported to a landfill.
5. The soil drying agent is conservatively calculated as 5% of the expected impacted material since most of the excavation is above the water table.
6. ISS volume takes the impacted soil area plus 20% to account for overlap in ISS mixing areas.
7. It is assumed that it will not be logistically feasible to segregate soil for reuse as backfill.
8. This estimate assumes that the salt storage bunker, utilities and fueling station will remain in place. The DPW garage will remain in place and be supported during excavation.
9. Backfill volume accounts for 30% compaction.
10. Lines 25 through 29 are calculated as a percentage of costs (Lines 1 through 24).
11. NPV assumes a 3% discount factor
12. Estimate provided is within the +50%/-30% range.

NATIONAL GRID – CANASTOTA
Appendix C. PRELIMINARY ENGINEER'S ESTIMATE - Alternative 3 Excavation to Commercial SCOs
11/5/2020

DIRECT CAPITAL COSTS					
Item	**Task**	**Quantity**	**Unit**	**Unit Cost**	**Total Cost**
1	Pre-Design Investigation	1	Lump Sum	$ 225,000	$ 225,000
2	Temporary re-location of DPW building personnel, equipment, and services	14.0	Month	$ 15,000	$ 210,000
3	Site Controls	1	Lump Sum	$ 20,000	$ 20,000
4	CAMP	11.0	Month	$ 16,000	$ 176,000
5	Surveying	1	Lump Sum	$ 50,000	$ 50,000
6	Odor and Dust Suppressant	11.0	Month	$ 21,000	$ 231,000
7	Demolition of DPW Garage	1	Lump Sum	$ 150,000	$ 150,000
8	Permanent Relocation of Salt Storage Bunker	1	Lump Sum	$ 135,000	$ 135,000
9	Relocation of Sewer Line	435	Linear Foot	$ 132	$ 57,420
10	Relocation of Utilities/Fueling Station	1	Lump Sum	$ 65,000	$ 65,000
11	Well Decommissioning	2	Well	$ 2,500	$ 5,000
12	Dewatering Equipment Mobilization	1	Lump Sum	$ 250,000	$ 250,000
13	Dewatering Treatment OM&M	10.0	Month	$ 50,000	$ 500,000
14	Dewatering Equipment Demobilization	1	Lump Sum	$ 50,000	$ 50,000
15	Excavation Support	8584	Square Foot	$ 90	$ 772,560
16	Overburden Excavation (0-4.5')	5929	Cubic Yard	$ 20	$ 118,580
17	Excavation of Gas Holder, Tar Well/Tar Separator, etc	1000	Cubic Yard	$ 35	$ 35,000
18	T&D of Gas Holder, Tar Well/Tar Separator, etc	1600	Ton	$ 95	$ 152,000
19	Impacted Material Excavation (4.5'-15')	7959	Cubic Yard	$ 20	$ 159,180
20	Soil-Drying Agent for ESMI T&D	255	Ton	$ 200	$ 50,938
21	Transport/Thermal Treatment of Soil	5348	Ton	$ 95	$ 508,103
22	Transport of Soil to Landfill	17127	Ton	$ 55	$ 941,987
23	Imported Backfill	18054	Cubic Yard	$ 35	$ 631,904
24	Restore site cover	31720	Square Foot	$ 11	$ 348,920
25	DPW Building Replacement	1	Lump Sum	$ 900,000	$ 900,000
26	Contractor Project Support	12.0	Month	$ 28,000	$ 336,000
27	Remediation Mobilization/Demobilization	15%	% of Costs	$ 7,079,591	$ 1,061,939
28	Engineering Design/Support	15%	% of Costs	$ 7,079,591	$ 1,061,939
29	Construction Management	15%	% of Costs	$ 7,079,591	$ 1,061,939
30	Performance and Payment Bonds	3%	% of Costs	$ 7,079,591	$ 212,388
31	Contingency	20%	% of Costs	$ 7,079,591	$ 1,415,918
	TOTAL DIRECT CAPITAL COSTS				**$ 11,893,713**

SHORT-TERM O&M					
Item	**Task**	**Quantity**	**Unit**	**Rounded**	**Total Cost**
32	Semi-Annual GW Monitoring Net Present Value	5	Year	$ 27,000	$123,652.09
	TOTAL SHORT-TERM O&M NPV COSTS				**$ 123,652**

LONG-TERM O&M					
Item	**Task**	**Quantity**	**Unit**	**Rounded**	**Total Cost**
33	Inspection and maintenance of Engineering and Institutional Controls Net Present Value	30	Year	$ 14,000	$274,406.18
	TOTAL LONG-TERM O&M NPV COSTS				**$ 274,406**

TOTAL COSTS		
Item	**Task**	**Total Cost**
1	TOTAL DIRECT CAPITAL COSTS	$ 11,893,713
2	TOTAL SHORT-TERM O&M NPV COSTS	$ 123,652
3	TOTAL LONG-TERM O&M NPV COSTS	$ 274,406
	GRAND TOTAL	**$ 12,291,772**

Notes
1. Lump Sum costs are based either on previous GEI project experience or RS Means. OM&M costs are based on previous GEI experience.
2. The excavation will require excavation support.
3. It is assumed that soil excavated from the overburden (0-4.5 feet bgs) will be disposed of in a landfill.
4. It is assumed that 40% of deeper soils (4.5-15 feet bgs) will be require thermal desorption and the remaining 60% can be transported to a landfill.
5. The soil drying agent is calculated as 5% of the expected impacted material.
6. It is assumed that it will not be logistically feasible to segregate soil for reuse as backfill.
7. This estimate assumes that the salt storage bunker, utilities and fueling station will be permanently relocated. The DPW garage will be demolished and rebuilt.
8. Backfill volume accounts for 30% compaction.
9. Lines 27 through 31 are calculated as a percentage of costs (Lines 1 through 26).
10. NPV assumes a 3% discount factor
11. Estimate provided is within the +50%/-30% range.

NATIONAL GRID – CANASTOTA
Appendix C. PRELIMINARY ENGINEER'S ESTIMATE - Alternative 4 Excavation to Unrestricted SCOs
11/5/2020

DIRECT CAPITAL COSTS					
Item	Task	Quantity	Unit	Unit Cost	Total Cost
1	Pre-Design Investigation	1	Lump Sum	$ 225,000	$ 225,000
2	Temporary re-location of DPW building personnel, equipment, and services	16.0	Month	$ 15,000	$ -
3	Site Controls	1	Lump Sum	$ 20,000	$ 20,000
4	CAMP	13.0	Month	$ 16,000	$ 208,000
5	Surveying	1	Lump Sum	$ 50,000	$ 50,000
6	Odor and Dust Suppressant	13.0	Month	$ 21,000	$ 273,000
7	Demolition of DPW Garage	1	Lump Sum	$ 150,000	$ 150,000
8	Permanent Relocation of Salt Storage Bunker	1	Lump Sum	$ 135,000	$ 135,000
9	Relocation of Sewer Line	435	Linear Foot	$ 132	$ 57,420
10	Relocation of Utilities/Fueling Station	1	Lump Sum	$ 65,000	$ 65,000
11	Well Decommissioning	2	Well	$ 2,500	$ 5,000
12	Dewatering Equipment Mobilization	1	Lump Sum	$ 250,000	$ 250,000
13	Dewatering Treatment OM&M	12.0	Month	$ 30,000	$ 360,000
14	Dewatering Equipment Demobilization	1	Lump Sum	$ 50,000	$ 50,000
15	Excavation Support	10692	Square Foot	$ 90	$ 962,280
16	Overburden Excavation (0-4.5')	8204	Cubic Yard	$ 20	$ 164,080
17	Sloped Excavation (3H:1V)	92	Cubic Yard	$ 20	$ 1,840
18	Excavation of Gas Holder, Tar Well/Tar Separator, etc	1000	Cubic Yard	$ 35	$ 35,000
19	T&D of Gas Holder, Tar Well/Tar Separator, etc	1600	Ton	$ 95	$ 152,000
20	Impacted Material Excavation (4.5'-24')	11152	Cubic Yard	$ 20	$ 223,040
21	Soil-Drying Agent for ESMI T&D	357	Ton	$ 200	$ 71,373
22	Transport/Thermal Treatment of Soil	7494	Ton	$ 95	$ 711,944
23	Transport of Soil to Landfill	23980	Ton	$ 55	$ 1,318,874
24	Imported Fill Backfill	25282	Cubic Yard	$ 35	$ 884,884
25	Restore site cover	52945	Square Foot	$ 11	$ 582,395
26	DPW Building Replacement	1	Lump Sum	$ 900,000	$ 900,000
27	Contractor Project Support	14.0	Month	$ 28,000	$ 392,000
28	Remediation Mobilization/Demobilization	15%	% of Costs	$ 8,023,129	$ 1,203,469.36
29	Engineering Design/Support	15%	% of Costs	$ 8,023,129	$ 1,203,469
30	Construction Management	15%	% of Costs	$ 8,023,129	$ 1,203,469
31	Performance and Payment Bonds	3%	% of Costs	$ 8,023,129	$ 240,694
32	Contingency	20%	% of Costs	$ 8,023,129	$ 1,604,626
	TOTAL DIRECT CAPITAL COSTS				**$ 13,703,857**

SHORT-TERM O&M					
Item	Task	Quantity	Unit	Unit Cost	Total Cost
33	Semi-Annual GW Monitoring Net Present Value	5	Year	$ 27,000	$123,652.09
	TOTAL SHORT-TERM O&M NPV COSTS				**$ 123,652**

LONG-TERM O&M					
Item	Task	Quantity	Unit	Unit Cost	Total Cost
34	Inspection and maintenance of Engineering and Institutional Controls Net Present Value	30	Year	$ 14,000	$274,406.18
	TOTAL LONG-TERM O&M NPV COSTS				**$ 274,406**

TOTAL COSTS		
Item	Task	Total Cost
1	TOTAL DIRECT CAPITAL COSTS	$ 13,703,857
2	TOTAL SHORT-TERM O&M NPV COSTS	$ 123,652
3	TOTAL LONG-TERM O&M NPV COSTS	$ 274,406
	GRAND TOTAL	**$ 14,101,915**

Notes
1. Lump Sum costs are based either on previous GEI project experience or RS Means. OM&M costs are based on previous GEI experience.
2. Excavations greater than 3 feet deep will require excavation support; excavation 3 feet or less will be sloped (3H:1V).
3. It is assumed that soil excavated from the overburden (0-4.5 feet bgs) will be disposed of in a landfill.
4. It is assumed that 40% of deeper soils (4.5-24 feet bgs) will be require thermal desorption and the remaining 60% can be transported to a landfill.
5. The soil drying agent is calculated as 5% of the expected impacted material.
6. It is assumed that it will not be logistically feasible to segregate soil for reuse as backfill.
7. This estimate assumes that the salt storage bunker, utilities and fueling station will be permanently relocated. The DPW garage will be demolished and rebuilt.
8. Backfill volume accounts for 30% compaction.
9. Lines 28 through 32 are calculated as a percentage of costs (Lines 1 through 27).
10. NPV assumes a 3% discount factor
11. Estimate provided is within the +50%/-30% range.