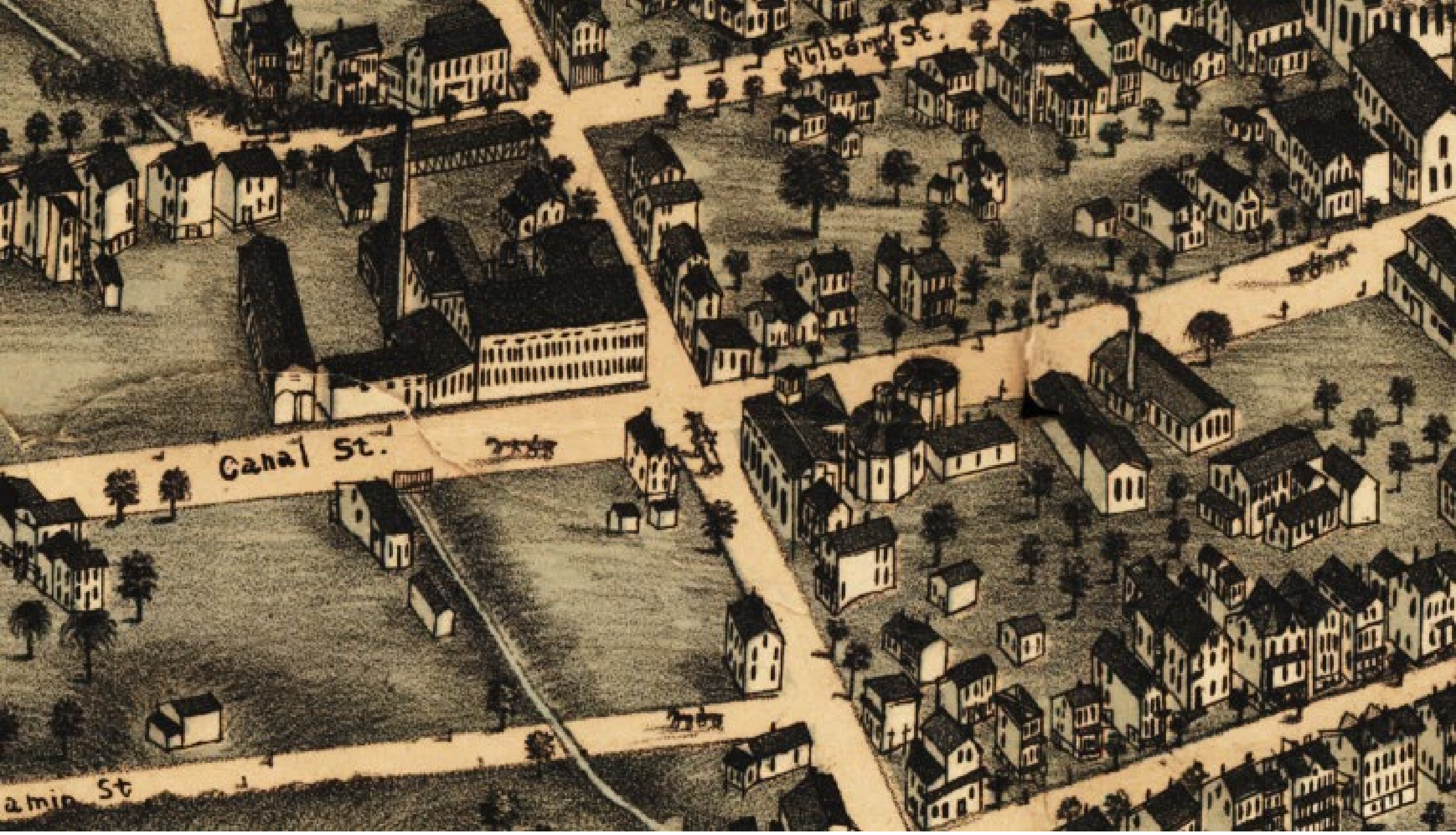

April 2019
Fulton Street Former Manufactured Gas Plant Site
NYSDEC Site # 336030

Feasibility Study Report

Prepared for Orange & Rockland Utilities, Inc.

April 2019
Fulton Street Former Manufactured Gas Plant Site
NYSDEC Site # 336030

Feasibility Study Report

Prepared for
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Certification Statement

I, Margaret A. Carrillo-Sheridan, PE certify that I am currently a NYS-registered professional engineer and that this Feasibility Study Report was prepared in accordance with all applicable statutes and regulations and in substantial conformance with the New York State Department of Environmental Conservation Division of Environmental Remediation (DER) Technical Guidance for Site Investigation and Remediation (DER-10) and that all activities were performed in full accordance with the DER-approved work plan and any DER-approved modifications.

____________________________________ Date ____________________

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APPENDICES

ABBREVIATIONS

µg/L	micrograms per liter
Anchor QEA	Anchor QEA Engineering, PLLC
BTEX	benzene, toluene, ethylbenzene, and xylene
CAMP	Community Air Monitoring Plan
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
COC	constituent of concern
C&D	construction and demolition
CY	cubic yard
DAR	Division of Air Resources
DER	Division of Environmental Remediation
DNAPL	dense nonaqueous phase liquid
DUS/HPO	dynamic underground stripping and hydrous pyrolysis/oxidation
ECL	Environmental Conservation Law
FEMA	Federal Emergency Management Agency
former MGP property	structures associated with the former MGP operations and located north of Fulton Street between Canal and South streets
FS	Feasibility Study
FS Report	*Feasibility Study Report*
GEI	GEI Consultants, Inc.
gpm	gallons per minute
GRA	general response action
HASP	health and safety plan
HDPE	high-density polyethylene
ICs	Institutional controls
ISCO	in situ chemical oxidation
Langan	Langan Engineering and Environmental Services, Inc.
LDR	land disposal restriction
LTTD	low-temperature thermal desorption
MGP	manufactured gas plant
mg/kg	milligram per kilogram
NAPL	nonaqueous phase liquid
NCP	National Contingency Plan
NYCRR	New York Code of Rules and Regulations
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health

O&M	operation and maintenance
O&R	Orange & Rockland Utilities, Inc.
the order	March 11, 1999 Administrative Order on Consent
OSHA	Occupational Safety and Health Administration
PAH	polycyclic aromatic hydrocarbon
POTW	publicly-owned treatment works
PPE	personal protective equipment
ppm	part per million
PRB	permeable reactive barrier
RAO	remedial action objective
RCRA	Resource Conservation and Recovery Act
RETEC	RETEC Group, Inc
RI	Remedial Investigation
RI Report	*Remedial Investigation Report, Fulton Street Former MGP Site*
SCG	standards, criteria, and guidelines
SCO	soil cleanup objective
SMP	site management plan
site	Orange and Rockland Utilities, Inc. Fulton Street former manufactured gas plant site
SUNY	State University of New York
SVOC	semivolatile organic compound
SWPPP	stormwater pollution prevention plan
TAGM	Technical and Administrative Guidance Memorandum
TOGS	Technical and Operational Guidance Series
USACE	U.S. Army Corp of Engineers
USDOT	U.S. Department of Transportation
USEPA	U.S. Environmental Protection Agency
USPS	U.S. Postal Service
UTS	universal treatment standard
UV	ultraviolet
VOC	volatile organic compound

Executive Summary

Introduction

This *Feasibility Study Report* (FS Report) presents an evaluation of remedial alternatives to address environmental impacts identified at the Orange and Rockland Utilities, Inc. (O&R) Fulton Street former manufactured gas plant (MGP) site (the site) located in Middletown, New York. This FS Report has been prepared by Anchor QEA Engineering, PLLC (Anchor QEA), on behalf of O&R and in accordance with the March 11, 1999 Administrative Order on Consent (the Order) Index #D3-0001-99-03 between O&R and the New York State Department of Environmental Conservation (NYSDEC).

The purpose of this FS Report is to identify and evaluate remedial alternatives that meet the following criteria:

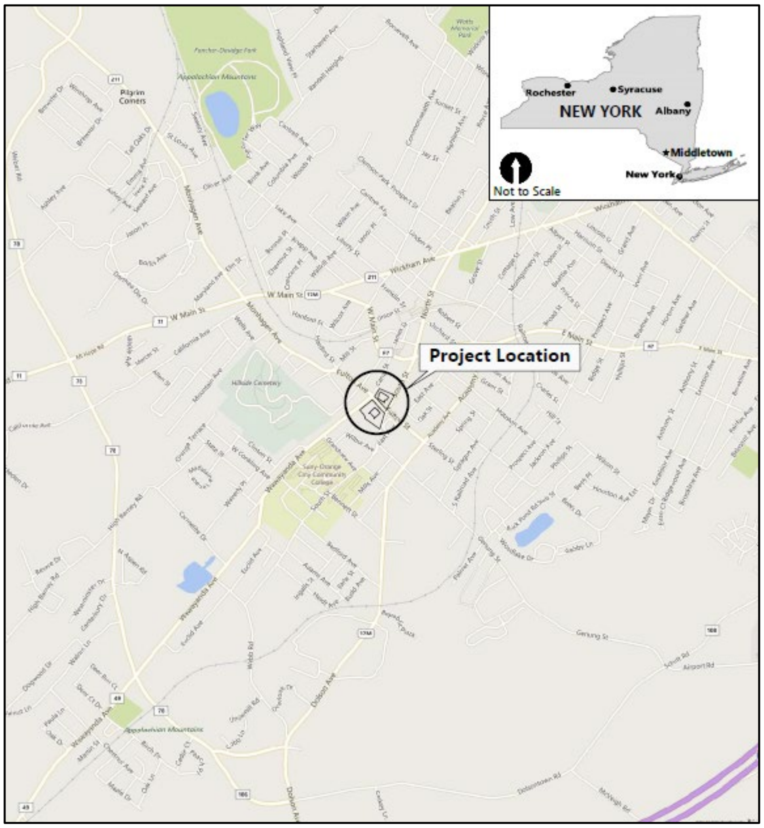
- Appropriate for site-specific conditions
- Protective of public health and the environment
- Consistent with relevant sections of NYSDEC guidance, the NCP, and the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)

The overall objective of this FS Report is to recommend a reliable, cost-effective remedy that achieves the remedial action objectives (RAOs) established for the site.

Background

For the purposes of this FS Report, the site is defined as the area where former MGP-related operations and equipment were located. The site is in a mixed-use commercial/industrial/residential area of Middletown, New York (Figure ES-1).

Figure ES-1
Site Location Map



Source: Background image by Microsoft (Bing).

The site currently houses an auto body shop and a transmission shop (the former MGP property; Tax Block 35, Lot 22) and includes the parking lot of the US Postal Service Office located across Fulton Street (Tax Block 736), where a naphtha tank used during gas production was located. The entire site encompasses approximately 1.8 acres. (Figure 1-2). The site is bisected by Fulton Street, which is a four-lane road that runs northwest-southeast. Most of the structures associated with the former MGP operations were located on Tax Block 35, Lot 22 which is located north of Fulton Street, between Canal and South streets ("the former MGP property"), and some supporting structures were located on the property currently occupied by the USPS post office south of Fulton Street between Wawayanda Avenue and South Street. The former MGP property is currently occupied by the following active businesses:

- Eagle Auto Body of Orange County (referred to as the autobody business)
- Eclectic Cars (Collector Car Sales)
- Aamco Transmission Repair

Hereafter, these businesses are collectively referred to as the "autobody, sales, and automotive repair shops".

Most of the site is covered with paved roadways and parking areas, sidewalks, and buildings. Portions of the site ground surface, including the USPS post office, the former MGP property, and the median within Fulton Street are landscaped with decorative plantings and/or covered with vegetation (e.g., grass and shrubbery).

The portion of Fulton Street between Canal and South Streets, and the supermarket, are collectively referred to as the "off-site area."

Site Geology and Hydrogeology

The overburden materials beneath the site are heterogeneous as a result of anthropogenic and geologic processes. Overburden strata, in descending order from the ground surface, consist of historic fill material (referred to as "fill"); alluvium; and a till unit, which is likely underlain by bedrock.

Groundwater flow beneath the site is primarily within two hydrostratigraphic units—the upper fill/alluvium unit and the till unit. The water table lies within the fill or alluvium at depths ranging from approximately 3 feet to 11 feet below grade. Groundwater in this unit is derived chiefly from upgradient sources north, northeast, and northwest of the site. The predominant groundwater flow direction beneath the former MGP property is to the south and southeast

Nature and Extent of Impacts

NAPLs in the ground beneath the site, primarily coal tar DNAPL, are responsible for most of the environmental impacts resulting from the former MGP. DNAPL has generally been observed in overburden materials at depths ranging from approximately 5 feet below grade to the top of till (ranging from approximately 15 feet to 20 feet below grade) on the former MGP property. DNAPL was also encountered in what appeared to be portions of remaining subsurface foundations associated with the former MGP structures encountered during the excavation of test pits (i.e., test pits TP-1 through TP-3) along the north side of Fulton Street.

DNAPL in the off-site area has generally been observed at depths ranging from 15 to 30 feet below grade and as deep as 45 feet below grade (within the till). As shown in attached Figure 1-6, DNAPL has been observed as far as approximately 500 feet downgradient (monitoring well MW-34) from the likely source of the DNAPL on the former MGP property. As described in more detail below, the observed distribution of DNAPL is largely a function of the presence of relatively lower permeable materials (i.e., the till unit and silt and clay lenses in the alluvium) and hydraulic gradients. Hydraulic gradients beneath the site have been altered due to the relocation of Monhagen Brook. Based on historical mapping, the brook was relocated sometime between 1946 and 1968 (i.e., following decommissioning of the MGP in the early 1920s). The resulting distribution of DNAPL was likely influenced to some degree by the hydraulic gradients pre- and post-relocation of Monhagen Brook.

DNAPL is distributed very irregularly beneath the site, particularly within the fill and upper portion of the alluvium. Due to gravitational forces, DNAPL migrated downward from potential source areas in the MGP operations area (e.g., gas holders, tar cistern) through the unsaturated zone (primarily fill) until it reached the water table at several locations. Beneath the water table, DNAPL migration is driven by gravitational and hydraulic forces. Upon encountering the water table in the fill/alluvium, the DNAPL spread laterally in the direction of groundwater flow and continued to move downward until it encountered lower permeability lenses in the alluvium and/or it reached the till surface. Upon reaching the till surface, the DNAPL spread laterally, following the till surface and pooling in low areas (e.g., trough, bowls) in the top of the unit. Evidence of pooling is reflected by the accumulation of DNAPL in six monitoring wells (i.e., monitoring wells MW-8, MW-11, MW-12, MW-20, MW-25, and MW-34), which were installed in relatively low areas in the till surface in the off-site area. The till does not appear to be an effective capillary barrier to prevent further downward migration of the DNAPL, particularly in the areas of the top of till depressions where DNAPL appears to have pooled. The presence of sand lenses and fracturing in the upper portion of the till further facilitates migration of NAPL into the till. DNAPL has been observed to penetrate as much as 15 feet of the till (i.e., soil borings SB-17 and SB-57 located south and east of the USPS post office, respectively).

MGP-related constituents of concern (COCs) include benzene, toluene, ethyl benzene, and xylenes (BTEX) and polycyclic aromatic hydrocarbons (PAHs). The distribution of COCs in soil at the site closely mimics that of the NAPL encountered during site investigations. Additionally, dissolved-phase COCs have been detected in groundwater samples collected from site monitoring wells at concentrations exceeding New York State (NYS) groundwater quality standards and guidance values.

Surface water, stormwater, and soil vapor were also characterized as part of site investigation activities. However, no MGP-related impacts have been identified in these media that require further action at this time.

Remedial Action Objectives

RAOs are medium-specific goals that, if met, would be protective of public health and the environment relative to the environmental concerns identified at the site. Potential site-wide remedial alternatives will be evaluated relative to their ability to meet the RAOs and be protective of public health and the environment. The RAOs for the site, in consideration of COCs and MGP-related waste materials (i.e., DNAPL), exposure pathways, and receptors, are presented in Table ES-1.

Table ES-1
Remedial Action Objectives

RAOs for Soil	
Public Health Protection	1. Prevent, to the extent practicable, ingestion/direct contact with MGP-related COCs/NAPL.
	2. Prevent, to the extent practicable, inhalation of or exposure to MGP-related VOCs from MGP-related COCs/NAPL.
Environmental Protection	3. Address, to the extent practicable, MGP-related COCs/materials that could result in impacts to groundwater.
RAOs for Groundwater	
Public Health Protection	1. Prevent, to the extent practicable, ingestion of groundwater containing dissolved-phase COCs at concentrations exceeding NYSDEC groundwater quality standards and guidance values.
	2. Prevent, to the extent practicable, contact with or inhalation of VOCs from groundwater containing MGP-related COCs at concentrations exceeding NYSDEC groundwater quality standards and guidance values.
Environmental Protection	3. Restore groundwater quality to pre-disposal/pre-release conditions, to the extent practicable.
	4. Address the source of groundwater impacts to the extent practicable.

Remedial Technology Screening and Development of Remedial Alternatives

The objective of the technology screening is to identify general response actions (GRAs), associated remedial technology types, and technology process options. The next step is to narrow the process options to those that have had documented success at achieving similar RAOs at former MGP sites to identify options that are implementable and potentially effective at addressing environmental impacts identified for the project site. Based on this screening, remedial technology types and technology process options were eliminated or retained and subsequently combined into potential site-wide remedial alternatives for further, more detailed evaluation. This approach is consistent with the screening and selection process provided in Division of Environmental Remediation-10 (DER-10).

Based on the results of the technology screening, the following potential site-wide remedial alternatives were developed:

- Alternative 1–No Action
- Alternative 2–NAPL Recovery, Groundwater Monitoring, and Institutional Controls
- Alternative 3–Utility Corridor Soil Removal, NAPL Recovery, Groundwater Monitoring, and Institutional Controls
- Alternative 4–Shallow Soil Removal at the Former MGP Property, NAPL Recovery, Groundwater Monitoring, and Institutional Controls

- Alternative 5–Targeted Soil Removal at the Former MGP Property, NAPL Recovery, Groundwater Monitoring, and Institutional Controls
- Alternative 6–Slurry-Supported Soil Removal at the Former MGP Property, Utility Corridor Stabilization, NAPL Recovery, Groundwater Monitoring, and Institutional Controls
- Alternative 7–Removal to 6 NYCRR Part 375-6 Unrestricted Use SCOs, NAPL Recovery, Groundwater Monitoring, and Institutional Controls

Detailed Evaluation of Alternatives

Following the development of the remedial alternatives, a detailed description of each alternative was prepared, and each alternative was evaluated with respect to the following criteria presented in DER-10:

- Short-term impacts and effectiveness
- Long-term effectiveness and permanence
- Land use
- Reduction of toxicity, mobility, or volume through treatment
- Implementability
- Compliance with standards, criteria, and guidelines (SCGs)
- Overall protection of public health and the environment
- Cost effectiveness

These evaluation criteria encompass statutory requirements and include other gauges such as overall feasibility. Descriptions of the evaluation criteria are presented in the following sections. Additional criteria, including community acceptance, will be addressed following submittal of this FS Report.

Comparative Analysis of Alternatives

Following the detailed evaluation of each alternative, a comparative analysis of the alternatives was completed using the seven evaluation criteria. The comparative analysis identified the advantages and disadvantages of each alternative relative to each other and with respect to the evaluation criteria. The results of the comparative analysis were used as a basis for recommending the preferred remedy for achieving the RAOs established for the site.

Preferred Remedial Alternative

The results of the comparative analysis were used as a basis for recommending a preferred remedial alternative for the site—Alternative 6. The primary components of the preferred remedial alternative consist of the following:

- Excavating accessible impacted soil and former MGP structures located in the southwestern corner of the former MGP.

- Performing in situ stabilization via jet grouting of soils underlying existing utilities adjacent to the building located on the former MGP.
- Transportation and off-site disposal (or recycling) of approximately 1,600 tons of surface material and other debris as construction and demolition (C&D) debris.
- Transportation and off-site treatment/disposal of approximately 3,900 tons of soil containing MGP-related impacts via low-temperature thermal desorption (LTTD).
- Restoring all disturbed surfaces to match existing site conditions.
- Installing up to 11 NAPL collection points to facilitate recovery of mobile NAPL.
- Installing up to seven new groundwater monitoring wells to facilitate site-wide groundwater monitoring.
- Establishing institutional controls (ICs) on the on-Site and off-site properties to control intrusive (i.e., subsurface) activities that could result in potential exposures to subsurface soil and groundwater containing MGP-related impacts at concentrations greater than applicable standards and guidance values.
- Preparing a site management plan (SMP) to document the following:
  - The ICs that have been established and will be maintained for the site.
  - Requirements for notifications of the presence of MGP-related impacts in soil and groundwater that would be provided to those requesting utility clearance for intrusive activities on the former MGP property or in the off-site area.
  - Known locations of remaining soil that contains COCs at concentrations greater than 6 New York Code of Rules and Regulations (6 NYCRR) Part 375-6 commercial soil cleanup objectives (SCOs).
  - Protocols (including health and safety requirements) for conducting invasive (i.e., subsurface) activities and managing potentially impacted material encountered during these activities.
  - Protocols and requirements for conducting semi-annual NAPL monitoring and annual groundwater monitoring.
  - Protocols for addressing significant changes in COC concentrations in groundwater based on the results of the annual groundwater monitoring.
- Conducting semi-annual NAPL monitoring/passive NAPL recovery to reduce the volume of mobile NAPL within the subsurface.
- Conducting annual groundwater monitoring to confirm groundwater flow direction and document the extent and concentrations of dissolved-phase COCs.
- Preparing an annual report to summarize semi-annual NAPL and annual groundwater monitoring activities and results.

1 Introduction

1.1 General

This *Feasibility Study Report* (FS Report) presents an evaluation of remedial alternatives to address environmental impacts identified at the Orange and Rockland Utilities, Inc. (O&R) Fulton Street former manufactured gas plant (MGP) site (the site) located in Middletown, New York. This FS Report has been prepared by Anchor QEA Engineering, PLLC (Anchor QEA), on behalf of O&R and in accordance with the March 11, 1999 Administrative Order on Consent (the Order) Index #D3-0001-99-03 between O&R and the New York State Department of Environmental Conservation (NYSDEC).

1.2 Regulatory Frame Work

This FS Report has been prepared to evaluate remedial alternatives to address environmental impacts at the site in a manner consistent with the Order and with the following documents:

- NYSDEC Division of Environmental Remediation (DER)-10 Technical Guidance for Site Investigation and Remediation (NYSDEC 2010a)
- Applicable provisions of the New York State (NYS) Environmental Conservation Law and associated regulations, including Title 6 of the New York Code of Rules and Regulations (NYCRR) Part 375-6 (6 NYCRR Part 375-6)
- U.S. Environmental Protection Agency (USEPA) guidance document titled, *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA* (USEPA 1988b)
- Applicable provisions of the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) regulations contained in Title 40 of the Code of Federal Regulations (CFR) Part 300

1.3 Purpose

The purpose of this FS Report is to identify and evaluate remedial alternatives that meet the following criteria:

- Appropriate for site-specific conditions
- Protective of public health and the environment
- Consistent with relevant sections of NYSDEC guidance, the NCP, and the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)

The overall objective of this FS Report is to recommend a reliable, cost-effective remedy that achieves the remedial action objectives (RAOs) established for the site.

1.4 Report Organization

This FS Report is organized as presented in Table 1-1.

Table 1-1
Report Organization

Section	Purpose
Section 1–Introduction	Provides background information relevant to the development of remedial alternatives evaluated in this FS Report.
Section 2–Identification of Standards, Criteria, and Guidelines	Identifies standards, criteria, and guidelines (SCGs) that govern the development and selection of remedial alternatives.
Section 3–Development of Remedial Action Objectives	Presents a summary of the site risk assessment and develops site-specific RAOs that are protective of public health and the environment.
Section 4–Technology Screening and Development of Remedial Alternatives	Presents the results of a screening process to identify potentially applicable remedial technologies and develops remedial alternatives that have the potential to meet the RAOs.
Section 5–Detailed Evaluation of Remedial Alternatives	Presents a detailed description and analysis of each potential remedial alternative using the evaluation criteria presented in the referenced guidance documents.
Section 6–Comparative Analysis of Alternatives	Presents a comparative analysis of each remedial alternative using the evaluation criteria.
Section 7–Preferred Remedial Alternative	Identifies the preferred remedial alternative for addressing the environmental concerns at the site.

1.5 Background Information

This section summarizes site background information relevant to the development and evaluation of remedial alternatives, including site location and physical setting, site history and operation, and previous investigations conducted at the site. The information presented herein is summarized from the *Remedial Investigation Report, Fulton Street Former MGP Site* (RI Report; GEI 2000) and the *Final Remedial Investigation Report* (Langan 2004).

1.5.1 Site Location, Zoning, and Physical Setting

For the purposes of this FS Report, the site is defined as the area where former MGP-related operations and equipment were located. The site is in a mixed-use commercial/residential area of Middletown, New York (attached Figure 1-1). The site currently houses an auto body shop and a transmission shop (the former MGP property; Tax Block 35, Lot 22) and includes the parking lot of the US Postal Service Office located across Fulton Street (Tax Block 736), where a naphtha tank used during gas production was located. The entire site encompasses approximately 1.8 acres.

Attached Figure 1-2 shows the site plan. As shown on Figure 1-2, the site is bisected by Fulton Street, which is a four-lane road that runs northwest-southeast. Most of the structures associated with the former MGP operations were located on Tax Block 35, Lot 22 which is located north of Fulton Street, between Canal and South Streets ("the former MGP property"), and some supporting structures were located on the property currently occupied by the USPS post office south of Fulton

Street between Wawayanda Avenue and South Street. The former MGP property is currently occupied by the following active businesses:

- Eagle Auto Body of Orange County (referred to as the autobody business)
- Eclectic Cars (Collector Car Sales)
- Aamco Transmission Repair

Hereafter, these businesses are collectively referred to as the "autobody, sales, and automotive repair shops".

Most of the site is covered with paved roadways and parking areas, sidewalks, and buildings. Portions of the site ground surface, including the USPS post office, the former MGP property, and the median within Fulton Street are landscaped with decorative plantings and/or covered with vegetation (e.g., grass and shrubbery).

The portion of Fulton Street between Canal and South Streets, and the post office, supermarket, and Southeast Towers properties are collectively referred to as the "off-site area."

The current zoning for the site and off-site area is listed as Downtown Mixed Use (DMU-1). A current zoning map for project area is included as Appendix A. The DMU-1 designation was developed as part of an initiative to improve the vitality of urban centers in 10 communities (including Middletown) within NYS (Middletown 2017). Permitted uses within the DMU-1 zone include retail stores; communications facilities, stores or offices; financial institutions; municipal uses; residential one- and two-family dwellings, second floor or higher floors only; and professional offices.

A surface water feature (Monhagen Brook) flows from northwest to southeast within a culvert beneath the median of Fulton Street. The brook enters a stone arch culvert approximately 1,000 feet northwest of the site near the intersection of Fulton and Mill streets and eventually transitions to a concrete box-culvert. The brook daylights approximately 2,000 feet southeast of the site near the intersection of Genung Street and Sprague Avenue. Portions of the box-culvert are more than 60 years old and have historically undergone various stages of construction. Based on prior investigation activities performed by others (on behalf of O&R), the current condition of the culvert is poor, and portions have recently been repaired due to collapse.

1.5.2 Site History and Operation

Gas production at the site began in approximately 1868 and continued until sometime in the late 1920s. Gas was initially produced using the coal carbonization process, and production was switched to the carbureted water gas process sometime between 1893 and 1904. The plant initially consisted of two gas holders, a condenser house, a purifier house, a meter room, a retort, a tar cistern, and various storage sheds. According to Sanborn maps for the area, by 1897, operations expanded to the southern side of Fulton Street on the current USPS post office property. As shown on the 1903 Atlas of Orange County (Figure 1-3), this expansion included construction of a naphtha tank near the former location of Monhagen Brook (prior to the brook's relocation beneath Fulton Street). At that time, a larger gas holder had been constructed in place of one of the original smaller holders and water gas machines and scrubbers were installed.

Figure 1-3
MGP Site Operations Circa 1903

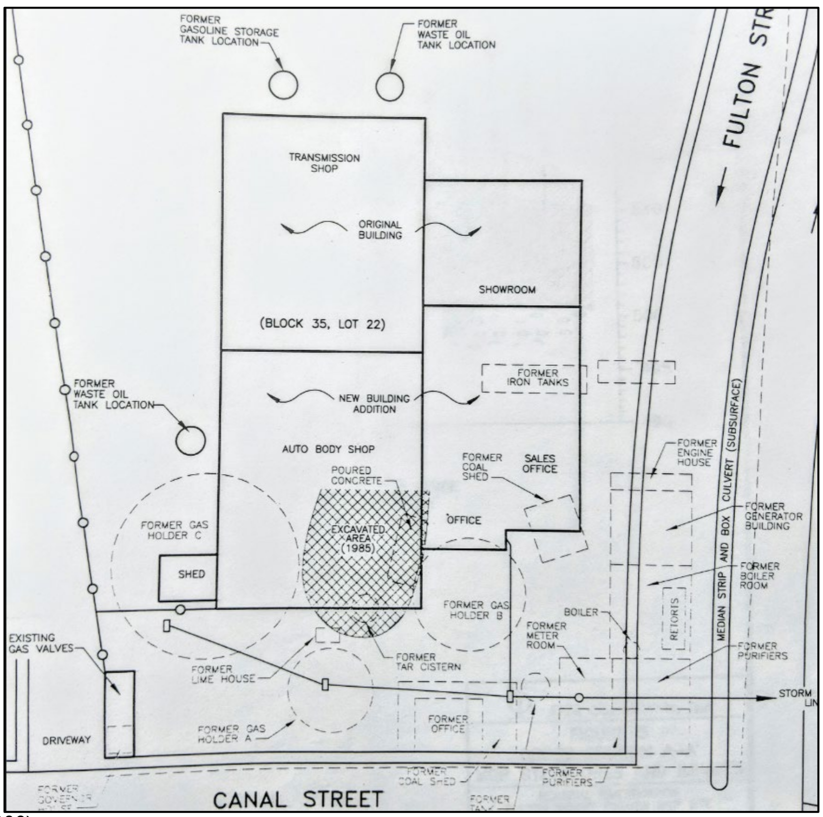
Source: Plate 25, Atlas of Orange County, New York, 1903.
https://www.hrvh.org/cdm/fullbrowser/collection/tpl/id/3524/rv/compoundobject/cpd/3576

Most of the above-grade buildings and structures associated with the MGP were demolished by 1925, but MGP-related subsurface building foundations and other buried structures remain at the site. Based on features shown on historical mapping, Monhagen Brook was re-routed to its current location beneath Fulton Street sometime between 1946 and 1968 as part of an urban renewal project.

1.5.3 Prior MGP Materials Removal

In September 1985, the previous property owner began the construction of an expansion to the building located on the MGP property. During excavation for the building footings, a brick structure containing tar ("tar cistern") was uncovered. O&R contracted EA Science and Technology and O.H. Materials Company to remove the former tar cistern and its contents, along with approximately 750 tons of impacted soil. During the removal activities, O.H. Materials reported that approximately 2,700 gallons of liquids were discharged into the excavation area from an adjacent underground tank (former gas holder B) and required removal. Following completion of the removal activities, the base of the removal area was then backfilled with concrete to stabilize the subsurface soils, followed by soil backfill. Figure 1-4 shows the extent of the prior MGP materials removal activities as well as the approximately locations of the MGP-related structures.

Figure 1-4
Extent of Prior MGP Materials Removal and Location of Historical MGP Structures



Source: RI Report (GEI 2000).

1.5.4 *Summary of Previous Investigations*

Following the MGP materials removal activities in 1985, the site was subjected to several environmental investigations including the following:

- 1988–Phase I Environmental Site Assessment conducted by Gibbs & Hill, Inc. for NYSDEC (former MGP property).

- 1992–Phase I Preliminary Site Assessment conducted by Wehran-New York, Inc. (Wehran) (USPS post office property)
- 1994–Phase I Site Audit conducted by Environmental Compliance Services, Inc. for the Hechler Development Corporation (former MGP property)
- 1995–Phase II Site Assessment conducted by Wehran (USPS post office property)
- 1997–Preliminary Site Assessment conducted by the RETEC Group, Inc. (RETEC)
- 1998 to 1999–Remedial Investigation conducted by GEI Consultants, Inc. (GEI)
- 2003–Supplemental Remedial Investigation (Supplemental RI) conducted by Langan Engineering and Environmental Services, Inc. (Langan)
- 2004 to 2005–Supplemental Remedial Investigation Addendum conducted by GEI
- 2010 Post Office Investigation conducted by Arcadis
- 2016 Feasibility Study Refinement Study (Arcadis 2017)

A summary of the prior investigation activities is provided in the following subsections.

1.5.4.1 Remedial Investigation

Activities and results for the RI conducted by GEI are presented in the November 2000 RI Report (GEI 2000). Investigation activities were conducted north and south of Fulton Street (i.e., the former MGP property and the off-site area) to evaluate the horizontal and vertical extent of MGP residuals and potential releases from former MGP structures and included the following:

- Completing 35 soil borings (8 at the former MGP property and 27 in the off-site area) and collecting soil samples for chemical analysis.
- Completing three soil borings within the water line bedding material beneath Fulton Street.
- Excavating three test pits to identify former MGP structures.
- Installing five groundwater monitoring wells (one at the former MGP property and four at the USPS post office property) and one non-aqueous phase liquid (NAPL) recovery well at the USPS post office property.
- Collecting two stormwater samples from catch basins that discharge to the Monhagen Brook culvert and two surface water samples and one sediment sample from Monhagen Brook.
- Collecting two rounds of site-wide groundwater samples for chemical analysis.

1.5.4.2 Supplemental Remedial Investigation

Activities and results for the Supplemental RI conducted by Langan are presented in the January 2004 *Final Remedial Investigation Report* (Langan 2004). The Supplemental RI was conducted to delineate the extent of MGP-related impacts, including the area south of the USPS post office property (i.e., the current location of the newly renovated supermarket and former State University of

New York [SUNY] offices). Investigation activities conducted by Langan consisted of the following actions:

- Conducting monthly bail-down testing and NAPL sampling at monitoring well MW-20.
- Completing 17 soil borings (seven at the former MGP property and 10 in the off-site area) to the top of the till and collecting two soil samples from each boring for chemical analysis.
- Installing two monitoring wells at the former MGP property and three monitoring wells in the off-site area.
- Collecting sediment material from the old Monhagen Brook culvert beneath the USPS post office property and submitting the sample for forensic analysis.
- Collecting 13 soil gas survey samples (five from the former MGP property and eight from the USPS and supermarket properties) and two ambient air samples (one from the MGP property and one from the USPS post office property).
- Collecting a round of site-wide groundwater samples for chemical analysis and water level/product thickness measurements.

1.5.4.3 Supplemental Remedial Investigation Addendum

Activities and results for the Supplemental RI Addendum conducted by GEI are presented in the March 2006 *Supplemental Remedial Investigation Addendum Report, Fulton Street Former MGP Site* (GEI 2006). GEI conducted the Supplemental RI Addendum activities to further characterize the horizontal and vertical extent of MGP-related impacts at the site and to identify contaminant migration pathways. For the Supplemental RI Addendum, the following activities were conducted:

- Completing 28 soil borings (including 13 borings into the till unit) and collecting 74 subsurface soil samples for chemical analysis.
- Installing four monitoring wells, each into the till surface, and collecting 15 groundwater samples and one round of site-wide water level measurements.
- Conducting dense nonaqueous phase liquid (DNAPL) bail-down testing and collecting a DNAPL sample for chemical and physical analyses.
- Collecting a total of four ambient air, two soil gas, three sub-slab, and five indoor air samples from the USPS post office property, autobody, sales, and automotive repair shops, Southwest Towers, and former SUNY Empire State College office buildings (now newly renovated supermarket) properties in support of a vapor intrusion evaluation for these buildings. The vapor intrusion evaluation, including the associated sampling activities, was conducted by RETEC.

1.5.4.4 USPS Post Office Investigation

The USPS post office investigation activities were implemented and completed on June 13, 2010, in accordance with a May 26, 2010 NYSDEC-approved letter work plan (ARCADIS 2010a). The investigation activities consisted of the following:

- Completing five soil borings and collecting subsurface soil samples along the path of the proposed stormwater drainage piping to confirm the absence of soils containing MGP-related impacts.
- Completing five soil borings and collecting subsurface soil samples immediately west of the post office, hydraulically downgradient from the former naphtha tank to further investigate/delineate the presence and extent of soils containing MGP-related impacts identified in this area during the Supplemental RI.
- Abandoning five existing monitoring wells located on the USPS post office property.

A detailed description of the post office investigation activities and results were presented in the July 7, 2010 Post Office Investigation Summary letter (ARCADIS 2010b).

1.5.4.5 Feasibility Study Refinement Investigation

In 2016, Arcadis completed an FS refinement investigation to identify the presence and extent of potential MGP-related source areas that could reasonably be addressed on the autobody shop property and beneath Fulton Street north of the Monhagen Brook culvert (Arcadis 2017). The investigation activities consisted of the following:

- Advancing 11 soil borings and collecting subsurface soil samples on the former MGP property (adjacent to the autobody and sales shops) and beneath Fulton Street
- Resurveying existing wells and surveying newly installed soil borings
- Conducting NAPL gauging at four wells – of the four wells gauged, only one well, MW-25 had measurable product (1.5 feet of DNAPL in the bottom of the well)
- Conducting a visual survey and inspection of eight site monitoring wells
- Abandoning MW-28, which was previously damaged

A detailed description of the FS refinement investigation activities and results were presented in the January 9, 2017 letter to NYSDEC (ARCADIS 2017).

1.6 Site Characterization

This section presents an overall site characterization and a summary of the nature and extent of impacted media at the site based on the results obtained for the site investigation activities conducted to date (as described in Section 1.5.4). The site characterization consists of a summary of site geology and hydrogeology and the nature and extent of impacts.

1.6.1 Site Geology and Hydrogeology

Geologic and hydrogeologic conditions at the site are discussed below. Attached Figure 1-2 shows the locations of the soil borings and monitoring wells referenced in the following subsections.

1.6.1.1 Geology

The overburden materials beneath the site are heterogeneous as a result of anthropogenic and geologic processes. Overburden strata, in descending order from the ground surface, consist of historic fill material (referred to as "fill"); alluvium; and a till unit, which is likely underlain by bedrock. The character and depositional history of these strata are briefly described below.

Fill is present at the ground surface or immediately beneath a thin layer of topsoil, concrete, or asphalt. The fill unit is generally 5 feet to 10 feet thick, but increases within former holder foundations, beneath Fulton Street, and in the former Monhagen Brook streambed west of the post office (i.e., soil boring SB-16). The fill consists of various shades of brown, coarse sands and gravels and re-worked clays mixed with brick, coal, cinders, clinkers, ash, and wood. Note that several voids were encountered during completion of the June 2010 post office investigation activities. Voids encountered in soil borings SB-69, SB-70, and SB-74 (from approximately 5 feet to 10 feet below grade) are potentially associated with the former Monhagen Brook streambed on the west side of the post office. An additional void was encountered in soil boring SB-73 (also located on the USPS post office property) from approximately 5 feet to 10 feet below grade.

The alluvium lies directly beneath the fill and represents the uppermost, undisturbed geologic unit beneath the site. The alluvium was likely deposited by a post-glacial version of Monhagen Brook as it meandered through the site area, resulting in discontinuous beds of coarse- and fine-grained deposits. The alluvium contains silt and clay lenses that are commonly intermingled with deposits comprised largely of coarse-grained material. The abrupt changes in grain size result in an associated change in permeability. The alluvium unit ranges from approximately 2 feet thick just southeast of the USPS post office (soil boring SB-15) to 25 feet thick (soil boring SB-32) near the supermarket located southeast of the USPS post office with an average thickness of 15 feet to 18 feet. The alluvium is less compacted and more permeable than the underlying till unit and, as a result, contains the majority of the residual NAPL and dissolved-phase COCs associated with the former MGP.

The till is the lowest geologic unit that was encountered during prior investigations beneath the site. Ordovician age shale and/or greywacke bedrock is likely present below the till. The characteristics of this unit are consistent with a lodgement till—that is, a till formed at the base of an over-riding glacier. This unit consists of silty sands with sub-rounded to sub-angular gravel in a very dense gray clay matrix. The upper portion of the till contains sand lenses and fractures. The fracture density appears to decrease with depth into the unit. The bottom of the till was not encountered during the site investigation activities and, as such, the thickness of this unit is unknown. The deepest boring (soil boring SB-13) penetrated approximately 30 feet of till. In general, the surface topography of the till mimics that of the ground surface, with the top of the till shallowest near the former MGP operations area (approximately 10 feet below grade) and deepest along the southern edge of Fulton Street (as deep as 35 feet below grade). A trough-like depression appears to exist in the till surface immediately south of and paralleling Fulton Street with several distinct bowls present within the trough. The bowls are possibly the result of scouring caused by a high-energy version of post-glacial Monhagen Brook.

1.6.1.2 Hydrogeology

Groundwater flow beneath the site is primarily within two hydrostratigraphic units—the upper fill/alluvium unit and the till unit. The alluvium and fill are combined as one hydrostratigraphic unit because they appear to contain similar hydrogeologic properties.

The water table lies within the fill or alluvium at a depth of approximately 3 feet to 11 feet below grade. The saturated thickness of the fill/alluvium unit ranges from approximately 3 feet to 31 feet. Groundwater in this unit is derived chiefly from upgradient sources north, northeast, and northwest of the site. A small amount of surface water also likely reaches this unit via infiltration, but most of the precipitation falling on the site area is directed to storm sewers via asphalt/concrete surfaces and catch basins. As shown in Figure 1-5, the predominant groundwater flow direction beneath the former MGP property is to the south and southeast. South of the former MGP property, groundwater primarily flows southeast, roughly parallel to the flow of Monhagen Brook, suggesting that the brook and/or historical location of the brook may have an influence on the direction of groundwater flow beneath the site. The vertical hydraulic gradient between the upper (upper approximately 10 feet) and lower (lower approximately 10 feet to 20 feet) portions of the fill/alluvium hydrostratigraphic unit is downward. As further discussed in Section 1.6.2.4, surface water and sediment samples collected from Monhagen Brook in the vicinity of the site have not indicated the presence of MGP-related COCs, indicating that the culverted brook in not in connection with contaminated site groundwater. The hydraulic conductivity of the fill/alluvium unit, as reported by GEI (GEI 2000, 2006), ranges from approximately 0.0034 feet/day to 2.7 feet/day.

Combining these values with a horizontal hydraulic gradient of 0.04 yields groundwater flow velocities ranging from approximately 0.005 feet/year to 165 feet/year. The wide range of hydraulic conductivities and flow velocities further demonstrate the highly heterogeneous nature of the fill/alluvium.

The till is fully saturated beneath the site. Water levels from three wells that fully screen the till suggest the horizontal groundwater flow direction in the till unit is generally toward the southeast, parallel to Fulton Street (like that of the fill/alluvium). Limited hydraulic head data for wells screened in the till and nearby wells screened in the fill/alluvium suggest there is a downward vertical hydraulic gradient from the alluvium to the till. Although hydraulic conductivity data are not available for the till, literature (Fetter 1994) suggests hydraulic conductivities for lodgement till ranges between $1.0x10^{-5}$ feet/day to $1.0x10^{-4}$ feet/day. As such, groundwater flow within the till is negligible compared to flow in the more permeable fill/alluvium unit above the till. Groundwater flow velocities in the till are likely less than 1 foot/year; however, flow velocities in the fractures and sand lenses observed in the upper portion of the till are likely several orders of magnitude greater than in the competent till. The degree of increased flow would depend on the interconnectedness of fractures and sand lenses.

1.6.2 Nature and Extent of Impacts

The results of the RI indicated subsurface soil and groundwater contain concentrations of benzene, toluene, ethylbenzene, and xylenes (BTEX), a subset of volatile organic compounds (VOCs); a more general class of organic compounds called polycyclic aromatic hydrocarbons (PAHs) and cyanide. PAHs are a subgroup of semi-volatile organic compounds (SVOCs) that consists of approximately 17 commonly recognized multi-ringed, aromatic compounds. These compounds are typically associated with coal tar NAPL from former MGP operations (USEPA 1988a).

In general, the primary MGP-related byproduct responsible for most of the impacts at a former MGP site is coal tar, which generally appears as a DNAPL. DNAPLs are heavier than water and tend to sink below the water table if released in enough quantities. Depending on the type of gas manufacturing processes employed, coal tar DNAPL may be only slightly denser (and slightly more viscous) than water, when compared to coal tars that were solid when exposed to ambient air and highly viscous (USEPA 1988a). Because the former MGP operations at this Site included coal carbonization, as well as carbureted water gas methods, the coal tar physical characteristics may vary across the Site.

Coal tar comprises many organic compounds, which includes BTEX and PAHs that are regulated by the NYSDEC. These two groups of compounds, in addition to NAPLs, are useful in characterizing the nature and extent of contamination on-Site related to former MGP operations (hereafter referred to as MGP-related impacts or MGP impacts). Visual characterization of media and laboratory analysis of environmental samples for these two classes of organic compounds is a useful way of identifying the nature and extent of environmental media affected by coal tar. Because coal tar (NAPL) typically contains elevated concentrations of these compounds, soil samples and groundwater monitoring wells that contain coal tar need not always be analyzed and could be assumed to contain levels of BTEX and PAHs at concentrations above applicable SCGs. Therefore, coal tar-related BTEX and PAHs have been identified as the constituents of concern (COCs) for the site. The following subsections present a summary of the nature and extent of MGP-related environmental concerns identified for the site based on these COCs and the presence of NAPL.

1.6.2.1 NAPL Distribution and Characterization

NAPLs in the ground beneath the site, primarily coal tar DNAPL, are responsible for most of the environmental impacts resulting from the former MGP. DNAPL has generally been observed in overburden materials at depths ranging from approximately 5 feet below grade to the top of till (ranging from approximately 15 feet to 20 feet below grade) on the former MGP property. DNAPL was also encountered in what appeared to be portions of remaining subsurface foundations associated with the former MGP structures encountered during the excavation of test pits (i.e., test pits TP-1 through TP-3) along the north side of Fulton Street.

DNAPL in the off-site area has generally been observed at depths ranging from 15 to 30 feet below grade and as deep as 45 feet below grade (within the till). As shown in attached Figure 1-6, DNAPL has been observed as far as approximately 500 feet downgradient (monitoring well MW-34) from the likely source of the DNAPL on the former MGP property. As described in more detail below, the observed distribution of DNAPL is largely a function of the presence of relatively lower permeable materials (i.e., the till unit and silt and clay lenses in the alluvium) and hydraulic gradients. Hydraulic gradients beneath the site have been altered due to the relocation of Monhagen Brook. Based on historical mapping, the brook was relocated sometime between 1946 and 1968 (i.e., following decommissioning of the MGP in the early 1920s). The resulting distribution of DNAPL shown in Figure 1-6 was likely influenced to some degree by the hydraulic gradients pre- and post-relocation of Monhagen Brook.

DNAPL is distributed very irregularly beneath the site, particularly within the fill and upper portion of the alluvium. Due to gravitational forces, DNAPL migrated downward from potential source areas in the MGP operations area (e.g., gas holders, tar cistern) through the unsaturated zone (primarily fill) until it reached the water table at several locations. Beneath the water table, DNAPL migration is driven by gravitational and hydraulic forces. Upon encountering the water table in the fill/alluvium, the DNAPL spread laterally in the direction of groundwater flow and continued to move downward until it encountered lower permeability lenses in the alluvium and/or it reached the till surface. Upon reaching the till surface, the DNAPL spread laterally, following the till surface and pooling in low areas (e.g., trough, bowls) in the top of the unit. Evidence of pooling is reflected by the accumulation of DNAPL in six monitoring wells (i.e., monitoring wells MW-8, MW-11, MW-12, MW-20, MW-25, and MW-34), which were installed in relatively low areas in the till surface in the off-site area. The till does not appear to be an effective capillary barrier to prevent further downward migration of the DNAPL, particularly in the areas of the top of till depressions where DNAPL appears to have pooled, and as shown on Figure 1-6. The presence of sand lenses and fracturing in the upper portion of the till further facilitates migration of NAPL into the till. DNAPL has been observed to penetrate as much as 15 feet of the till (i.e., soil borings SB-17 and SB-57 located south and east of the USPS post office, respectively).

Monitoring well MW-20 (located east of the post office in the off-site area) has historically collected the greatest amount of NAPL. A DNAPL sample collected from monitoring MW-20 by Langan in 2003 had a specific gravity of 1.06 (i.e., slightly heavier than water) and viscosity of 26.8 centipoise. Note that this sample was analyzed at room temperature (i.e., 23°Celsius) and was not typical ambient groundwater temperature (i.e., 8°Celsius). Another DNAPL sample was collected from monitoring well MW-20 by GEI in 2005. This DNAPL sample had a specific gravity of 1.1 and a viscosity of 25 centistokes (approximately 28 centipoise). Although not reported by GEI, the 2005 sample was also likely analyzed at room temperature based on the relatively low viscosity. MGP NAPL typically exhibits a higher viscosity (i.e., is less flowable) when encountered at ambient groundwater temperatures.

Coal tar was also observed in the northwest corner of the USPS post office property parking lot near the corner of Wawayanda Avenue and Fulton Street in soil boring SG-24 (13 feet below grade) and the soil boring completed at the location of monitoring well MW-12 (9 to 22 feet below grade).

Blebs of residual product were noted in soil samples collected from 10 feet to 15 feet below grade within soil boring SB-65 (completed by GEI as part of the Supplemental RI Addendum). This depth, which generally coincides with the seasonal depth range of the water table, potentially suggests the residual material in this area may have been lighter than water (e.g., petroleum).

ARCADIS completed soil borings SB-69 through SB-73 (during the June 2010 post office investigation activities) to further delineate the visual impacts observed in soil boring SB-65. Petroleum-like odors were noted in soil borings SB-71 and SB-72 (from approximately 7 feet to 15 feet below grade), and a light sheen was noted in soil boring SB-71 at approximately 11 feet below grade. No other visual impacts were observed in soil samples collected during the June 2010 USPS post office investigation.

The results of the 2016 FS refinement investigation indicated NAPL-saturated (or partially saturated) soils were encountered in one of the six soil borings installed within the Fulton Street right of way (ROW) starting at depths greater than 10 feet below ground surface (bgs). None of the borings installed within the Fulton Street ROW had visual indications of MGP-related impacts in the upper 3 feet. The depth to NAPL-saturated (or partially saturated) soils within Fulton Street are therefore not likely to be encountered during future intrusive work in the Fulton Street ROW. Further, the observation of NAPL-saturated soils within Fulton Street were observed at elevations located below the invert of the Monhagen Brook culvert. Based on the results of the FS refinement investigation, the subsurface soils within the Fulton Street ROW do not serve as a migration pathway for MGP source material (i.e., NAPL) to the Monhagen Brook culvert.

1.6.2.2 Soil Quality

The extent of soil affected by the MGP has a strong correlation to the observed NAPL distribution across the site. Note that surface soils are not considered to be impacted with MGP-related COCs. As indicated above, most of the site surfaces consist of paved roadways, parking areas, sidewalks, and buildings. Although most soil samples were collected at depths greater than 5 feet below grade, soil samples collected at shallow depths (i.e., between 1 foot and 5 feet below grade) generally did not contain BTEX and PAHs at concentrations greater than 6 NYCRR Part 375-6 restricted use commercial soil cleanup objectives (SCOs). Although Technical and Administrative Guidance Memorandum (TAGM) 4046 has since been replaced by 6 NYCRR Part 375-6 SCOs, the guidance values for total VOCs and total SVOCs contained in TAGM 4046 are still considered useful for assessing the extent of soils affected by historical releases from an MGP site. TAGM 4046 established soil cleanup guidance for total VOCs and SVOCs, specifically those less than or equal to 10 milligrams/kilogram (mg/kg) VOCs and those less than or equal to 500 mg/kg SVOCs, which are often used to identify soils containing MGP-related impacts.

Elevated concentrations of MGP-related COCs on the former MGP property were detected in soil samples collected from borings SB-10 (18 feet to 20 feet) and SB-64 (16 feet to 18 feet). The greatest concentrations of COCs on the former MGP property were detected in a sample collected from soil boring SB-10, which contained total BTEX and total PAHs, at concentrations of 1,800 mg/kg and 2,000 mg/kg, respectively.

As indicated above, ARCADIS completed soil borings SB-69 through SB-73 (during the June 2010 post office investigation activities) to further delineate the visual impacts observed in soil boring SB-65, located downgradient from the former naphtha tank.

Although visual characterization of a soil sample collected from the 10-foot to 15-foot depth interval at soil boring SB-71 indicated the presence of a light sheen, analytical results for a soil sample collected from this interval indicated that BTEX compounds and PAHs were not present at concentrations greater than laboratory detection limits. Additionally, based on the analytical results for shallow subsurface soil samples (i.e., 10 feet to 15 feet below grade) collected from soil borings SB-69 though SB-73, soil in this area only contains select PAHs at concentrations that slightly exceed 6 NYCRR Part 375-6 restricted use soil cleanup objectives (SCOs) for the protection of human health under commercial future site use (commercial SCOs).

Soil samples collected from borings installed within the Fulton Street ROW did not contain COCs at concentrations above the commercial SCOs at depths less than 10 feet below grade indicating soils impacted by MGP source materials would not likely be encountered during (future) intrusive work in Fulton Street.

Select soil samples collected at depths less than 15 feet below grade in the off-site area contained individual BTEX compounds and PAHs at concentrations that slightly exceeded 6 NYCRR Part 375-6 SCOs. These samples were taken from the following locations:

- Corner of Wawayanda Avenue and Fulton Street–Soil samples collected from soil borings SB-09 (12.5 feet below grade) and SG-23 (14 to 15 feet below grade) contained BTEX compounds at concentrations slightly greater than unrestricted use SCOs.
- Front of USPS Post Office–Soil samples collected from soil borings SB-56 (1 foot to 3 feet below grade) and SB-62 (5 feet to 7 feet below grade), as well as several shallow subsurface soil samples collected during the June 2010 USPS post office investigation, contained BTEX compounds and PAHs at concentrations only slightly exceeding unrestricted use SCOs.

Except for visually impacted material encountered near the corner of Wawayanda Avenue and Fulton Street and the area downgradient from the former naphtha tank, there were no potentially MGP-related source materials encountered at depths shallower than 15 feet below grade in the off-site area. Therefore, the low-level concentrations of BTEX compounds and PAHs detected in soil samples collected at depths shallower than 15 feet below grade from in front of and west of the USPS post office are attributed to historic fill material deposition and are not associated with the former MGP operations.

Soil samples collected at depths greater than 15 feet below grade from soil borings completed in the off-site area generally contained the greatest concentrations of COCs. Samples collected from soil borings completed in front (east) of the USPS post office, including soil borings SB-11 (21 feet), SB-13 (32 to 34 feet), SB-30 (26 to 27 feet), and SB-57 (35 to 36 feet), contained total BTEX at concentrations ranging from 990 mg/kg to 2,500 mg/kg and total PAHs at concentrations ranging from 620 mg/kg to 5,300 mg/kg. A soil sample collected from soil boring SB-47 (23 feet to 24 feet; completed on the supermarket property) contained total BTEX and total PAHs, at concentrations of 940 mg/kg and 4,000 mg/kg, respectively.

1.6.2.3 Groundwater Quality

Similar to the extent of MGP-impacted soil, the extent of groundwater affected by the MGP historical releases has a strong correlation to the observed NAPL distribution across the site. As shown in Figure 1-7, dissolved-phase BTEX, PAHs, and/or cyanide are present in groundwater samples collected from the former MGP property, along the southern edge of Fulton Street, and near the former naphtha tank at concentrations greater than NYSDEC Class GA Standards or Guidance Values presented in NYSDEC's *Division of Water, Technical and Operational Guidance Series (TOGS 1.1.1) Ambient Water Quality Standards and Guidance Values and Groundwater Effluent Limitations* (reissued June 1998 and addended April 2000 and June 2004; USEPA 2004). The greatest concentrations of dissolved-phase BTEX and PAHs on the former MGP property were detected in groundwater samples collected from monitoring well MW-10 (located near the southwest corner of the automotive sales business). Cyanide was detected at concentrations greater than the NYSDEC Class GA Standards in groundwater samples collected from monitoring well MW-6 (located near the southwest corner of the autobody, sales, and automotive repair shops). Monitoring well MW-6 is the only location where cyanide has been detected at concentrations greater than applicable groundwater SCGs. Additionally, cyanide has not been detected in soil samples at concentrations greater than applicable soil SCGs. Therefore, based on the limited presence, cyanide is not considered a COC.

Groundwater samples collected from monitoring wells MW-2 (southwest corner of the post office downgradient of the former naphtha tank), MW-8 and MW-11 (in front of the post office), and MW-19 (near the west corner of Fulton and Canal street) each contained BTEX and PAHs at concentrations greater than NYSDEC Class GA Standards or Guidance Values. The highest concentrations of BTEX compounds were observed in a groundwater sample collected in 1999 from monitoring well MW-19 (located near the southwest corner of the intersection of Fulton and South Streets) which contained benzene at a concentration of 16,000 micrograms per liter (µg/L). As indicated above, NAPL has historically accumulated in monitoring wells MW-8, MW-11, MW-20, each located in front of the USPS post office property. Groundwater samples collected from monitoring wells MW-8 and MW-11 have historically contained the highest concentrations of PAHs, specifically naphthalene has been detected at concentrations up to 11,000 µg/L.

Similar to DNAPL distribution, groundwater adversely affected by MGP-related materials occurs primarily in the more permeable fill and alluvium. The upper portion of the till is also expected to contain dissolved-phase COCs at concentrations greater than NYSDEC Class GA Standards or Guidance Values, particularly in areas where DNAPL has penetrated the till surface. Given the low permeability of the till, the areas where dissolved-phase COCs in groundwater are present in the till are expected to be isolated to the immediate vicinity of DNAPL. Dissolved-phase impacts in groundwater in the till unit are not expected to extend a great distance downgradient from the DNAPL.

The extent of groundwater affected by the MGP is defined in all directions by clean samples collected from wells located in areas side-gradient and downgradient from the observed NAPL-impacted soils. The downgradient extent of dissolved-phase COCs is defined by clean groundwater samples collected in 2003 and 2005 from monitoring well MW-39 (located approximately 70 feet downgradient from DNAPL observed in monitoring well MW-34). However, it should be noted that monitoring well MW-39 may not have been installed deep enough to accurately monitor dissolved-phase COCs potentially emanating from the DNAPL observed at monitoring well MW-34.

1.6.2.4 Monhagen Brook Surface Water and Sediment Quality

As indicated above, Monhagen Brook was relocated to a culvert beneath Fulton Street subsequent to the MGP closure. The FS refinement study documented that soils containing potentially mobile DNAPL are not present in the Fulton Street ROW at elevations above the culvert invert. In addition, based on sampling conducted as part of the site investigation activities, and as summarized in the bullets below, neither surface water nor sediment samples collected from Monhagen Brook in the vicinity of the site have indicated the presence of MGP-related COCs:

- Stormwater samples U-4 and U-5 were collected from catch basins located immediately upgradient and downgradient of the site (respectively). The compositional signature of the compounds detected in these samples did not appear to be related to the former MGP based on the presence of multiple VOCs, SVOCs, and inorganics typically not associated with MGP impacts. Furthermore, no significant differences were noted in the concentrations between the upstream and downstream samples, which would suggest MGP-related impacts are not affecting surface water quality in the brook.
- Surface water samples (U-6 and U-7) and a sediment sample (U-8) collected from the Monhagen Brook did not indicate the presence of site-related impacts. Surface water sample U-6 was collected approximately 1,000 feet northwest (i.e., upstream) of the site at the location where Monhagen Brook enters the culvert that runs beneath Fulton Street. Surface water sample U-7 and sediment sample U-8, were collected approximately 2,000 feet downstream of the site where Monhagen Brook exits the culvert that runs beneath Fulton Street.
- Downward vertical hydraulic gradients exist in the alluvium, suggesting that dissolved-phase COCs (associated with the DNAPL located at depth below the brook culvert) would not be moving upward into the Monhagen Brook culvert.

1.6.2.5 Soil Vapor and Indoor Air Quality

Analytical results for the soil gas and ambient air samples collected by Langan in 2003 as part of the supplemental RI were compared to New York State Department of Health (NYSDOH) background (75th percentile) and USEPA (75th percentile) indoor air VOC concentrations for screening levels. All five soil gas samples collected at the former MGP property and all eight soil gas samples collected from the USPS post office property contained BTEX compounds and additional volatile organics at concentrations greater than screening levels. Ambient air samples collected from both properties contained some BTEX compounds and other volatile organics detected in the soil gas samples. The presence of these compounds can likely be attributed to the automotive shops, which likely affect the local background air quality.

Analytical results for the indoor air, sub-slab, and soil gas samples collected by RETEC in 2005 were compared to NYSDOH background (75th and 90th percentiles) indoor air VOC concentrations for screening levels. The results of the 2005 sampling activities included the following:

- Former SUNY office buildings (newly renovated supermarket)–Most MGP-related VOCs detected in sub-slab soil gas samples collected from beneath the SUNY office building (identified as SUNY Southwinds in the March 2006 *Supplemental Remedial Investigation Addendum Report*) were within the NYSDOH background levels. Toluene and xylenes were detected in the sub-slab soil gas samples at concentrations within the same order of magnitude as the typical indoor range. As indicated in the *Supplemental Remedial Investigation Addendum Report* (GEI 2006), these levels do not affect the indoor air quality of the SUNY office building because potentially MGP-related VOCs detected in indoor samples were within the NYSDOH background levels.
- Southeast Towers–MGP-related VOCs were not detected in a soil gas sample collected from the Southeast Towers property (identified as the Fulton Plaza property in the March 2006 *Supplemental Remedial Investigation Addendum Repor*t). Indoor air sampling was not conducted at the Southeast Towers property.
- Autobody, sales, and automotive repair shops–Indoor air samples were not collected from the automotive shops based on the potential for interference from VOCs that are associated with autobody, sales, and automotive repair activities (e.g., oils, grease, lubricants, and paints). Sub-slab soil vapor samples collected from beneath the automotive shops contained elevated concentrations of toluene and total xylenes. However, the elevated concentrations are attributed to the common products used at the autobody, sales, and automotive repair shops and did not contain elevated concentrations of additional compounds typically associated with MGP-related impacts (e.g., naphthalene).
- USPS post office property–Toluene was the only MGP-related VOC that was detected at concentrations greater than the 90th percentile of NYSDOH background levels in the indoor air samples collected in the USPS post office property. Toluene was also detected in ambient air and sub-slab soil gas samples collected from the USPS post office property, but at notably lower concentrations relative to the indoor air samples. As indicated in the *Supplemental Remedial Investigation Addendum Report* (GEI 2006), these results indicate the potential presence of an internal source of toluene (toluene is a common constituent of adhesives and inks), rather than vapor intrusion from subsurface soils/impacts.

2 Identification of Standards, Criteria, and Guidelines

2.1 General

This FS Report was prepared in general conformance with the applicable guidelines, criteria, and considerations set forth in the following NYSDEC guidance, criteria, and regulations:

- DER-10–Technical Guidance for Site Investigation and Remediation, dated May 3, 2010
- 6 NYCRR Part 375–Environmental Remedial Programs, effective December 14, 2006

This section presents the SCGs that have been identified for the site.

2.2 Definition of Standards, Criteria, and Guidelines

"Standards and criteria" are cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under Federal or state law that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance.

"Guidelines" are non-promulgated criteria, advisories and/or guidance that are not legal requirements and do not have the same status as "standards and criteria." However, remedial programs should be designed with consideration given to guidance documents that, based on professional judgment, are determined to be applicable to the project (6 NYCRR 375-1.8[f][2][ii]).

SCGs will be applied so the selected remedy will conform to standards and criteria that are generally applicable, consistently applied, and officially promulgated, as well as those that are either directly applicable, or that are not directly applicable but relevant and appropriate, unless good cause (as defined in 6 NYCRR 375-1.8 [f][2][i]) exists why conformity should be dispensed with. The following is a list of examples of good cause:

- Conformity to a standard or criterion will result in greater risk to the public health and the environment.
- Conformity to a standard or criterion is technically impracticable from an engineering or scientific perspective.
- The program or project will attain a level of performance that is equivalent to that required by the standard or criterion using another method or approach.

2.3 Types of Standards, Criteria, and Guidelines

NYSDEC has provided guidance on applying the SCG concept to the RI/FS process. In accordance with NYSDEC guidance, SCGs are to be progressively identified and applied on a site-specific basis as the RI/FS proceeds. The SCGs considered for the potential remedial alternatives identified in this FS Report were categorized into the following classifications:

- Chemical-Specific SCG –These SCGs are health- or risk-based numerical values or methodologies that, when applied to site-specific conditions, result in the establishment of numerical values for each COC. These values establish the acceptable amount or concentration of chemical constituents that may be found in, or discharged to, the ambient environment.
- Action-Specific SCGs–These SCGs are technology- or activity-based requirements or limitations on actions taken with respect to hazardous waste management and remediation of the site.
- Location-Specific SCGs–These SCGs are restrictions placed on the concentration of hazardous substances or the conduct of activities solely because they occur in specific locations.

2.4 Standards, Criteria, and Guidelines

The SCGs identified for the evaluation of remedial alternatives are presented below.

2.4.1 Chemical-Specific Standards, Criteria, and Guidelines

The potential chemical-specific SCGs for the site are summarized in the attached Table 2-1.

The SCOs presented in 6 NYCRR Part 375-6 are chemical-specific SCGs that are relevant and appropriate to the Site. Specifically, the SCOs for the protection of human health based on a commercial future use are applicable based on the current Site use and zoning. Commissioner Policy-51 (CP-51) provides a uniform and consistent process for the selection of soil cleanup levels appropriate for remedial programs under the NYSDEC's jurisdiction and is intended to be used in conjunction with applicable regulations.

Chemical-specific- SCGs that potentially apply to the waste materials generated during remedial activities are the Resource Conservation and Recovery Act (RCRA) and NYS regulations regarding identifying and listing hazardous wastes outlined in 40 CFR Part 261 and 6 NYCRR Part 371, respectively. Included in these regulations are the regulated levels for the Toxicity Characteristic Leaching Procedure constituents. The Toxicity Characteristic Leaching Procedure constituent levels are a set of numerical criteria at which solid waste is considered a hazardous waste by the characteristic of toxicity. In addition, the hazardous characteristics of ignitability, reactivity, and corrosivity may also apply, depending on the results of waste characterization activities.

Another set of chemical-specific SCGs that may apply to waste materials generated at the Site (e.g., soil that is excavated and determined to be a hazardous waste) are the USEPA Universal Treatment Standards (UTSs) and Land Disposal Restrictions (LDRs), as listed in 40 CFR Part 268. These standards and restrictions identify hazardous wastes for which land disposal is restricted and define acceptable treatment technologies or concentration limits for those hazardous wastes based on their waste code characteristics. The UTSs/LDRs also provide a set of numerical criteria at which a hazardous waste is restricted from land disposal, based on the concentration of select constituents present. In addition, the UTSs/LDRs define hazardous waste soil and hazardous waste debris and specify alternative treatment standards and treatment methods required to treat or destroy hazardous constituents on or in hazardous waste debris.

Pursuant to the USEPA's "Contained-in Policy," environmental media (soil, groundwater, and sediment) and debris impacted by a hazardous waste are subject to RCRA hazardous waste management requirements until they no longer contain the hazardous waste. Specifically, environmental media/debris that has been impacted by a release of characteristic hazardous waste must be managed as hazardous waste until the media/debris no longer exhibits that characteristic (based on laboratory testing). UTS/LDR requirements will continue to apply for the waste in accordance with 40 CFR Part 268. In addition, environmental media/debris containing a listed hazardous waste must be managed as hazardous waste until the media/debris no longer contains the listed hazardous waste at concentrations exceeding health-based levels. Under certain circumstances, the UTS/LDR requirements might continue to apply. Although the USEPA has not established generic health-based "contained-in" levels for listed hazardous wastes, they authorized individual states to establish their own levels. The NYSDEC has established "contained-in" criteria for environmental media and debris, which are presented in TAGM 3028 titled, "Contained-In Criteria" for Environmental Media; Soil Action Levels (NYSDEC 1997).

Groundwater beneath the site is classified as Class GA and, as such, the New York State Groundwater Quality Standards (6 NYCRR Parts 700-705) and ambient water quality standards presented in the NYSDEC's Division of Water, Technical and Operational Guidance Series (TOGS 1.1.1) Ambient Water Quality Standards and Guidance Values and Groundwater Effluent Limitations are potentially applicable chemical-specific standards even though groundwater at the site is not currently, and will not likely in the future, be used as a potable water supply. These standards identify acceptable levels of constituents in groundwater based on potable use.

The *Guidance for Evaluating Soil Vapor Intrusion in the State of New York* (NYSDOH 2006) provides guidance on identifying and addressing current and potential human exposures to vapors associated with known or suspected volatile chemical contamination. Although vapor intrusion may also occur with "naturally occurring" subsurface gases (e.g., radon, methane, and hydrogen sulfide), the guidance discusses soil vapor intrusion in terms of environmental contamination only. The guidance is applicable anywhere a soil vapor intrusion investigation is warranted in NYS. As previously discussed, the soil vapor intrusion investigations conducted at the Site indicated indoor air quality within the buildings located on site appeared to be primarily affected by subsurface vapor intrusion or from sources not related to historical MGP operations. As previously discussed, the soil vapor intrusion investigations conducted at the site indicated that indoor air quality within the buildings located on site did not appear to be impacted by subsurface intrusion of MGP-related vapors.

2.4.2 Action-Specific Standards, Criteria, and Guidelines

Potential action-specific SCGs for this site are summarized in attached Table 2-2.

Action-specific SCGs include general health and safety requirements, as well as general requirements regarding handling and disposal of waste materials (including transportation and disposal, permitting, manifesting, disposal, and treatment facilities), discharge of water generated during implementation of remedial alternatives, and air monitoring requirements for site activities (including permitting requirements for on-site treatment systems).

The NYSDEC Division of Air Resources policy document *DAR-1 Guidelines for the Evaluation and Control of Ambient Air Contaminants Under Part 212* (NYSDEC 2016) incorporates applicable federal and NYS regulations and requirements pertaining to air emissions, which may be applicable for soil or groundwater alternatives that result in certain air emissions.

New York Air Quality Standards provide requirements for air emissions (6 NYCRR Part 257). Emissions from remedial activities will meet the air quality standards based on the air quality class set forth in the NYS Air Quality Classification System (6 NYCRR Part 256) and the permit requirements in New York Permits and Certificates (6 NYCRR Part 201).

Community air monitoring may be required in accordance with the NYSDOH Generic Community Air Monitoring Plan (CAMP) included in Appendix 1A of DER-10.

One set of potential action-specific SCGs for the site consists of the LDRs, which regulate land disposal of hazardous wastes. LDRs are applicable to alternatives involving the disposal of hazardous waste (if any). Because MGP wastes resulted from historical operations that ended before the passage of RCRA, material containing MGP-related impacts is only considered a hazardous waste in New York if it is removed (generated) and it exhibits a characteristic of a hazardous waste. However, if the impacted material only exhibits the hazardous characteristic of toxicity for benzene (D018), it is conditionally exempt from the hazardous waste management requirements (6 NYCRR Parts 370 through 374 and 376) when destined for thermal treatment. Specific to management of waste containing coal tar, NYSDEC has issued an MGP program policy guidance document *TAGM HWR-4061, Management of Coal Tar Waste and Coal Tar Contaminated Soils and Sediment from Former Manufactured Gas Plants* (NYSDEC 2002), which states coal tar waste, as well as soils and sediment that have been contaminated with coal tar waste from former MGPs 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.

The NYSDEC will no longer allow amendment of soil at MGP sites with lime kiln dust and quick lime containing greater than 50% calcium/magnesium oxide due to vapor issues associated with free oxides. Guidance issued in the form of a letter from the NYSDEC to the NYS utility companies[1] indicated lime kiln dust/quick lime will not be permitted for use during future remedial activities.

The U.S. Department of Transportation (USDOT) and NYS rules for the transport of hazardous materials are provided in 49 CFR Parts 107 and 171.1 through 172.558 and 6 NYCRR 372.3. These rules include procedures for packaging, labeling, manifesting, and transporting hazardous materials and are potentially applicable to the transport of hazardous materials under any remedial alternative. NYS requirements for waste transporter permits are included in 6 NYCRR Part 364, along with standards for collection, transport, and delivery of regulated wastes within New York. Contractors transporting waste materials off site during the selected remedial alternative must be properly permitted.

Remedial alternatives conducted within the site must comply with applicable requirements outlined under the Occupational Safety and Health Administration (OSHA). General industry standards are outlined under OSHA (29 CFR 1910) that specify time-weighted average concentrations for worker exposure to various compounds and training requirements for workers involved with hazardous waste operations. The types of safety equipment and procedures to be followed during site remediation are specified under 29 CFR 1926, and recordkeeping and reporting-related regulations are outlined under 29 CFR 1904.

In addition to OSHA requirements, the RCRA (40 CFR Part 264) preparedness and prevention procedures, contingency plan, and emergency procedures are potentially relevant and appropriate to those remedial alternatives that include generation, treatment, or storage of hazardous wastes.

2.4.3 Location-Specific Standards, Criteria, and Guidelines

Potential location-specific SCGs for the site are summarized in attached Table 2-3. Examples of potential location-specific SCGs include regulations and federal acts concerning activities conducted in floodplains, wetlands and historical areas, and activities affecting navigable waters and endangered/threatened or rare species. Based on the Federal Emergency Management Agency (FEMA) National Flood Insurance Program Map Number 36071C0258E, dated August 3, 2009, portions of the site (i.e., Fulton Street, parts of the USPS post office property parking area, and parts of the supermarket and Southeast Towers properties) are located within the limits of a 100-year floodplain. Location-specific SCGs also include local requirements, such as local building permit conditions for permanent or semi-permanent facilities constructed during the remedial activities (if

[1] Letter from Robert W. Schick, NYSDEC Director – Remedial Bureau C, Division of Environmental Remediation to Con Edison, Orange and Rockland Utilities, Central Hudson Gas and Electric, NYS Electric and Gas, and National Grid regarding: Use of Quicklime and Other Materials, dated May 20, 2008.

any), Middletown Department of Public Works street work permit permits, and influent/pre-treatment requirements for discharging water to the publicly-owned treatment works (POTW).

3 Development of Remedial Action Objectives

3.1 General

This section presents the RAOs for impacted media identified at the site. These RAOs represent medium-specific goals that are protective of public health and the environment (NYSDEC 2010a). These RAOs were developed by considering the results of the site investigation activities (specifically the Risk Assessment conducted as part of the Supplemental RI) and with reference to potential SCGs, as well as current and foreseeable future anticipated uses of the site. RAOs are developed to specify the COCs within the site and to assist in developing goals for cleanup of COCs in each medium requiring remediation.

3.2 Risk Assessment

A qualitative risk assessment to evaluate potential exposure pathways was conducted as part of the RI activities and summarized in the *Final Remedial Investigation Report* (Langan 2004). An exposure pathway is complete only if all the following conditions are present:

- A source of COCs.
- Transport of COCs from the source through any environmental medium (i.e., soil, groundwater, indoor air, or soil vapor).
- A receptor (e.g., construction worker/utility worker, site worker, or the public) may potentially be exposed to the COCs.
- A point of contact for COCs to be taken in by the receptor (e.g., through dermal contact, ingestion, and/or inhalation).

Potential sources of COCs include NAPL and soil, groundwater, and soil vapor containing MGP-related compounds at concentrations above SCGs. Exposure pathways are based on current use of the site and the anticipated future use of the site (assumed to be consistent with the current use). Potential receptors include the following:

- Current (or future) site workers who are (or will be) present at the site on a routine basis
- Construction workers (e.g., workers who could be exposed on a short-term basis such as during construction activities)
- General populations located near the site

Table 3-1 presents the results of the qualitative human health exposure assessment, followed by a summary of the conclusions presented in the 2004 Risk Assessment.

Table 3-1
Qualitative Human Health Exposure Assessment Results

Media	Construction/Utility Worker			Commercial Occupant/Visitor		
	Dermal	Ingestion	Inhalation	Dermal	Ingestion	Inhalation
Surface Soil	I	I	I	I	I	I
Subsurface Soil	P	P	P	I	I	I
Groundwater	P	P	P	I	I	I
Surface Water	I	I	I	I	I	I
Indoor Air	I	I	I	I	I	I

Notes: Results summarized from *Final Remedial Investigation Report* (Langan 2004)
1. Considers MGP-related compounds only
I: Incomplete Exposure Pathway
NA: not applicable
P: Potentially Complete Exposure Pathway

- Surface soil–Most of the surfaces at the site consist of paved roadways, sidewalks, buildings, and landscaped/vegetated areas. Soils containing MGP-related COCs are generally encountered at depths of greater than 5 feet below grade. Therefore, surface soil does not represent a complete exposure pathway.
- Subsurface Soil–Site workers that complete routine activities (i.e., USPS post office and automotive shop employees) are not likely to be exposed to MGP-related impacts in subsurface soils due to the depth of the impacted media and the existing surface materials that provide a physical barrier to the impacted media. The most significant potential for human exposure to MGP-related impacts in subsurface soil would be direct contact by construction workers conducting excavation activities. NAPL and subsurface soils impacted by MGP-related materials are generally encountered at depths greater than 5 feet below grade at the former MGP property and at depths greater than 15 feet below grade at the USPS post office and supermarket properties. Construction workers, other site workers, and nearby residents may potentially be exposed to airborne VOCs and dust during intrusive work (i.e., excavation activities).
- Groundwater–Local businesses and residences at and in the vicinity of the site obtain water from a public water supply. Therefore, groundwater potentially containing MGP-related impacts used for potable purposes does not represent a complete exposure pathway.

However, based on the depth to groundwater, construction workers may be exposed (via incidental ingestion or dermal contact) to groundwater containing dissolved-phase COCs during subsurface excavation activities.

- Surface Water–Monhagen Brook is classified as a Class D waterbody (secondary contact recreation) and is not a suitable supply for drinking water. Potential human exposures would be limited to recreational uses (e.g., wading, fishing); however, the brook is not considered a suitable source for recreation or fishing. Monhagen Brook surface water and sediment do not contain MGP-related impacts. Therefore, surface water does not represent a complete exposure pathway.
- Indoor Air–Based on the analytical results of sub-slab, soil vapor, ambient air, and indoor air samples collected from the various properties and associated buildings at the site, indoor air within buildings in the off-site area is not, or does not have the potential to be, impacted with MGP-related organics. Although soil vapor and sub-slab vapor samples collected from the former MGP property contained elevated concentrations of toluene and xylene (which are associated with several products typically used with automobile repair), the soil gas did not contain elevated concentrations of compounds typically associated with MGP operations (e.g., naphthalene). Therefore, there does not appear to a complete exposure pathway to indoor air associated with MGP-related impacts.

3.3 Remedial Action Objectives

RAOs are medium-specific goals that, if met, would be protective of public health and the environment relative to the environmental concerns identified at the site. Potential site-wide remedial alternatives will be evaluated relative to their ability to meet the RAOs and their ability to be protective of public health and the environment. The RAOs for the site, in consideration of COCs and MGP-related source materials (e.g., DNAPL), exposure pathways, and receptors, are presented in Table 3-2.

Table 3-2
Remedial Action Objectives

RAOs for Soil	
Public Health Protection	1. Prevent, to the extent practicable, ingestion/direct contact with MGP-related COCs/NAPL.
	2. Prevent, to the extent practicable, inhalation of or exposure to MGP-related VOCs from MGP-related COCs/NAPL.
Environmental Protection	3. Address, to the extent practicable, MGP-related COCs/materials that could result in impacts to groundwater.

RAOs for Groundwater	
Public Health Protection	4. Prevent, to the extent practicable, ingestion of groundwater containing dissolved-phase COCs at concentrations exceeding NYSDEC groundwater quality standards and guidance values.
	5. Prevent, to the extent practicable, contact with or inhalation of VOCs from groundwater containing MGP-related COCs at concentrations exceeding NYSDEC groundwater quality standards and guidance values.
Environmental Protection	6. Restore groundwater quality to pre-disposal/pre-release conditions, to the extent practicable.
	7. Address the source of groundwater impacts to the extent practicable.

4 Technology Screening and Development of Remedial Alternatives

4.1 General

The objective of the technology screening is to identify general response actions (GRAs), associated remedial technology types, and technology process options, and then narrow the universe of process options to those with documented success at achieving similar RAOs at former MGP sites to identify options that are implementable and potentially effective at addressing soils and groundwater which exceed RAOs at the site. Based on this screening, remedial technology types and technology process options were eliminated or retained and subsequently combined into potential site-wide remedial alternatives for further, more detailed evaluation. This approach is consistent with the screening and selection process provided in DER-10.

This section identifies potential remedial alternatives to address affected site media, specifically subsurface soils and groundwater containing MGP-related COCs (including coal tar DNAPL) at concentrations above SCGs. As an initial step, GRAs potentially capable of addressing soils and groundwater were identified. GRAs are medium specific- and may include various non-technology-specific actions such as treatment, containment, institutional controls (ICs), and excavation, or any combination of such actions. Based on the GRAs, potential remedial technology types and process options were identified and screened to determine the technologies and associated process options that were the most appropriate for the Site. Technologies and process options that were retained through the screening were used to develop potential remedial alternatives. Detailed evaluations of these assembled remedial alternatives are presented in Section 5.

According to DER-10, the term "technology type" refers to a general category of technologies appropriate to site-specific conditions and COCs such as chemical treatment, immobilization, biodegradation, and capping. The term "technology process option" refers to a specific process within a technology type. For each GRA identified, several technology types and associated technology process options were identified. In accordance with DER-10, each remedial technology type and its associated technology process options are briefly described and screened, on a medium-specific basis, to identify those that are technically implementable and potentially effective given site-specific conditions. This approach was used to determine if the application of a particular remedial technology type and technology process option would be applicable given site-specific conditions for remediation of soil and groundwater.

4.2 Identification of Remedial Technologies

Remedial technology types that are potentially applicable for addressing soil and groundwater were identified through a variety of sources, including vendor information, engineering experience, and review of available literature that included the following documents:

- *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA* (USEPA 1988b)
- *DER-31/Green Remediation* (NYSDEC 2011)
- *DER-33/Institutional Controls: A Guide to Drafting and Recording Institutional Controls* (NYSDEC 2010b)
- *Technology Screening Guide for Treatment of CERCLA Soils and Sludges* (USEPA 1988c)
- *Remediation Technologies Screening Matrix and Reference Guide* (USEPA 2002)
- Management of MGP Sites (GRI 1996)

According to USEPA guidance (USEPA 1988b) and DER-10, remedial technology types and process options can be identified by drawing on a variety of sources, including regulatory references and standard engineering texts not specifically directed toward environmental remediation sites. Although each former MGP site offers its own unique site characteristics, the evaluation of remedial technology types and process options that are applicable to MGP-related COCs, or have been implemented at other MGP sites, is well documented. This collective knowledge and experience, and regulatory acceptance of previous feasibility studies performed on MGP-related sites with similar impacts, were used to reduce the universe of potentially applicable process options for the Site to those with documented success in achieving similar RAOs.

Chapter 4 of DER-10 also notes that technology types and process options should be identified based on site-specific conditions (including contamination). The former MGP property's current configuration and use as an active business in the City of Middletown, as well as the other commercial businesses within the site will be considered when identifying appropriate technology types and process options.

4.3 General Response Actions

Based on the RAOs identified in Section 3, the following GRAs have been established for soil and groundwater containing MGP-related COCs:

- No Action
- Institutional Controls/Engineering Controls
- In-Situ Containment/Controls
- In-Situ Treatment
- Removal
- Ex Situ On-Site Treatment and/or Disposal (soil and groundwater only)

- Off-Site Treatment and/or Disposal

4.4 Remedial Technology Screening Criteria

Potentially applicable remedial technology types and technology process options were identified for each of the GRAs and were subjected to preliminary and secondary screening to retain the technology types and process options that could be implemented and would potentially be effective at achieving the RAOs established for the site. As presented above, for the purposes of the screening evaluations, remedial technology type refers to a general category of technologies, such as capping or immobilization, while the technology process option (e.g., asphalt cap, jet-grouting) is a specific process within each remedial technology type.

Screening was conducted to identify potential technologies and technology processes to address soil and groundwater. RAOs have been developed for soil and groundwater and subsequently include remedial objectives for NAPL (primarily coal tar DNAPL) within these media. Criteria used to complete the preliminary and secondary screening are presented in the following subsections.

For this FS Report, the various alternatives for off-site treatment or disposal of impacted media (e.g., subsurface soil) that may be removed from the Site (if a removal remedy is selected) were not evaluated. This was purposely done to avoid committing O&R to a specific process option at this time, and to allow for an evaluation of costs of potential off-site disposal/treatment facilities at the time that the preferred alternative is implemented. Disposal/treatment facility costs may fluctuate significantly based on season, market conditions and facility capacity, along with the actual methods of off-site disposal. For alternative evaluation purposes, this FS Report does, however, include an estimated unit cost for off-site low temperature thermal desorption (LTTD) of materials, where appropriate.

4.4.1 Preliminary Screening

Preliminary screening was performed to reduce the number of potentially applicable technology types based on technical implementability and effectiveness (long- and short-term). Technical implementability was determined using existing site conditions (including physical above-grade obstructions posed by active businesses) as well as site characterization data to screen out remedial technology types and technology process options that could not reasonably or practicably be implemented. The effectiveness of a technology is measured by its ability to meet the established RAOs.

4.4.2 Secondary Screening

The technology process options retained through preliminary screening were subjected to a secondary screening to further evaluate potential means to address impacted site media and choose, when possible, one representative remedial technology process option for each retained remedial technology type to simplify the subsequent development and evaluation of the remedial alternatives. Technology process options were evaluated in relative terms to other technology process options of the same remedial technology type using the following criteria:

- Effectiveness–This criterion is used to evaluate each technology process option relative to other process options within the same remedial technology type. This evaluation focused on the following process options:
  - Ability to meet and continue to meet the RAOs in the future
  - Impacts to public health and the environment during the construction and implementation phase
  - Reliability with respect to the nature and extent of impacts and site conditions
- Implementability– Implementability encompasses the technical and administrative feasibility of implementing a process option. Because technical implementability was considered during the preliminary screening, this subsequent, more detailed evaluation places more emphasis on the institutional aspects of implementability (e.g., the ability to obtain necessary permits for off-site actions and the availability of treatment, storage, and disposal services). This criterion also evaluates the ability to construct and reliably operate the technology process option, as well as the availability of specific equipment and technical specialists to design, install, and operate and maintain the remedy.
- Relative Cost–This criterion evaluates the overall cost required to implement the remedial technology. As a screening tool, relative capital and operation and maintenance (O&M) costs are used rather than detailed cost estimates. For each technology process option, relative costs are presented as low, moderate, or high. Costs are estimated based on engineering judgment and industry experience.

4.5 Remedial Technology Screening Results

Based on the results of the secondary screening, the remedial technology types and process options that were retained for further evaluation are discussed below. The basis of selection for each representative subsurface soil, groundwater and NAPL remedial technology type and process option is briefly presented.

As required by DER-10, the "No Action" technology has been included and retained through the screening evaluation. The "No Action" GRA will serve as a baseline for comparing the potential overall effectiveness of the other technologies. Additionally, evaluation of technologies that would restore the site to "pre-disposal conditions" is also required. However, as discussed in Section 4.7, remediation to pre-disposal conditions is not implementable or practicable for this site.

A summary of the preliminary and secondary screening of remedial technologies to address impacted soil, groundwater, and NAPL is presented in the following subsections and in Tables 4-1, 4-2, and 4-3, respectively.

4.5.1 Soil

This section describes the basis for retaining representative soil remedial technology types and technology process options through the technology screening. Note that surface soils at the site are not considered impacted by historical MGP operations and the evaluation of technology types and process options is focused on subsurface soils.

4.5.1.1 No Action

No action would be completed to address impacted soil. The "No Action" alternative is readily implementable at no cost and was retained to serve as a baseline against which other alternatives will be compared.

4.5.1.2 Institutional Controls

Remedial technology types associated with this GRA consist of non-intrusive administrative controls focused on minimizing potential exposure to impacted media. ICs would be utilized to limit permissible future site uses, as well as establish health and safety requirements to be followed during subsurface activities that could result in a construction worker's exposure to MGP-impacted soil or groundwater. Typical IC mechanisms include placement of a deed restriction or environmental easement on the affected Site.

Deed restrictions/environmental easements are not applicable to off-Site properties, including roadways or publicly-owned land. For properties that are off-Site or are publicly-owned, including roadways, types of ICs that can be implemented include zoning restrictions, deed notices, public health advisories, and informational devices.

Institutional controls will not achieve soil RAOs as stand-alone processes because these measures would not treat, contain, or remove impacted soil. However, this process option was retained because ICs can be readily implemented (at a relatively low cost) in conjunction with other remedial technologies to reduce the potential for exposure to impacted soil.

4.5.1.3 Engineering Controls

The remedial technology type identified and retained under this GRA consisted of surface controls. The existing cover materials would be maintained to provide continued protection against potential exposure to subsurface soil containing COCs.

4.5.1.4 In Situ Containment/Control

Capping and containment were identified as potentially suitable remedial technology types for in-situ containment/controls. The capping options reviewed as part of the secondary screening included clay/soil, asphalt and concrete caps. Containment options included sheet pile and slurry walls.

The capping options are readily implemented, and their relative costs are comparable (moderate). Due to the continued use of the site (following completion of remedial activities) as a parking area and/or storage area for equipment, the clay/soil cap technology process option was not retained because soil cap types are not suitable for use in high-traffic areas. The asphalt/concrete cap was not retained because the existing cover materials have been shown to be protective of human health and will be retained in each site-wide alternative as a surface control. In addition, overall the capping option was not retained for further evaluation because MGP-related impacts are not present in the shallow surface soils (i.e., less than 3 feet below grade). Therefore, construction of a site cap would not provide any additional reduction to potential future exposures to site impacts.

Containment process options (such as slurry walls or sheet pile walls) were not retained for secondary screening due to nature of subsurface materials at the Site (specifically, the presence of a fractured till layer) as well as the presence of upward hydraulic gradients in certain areas at the site. Installation of any low-permeability containment wall could cause changes in local groundwater flow patterns, including raising the groundwater table elevation in site areas with upward hydraulic gradients.

4.5.1.5 In Situ Treatment

Remedial technology types associated with this GRA consist of those that treat or stabilize impacted soil in situ (i.e., without removal). These technologies would actively address MGP-related COCs in soil to achieve the RAOs established for the site. The remedial technology types evaluated under this GRA consist of immobilization, extraction/in situ stripping, chemical treatment, and biological treatment. Technology process options screened under these remedial technology types include:

- Solidification/stabilization (immobilization)
- Dynamic underground stripping and hydrous pyrolysis/oxidation (DUS/HPO; extraction/in situ stripping)
- Chemical oxidation and surfactant enhanced chemical oxidation (chemical treatment)
- Biodegradation and soil vapor extraction/soil venting (biological treatment)

Solidification/stabilization was not retained as a standalone remedial technology. However, this technology process option may potentially be used to address small, localized areas of NAPL-impacted soil. Solidification (via large auger or bucket mixing) is not considered implementable or effective on a site-wide basis given site-specific conditions. Limited space is available on both the former MGP property and the off-site area for grout/slurry mixing and material handling. The presence of subsurface obstructions (i.e., former MGP structures and utilities) further limits the implementability of solidification/stabilization on the former MGP property. Solidification/stabilization would likely only be able to be achieved using jet-grouting methods.

As indicated in Section 1.6.2, MGP-related coal tar DNAPL appears to have pooled in localized low areas in the till surface at several locations. These areas may be very difficult to stabilize due to physical constraints. Solidification/stabilization may not be effective at addressing DNAPL-impacted soils immediately above (i.e., within 5 feet to 10 feet of) the till due the density of soils (standard penetration testing indicated blow counts N>30), as well as the potential presence of cobbles greater than 6 inches in size in any dimension. The undulating till surface presents additional challenges for stabilizing impacted soil to the top of the till surface (because mixing augers may bind or otherwise jam on the sloped edges of the till surface). DNAPL and impacted media below the top of the till could not be treated based on equipment limitations (mixing augers and buckets are not effective in stabilizing dense soils like till). Finally, stabilization of a large volume of material would change the hydrogeologic characteristics at the site, and without complete treatment of MGP-impacted materials, the altered groundwater flows and gradients may serve to mobilize previously stable NAPL laterally or vertically downward farther into the till below the stabilized mass.

Based on the results of the screening, DUS/HPO, chemical oxidation, biodegradation, and soil vapor extraction/soil venting were not retained for further evaluation due to implementation challenges and general ineffectiveness at addressing heavily impacted soil. Additionally, each of these processes would require long-term operation and monitoring due to the nature of site impacts.

Specific concerns related to DUS/HPO include the potential for the uncontrolled migration of NAPL and the presence of underground structures and obstructions that could limit the effectiveness of the technology process option. DUS/HPO could also increase the potential for soil vapor intrusion due to the increased volatilization of organics from impacted soils. DUS/HPO is typically more effective for addressing chlorinated solvents. Relative costs associated with DUS/HPO are high.

Pilot studies conducted at other former MGP sites have shown in situ chemical oxidation (ISCO) (including surfactant enhanced ISCO) is only partially effective in the treatment of soil containing MGP-related impacts. ISCO has been shown to be effective at treating the dissolved-phase impacts associated with the NAPL but does not effectively treat soil containing MGP-related impacts. Multiple applications with large quantities of highly reactive oxidants would be required due to the nature of site impacts. Based on the ineffectiveness in addressing impacted soil, oxidant would need to be administrated throughout the long-term. The presence of underground utilities and associated preferential pathways on the former MGP property, as well as the limited space on the former MGP property and in the off-site area available for process chemical storage, reduces implementability. Similar to DUS/HPO, potential soil vapor intrusion concerns are associated with chemical oxidation. The relative costs to implement chemical oxidation are high.

Biodegradation and soil vapor extraction/soil venting are relatively ineffective processes for addressing the heavier hydrocarbons and PAHs associated with MGP-related impacts in soil, and the treatment systems would likely need to operate for an indefinite period to have a measurable effect. Based on the ineffectiveness at addressing impacted soil, neither of these processes was retained.

4.5.1.6 Removal

Removal is a proven technology to address impacted material and would achieve several RAOs. When combined with proper handling of the excavated material, this technology process would be effective at minimizing potential risks to current and future on-site workers and residents. Excavation could be implemented (i.e., equipment and contractors needed to complete soil removal are readily available). However, the presence of active high-use roadways, the Monhagen Brook culvert, and the density of buildings/structures that are currently present near and/or above impacted materials would make side-wide soil removal difficult. Extensive excavations below roadways, the culvert, and existing buildings located within site are considered impracticable. Therefore, site-wide excavations would be significantly difficult to implement at the site. Targeted excavations (e.g., in open area without buildings and select portions of roadways) would generally be more implementable. The anticipated relative capital cost of removal is high.

4.5.1.7 Ex Situ On-Site Treatment and/or Disposal

Remedial technology types associated with this GRA consist of measures to treat impacted soil on-site after soil has been excavated or otherwise removed from the ground. The remedial technology types evaluated under this GRA consist of immobilization, extraction, thermal destruction, chemical treatment, and disposal. The following technology process options were screened under these remedial technology types:

- Solidification/stabilization (immobilization)
- LTTD (extraction)
- Incineration (thermal destruction)
- Chemical oxidation and soil washing (chemical treatment)
- Solid waste landfill and Subtitle C landfill (disposal)

Due to the current and anticipated future uses of the site and the surrounding areas (i.e., commercial/urban setting), none of the ex situ on-site treatment and/or disposal technology types and associated technology process options are considered practicable, technically implementable, or administratively feasible given the density of the buildings and population, lack of available space, lack of public acceptance, and potential for exposures during on-site treatment or disposal.

The solidification/stabilization technology process option has been retained for detailed analysis in conjunction with off-site disposal. This technology process option may be utilized to remove free liquids from excavated soils prior to off-site transportation and disposal

4.5.1.8 Off-Site Treatment and/or Disposal

Remedial technology types associated with this GRA consist of measures to treat or dispose of impacted soil at off-site locations after soil has been removed from the ground. The remedial technology types evaluated for this GRA consist of recycle/reuse, thermal destruction, extraction, and disposal. Technology process options screened under these remedial technology types include:

-
- Incineration (thermal destruction)
- LTTD (extraction)
- Solid waste landfill and Subtitle C landfill (disposal)

Fuel blending/co-burn in utility boiler, LTTD, and off-site disposal at a solid waste landfill were all retained for further evaluation. The relative cost for fuel blending and LTTD options is moderate and both are considered an effective means for treating soil containing MGP-related impacts. Disposal at an off-site soil waste landfill would be reserved for material that could not be reused as on-site fill and that was not appropriate for treatment via LTTD (e.g., concrete and debris). The final off-site treatment or disposal of waste materials will be evaluated as part of the remedial design for the selected site remedy. This will allow for an evaluation of the costs associated with these potential off-site treatment/disposal processes, which can fluctuate significantly based on season, market conditions, and treatment/disposal facility capacity. In addition, multiple off-site treatment technologies could be utilized to treat or dispose of media with different concentrations of COCs. However, for preparing this FS Report, the LTTD and solid waste landfill alternatives are assumed as the off-site treatment/disposal technology process options for hazardous (D018) and non-hazardous materials (respectively) that may be generated during implementation of a remedial alternative.

Incineration and Subtitle C landfill technology processes were not retained through the technology screening. The relative cost for incineration is high and, although incineration would be an effective means for treating soil containing MGP-related impacts, LTTD is equally effective for treating impacted soil at a lower cost. Disposal at a Subtitle C landfill was not retained as an option because material that is characteristically hazardous would still require pre-treatment to meet NYS UTSs/LDRs prior to disposal.

4.5.2 Groundwater

This section describes the basis for retaining representative groundwater remedial technology types and technology process options through the technology screening.

4.5.2.1 No Action

No action would be completed to address impacted groundwater. The "No Action" alternative is readily implementable at no cost and was retained to serve as a baseline against which other alternatives will be compared.

4.5.2.2 Institutional Controls

Remedial technology types associated with this GRA generally consist of non-intrusive administrative controls used to minimize the potential for contact with, or use of, site groundwater. The remedial technology type screened under this GRA consisted of ICs. Technology process options for ICs include deed restrictions, groundwater use restrictions, zoning restrictions, deed notices, public health advisories, and informational devices. This technology process is considered readily implementable; therefore, it was retained for further evaluation. Because ICs would not treat, contain, or remove any COCs in site groundwater, ICs alone would not achieve the RAOs established for the site. However, ICs would work toward the RAOs of preventing potential human exposures to groundwater containing COCs. Institutional controls could enhance the effectiveness of other technology types/technology process options at a relatively low cost when included as part of a site-wide remedy.

4.5.2.3 In Situ Containment/Controls

Remedial technology types associated with this GRA involve addressing impacted groundwater without removal or treatment. The remedial technology type evaluated under this GRA consisted of containment. Technology process options screened under this remedial technology type consisted of sheetpile walls, slurry walls, and high-density polyethylene (HDPE) liners. Based on the presence of the fractured till and the undulating nature of the top of till surface, containment options would not be effective at preventing groundwater flow to and from areas containing MGP-related impacts. Therefore, none of the containment process options were retained.

4.5.2.4 In Situ Treatment

Remedial technology types associated with this GRA involve addressing impacted groundwater without removal. Remedial technology types evaluated under this GRA consist of biological treatment and chemical treatment. The following technology process options were screened under these remedial technology types:

- Groundwater monitoring, enhanced biodegradation, and biosparging (biological treatment)
- Chemical oxidation and permeable reactive barrier (PRB; chemical treatment)

Although groundwater monitoring alone, without source removal, will likely not achieve groundwater RAOs, this technology process was retained as a measure to monitor and document groundwater conditions over time based on implementability and low relative costs.

None of the other in situ treatment remedial technology processes were retained through secondary screening. Enhanced biodegradation, biosparging, and chemical oxidation were not retained because these processes would not be an effective means for treating NAPL (i.e., the source for dissolved-phase impacts). Additionally, without a means to address the source for dissolved-phase impacts (i.e., NAPL-impacted soil), ongoing treatment of dissolved-phase COCs in groundwater (i.e., enhanced biodegradation, biosparging, and chemical oxidation) would not be a cost-effective means for addressing impacted groundwater over the long-term.

Past studies (Doherty et al. 2006) have found that PRBs designed to address MGP-related impacts were generally highly sorptive and did not inhibit microbiological activity; however, leaching tests revealed that the medium would fail as a long-term barrier material. Therefore, periodic replacement of the wall material would be required. PRBs were not retained for further evaluation based on the nature and extent of dissolved-phase impacts, the relatively low potential for exposure to impacted groundwater, and the implementability difficulties associated with installing and maintaining a PRB in a commercial/urban setting on property not owned by O&R, as well as the difficulty of installing a PRB into the till layer.

Chemical oxidation was not retained for further evaluation because significant constraints exist that may limit the application of this process option, including the presence of underground utilities and associated preferential pathways for the oxidant, the presence of underground obstructions (e.g., former MGP structures) on the former MGP property, the limited space available on the former MGP property and in the off-site area for process chemical storage/generation of ozone, and the potential to cause soil vapor intrusion in the commercial/urban site setting. A bench-scale treatability study would be required to estimate oxidant demand; however, it is anticipated multiple treatments would be costly and highly reactive oxidants would likely be required.

4.5.2.5 Removal

Remedial technology types associated with this GRA consider removal of groundwater containing MGP-related impacts for treatment and/or disposal. The remedial technology type evaluated under this GRA consisted of hydraulic removal. Technology process options screened under this remedial technology type included vertical extraction wells and horizontal extraction wells.

In general, inefficiencies associated with pump-and-treat technologies exist, including the overall ineffectiveness of treating source material (especially PAHs and NAPL that have high soil organic carbon-water partitioning coefficient values and; therefore, do not dissolve rapidly), large volumes of water that would require removal and treatment, and the limited space to construct and operate pump-and-treat equipment. Installation of horizontal extraction wells includes use of specialized drilling equipment that requires a large amount of space, and subsurface site conditions (e.g., multiple obstructions, and subsurface utilities) are not suitable for the installation of horizontal wells. Therefore, vertical and horizontal extractions wells were not retained for further evaluation.

4.5.2.6 Ex Situ On-Site Treatment

Remedial technology types associated with this GRA consider the on-site treatment of extracted impacted groundwater. The remedial technology types evaluated under this GRA consisted of chemical treatment and physical treatment. Technology process options screened under these remedial technology types included:

- Ultraviolet (UV) oxidation and chemical oxidation (chemical treatment)
- Carbon adsorption, filtration, air stripping, precipitation/coagulation/flocculation, and oil/water separation (physical treatment)

As indicated above, no groundwater extraction technology process options were retained through the technology screening. Therefore, ex situ on-site treatment technology process options will not be required. Additionally, similar to the ex situ on-site soil treatment technologies, due to the current and anticipated future uses of the site and the surrounding areas (i.e., commercial/urban setting), none of the ex situ on-site groundwater treatment technology process options are considered practicable, technically implementable, cost effective, or administratively feasible given the density of the building spacing and population, lack of available space, lack of public acceptance, and potential for long-term exposures as a result of the construction and operation of an on-site water treatment system. Note, although not retained, ex situ on-site treatment technology process options may be used in support of other remedial technology processes (i.e., treatment of groundwater removed during excavation activities).

4.5.2.7 Off-Site Treatment and/or Disposal

Remedial technology types associated with this GRA consider the off-site treatment/disposal of extracted groundwater. The remedial technology type evaluated under this GRA consisted of groundwater disposal. Technology process options screened under this technology type included: discharge to a local POTW, discharge to surface water via a storm sewer, and discharge to a privately-owned and commercially operated treatment facility.

As indicated above, groundwater extraction processes are not considered effective or readily implementable; therefore, they were not retained. Potential side-wide remedial alternatives will not require an ongoing to discharge/disposal of treated/untreated groundwater removed from the subsurface. Note, although not retained, off-site treatment/disposal technology process options may be used in support of other remedial technology processes (i.e., treatment/disposal of groundwater removed during excavation activities).

4.5.3 NAPL

This section describes the basis for retaining representative remedial technology types and technology process options to address soil and groundwater affected by MGP-related NAPL through the technology screening.

4.5.3.1 No Action

No action would be completed to address NAPL. The "No Action" alternative is readily implementable at no cost and was retained to serve as a baseline against which other alternatives will be compared.

4.5.3.2 Institutional Controls

Remedial technology types associated with this GRA generally consist of non-intrusive administrative controls used to minimize the potential for contact with NAPL. The remedial technology type screened under this GRA consists of ICs. Technology process options for ICs include deed restrictions, environmental land use restrictions, zoning restrictions, deed notices, public health advisories, and informational devices. Institutional controls would be utilized to limit permissible future site uses, as well as establish health and safety requirements to be followed during subsurface activities that could result in a construction worker's exposure to NAPL.

Institutional controls will not achieve RAOs as stand-alone processes because these measures would not treat, contain, or remove NAPL. However, this process was retained because ICs can be readily implemented (at a relatively low cost) in conjunction with other remedial technologies to reduce the potential for exposure to NAPL.

4.5.3.3 In Situ Containment/Controls

Remedial technology types associated with this GRA consist of measures to address NAPL by reducing mobility and/or the potential for exposure without removal or treatment. Remedial technology types evaluated under this GRA consist of capping and containment. Technology process options screened under these remedial technology types include:

- Asphalt/concrete cap, clay/soil cap, and synthetic cap (capping)
- Sheet pile wall, slurry wall, HDPE liner (containment)

None of the capping technology process options were retained for further evaluation. Although each of these technology process options is readily implementable at low to moderate costs, NAPL is located at depths greater than 5 feet below grade on the former MGP property and at depths generally greater than 15 feet below grade in the off-site area. Therefore, construction of a cap(s) would not provide any additional reduction to potential future exposures to NAPL.

Sheet pile walls, slurry walls, and HDPE liners were all retained for further evaluation. Based on the presence of NAPL in the fractured till, site-wide containment options would not effectively reduce the potential for future NAPL migration. Although site-wide containment is not a practicable option, containment process options were retained for use in targeted areas to prevent further NAPL migration (e.g., recontamination of targeted fill/alluvium excavations) and enhance the recovery/collection of mobile NAPL.

4.5.3.4 In Situ Treatment

Remedial technology types associated with this GRA consist of those that treat or stabilize NAPL soil in situ (i.e., without removal). These technologies would actively address MGP-related NAPL to achieve the RAOs established for the site. The remedial technology types evaluated under this GRA consist of immobilization, extraction/in situ stripping, chemical treatment, and biological treatment. The following technology process options were screened under these remedial technology types:

- Solidification/stabilization (immobilization)
- DUS/HPO (extraction/in situ stripping)
- Chemical oxidation and surfactant enhanced chemical oxidation (chemical treatment)
- Biodegradation, enhanced biodegradation, and biosparging (biological treatment)

Like the technology screening conducted for soil, solidification/stabilization was retained for addressing NAPL on a small, localized basis only. Although this technology process option may be effective at treating/stabilizing some of the NAPL, it is not considered implementable or effective on a site-wide basis. Similar to solidification/stabilization of soil, challenges that exist for using this technology process option for addressing NAPL include: space restrictions for grout/slurry mixing and material handling; difficulties in stabilizing material to the top of the till surface due to the undulating nature of till surface and density of material above the till; presence of NAPL in fractured till that could not be addressed by this process option; the apparent pooling of NAPL in localized low areas of the till surface (i.e., the area that would be most difficult to successfully treat); and potential unknown changes in site hydrogeology that may mobilize previously stable NAPL.

DUS/HPO, chemical oxidation, biodegradation, enhanced biodegradation, and biosparging were not retained for further evaluation due to implementation challenges and general ineffectiveness at addressing NAPL. Additionally, each of these processes would require long-term operation and monitoring due to the nature of site impacts.

Specific concerns related to DUS/HPO include the potential for the uncontrolled migration of NAPL and the presence of underground structures and obstructions on the former MGP property that could limit the effectiveness of the technology process option. DUS/HPO could also increase the potential for soil vapor intrusion due to the increased volatilization of organics from impacted soils.

DUS/HPO is typically more effective for addressing chlorinated solvents. Relative costs associated with DUS/HPO are high.

Pilot studies conducted at other former MGP sites have shown that ISCO (including surfactant enhanced ISCO) is only partially effective in the treatment of NAPL. ISCO has been shown to be effective at treating the dissolved-phase impacts associated with the NAPL but does not effectively treat or significantly reduce NAPL volume. Multiple applications with large quantities of highly reactive oxidants would be required due to the nature of site impacts. Based on the ineffectiveness in addressing NAPL, oxidant would need to be administrated over the long-term. The presence of underground utilities and associated preferential pathways and the limited space available for process chemical storage reduces implementability. Similar to DUS/HPO, potential soil vapor intrusion concerns are associated with chemical oxidation. The relative costs to implement chemical oxidation are high.

Biodegradation, enhanced biodegradation, and biosparging are relatively ineffective processes for addressing NAPL, and it is anticipated the systems associated with these technology process options would need to operate for an indefinite period to have a measurable effect. Based on the ineffectiveness at addressing NAPL, none of these processes were retained.

4.5.3.5 Removal

Remedial technology types associated with this GRA consider removal of NAPL for treatment and/or disposal. Technology process options screened under this remedial technology type included active removal, passive removal, collection trenches/passive barrier wall, and hot water/steam injection.

Active and passive removal of NAPL technology process options were retained under this GRA based on the options' potential effectiveness for recovering NAPL, relative cost, and implementability. Collection trenches/passive barrier walls were also retained. However, large-scale trenches and passive barrier walls are not considered implementable due to the lack of space available on the former MGP property, as well as the depth of NAPL in the off-site area. Hot water/steam injection was not retained as this technology process option may facilitate uncontrolled migration of NAPL and soil vapor intrusion concerns are associated with this option.

4.5.3.6 Off-Site Treatment/Disposal

Remedial technology types associated with this GRA consider the off-site treatment/disposal of extracted NAPL. The remedial technology type evaluated under this GRA consisted of NAPL disposal. The technology process option screened under this technology type included discharge to a privately-owned and commercially operated treatment facility. As indicated above, active and passive NAPL removal were retained as a potential NAPL removal technology process options. Discharge (i.e., off-site transportation and disposal) to a privately-owned and commercially operated treatment facility is an effective means for the treatment/disposal of NAPL; therefore, it was retained through the technology screening process.

4.6 Summary of Retained Technologies

As indicated previously, results of the remedial technology screening process for soil, groundwater, and NAPL are presented in attached Tables 4-1, 4-2, and 4-3, respectively. Remedial technologies retained for soil, groundwater, and NAPL are summarized below in Tables 4-4, 4-5, and 4-6.

Table 4-4
Retained Soil Technologies

GRA	Technology Type	Technology Process Option
No Action	No Action	No action
Institutional Controls	Institutional Controls	Deed restrictions, environmental land use restrictions, enforcement and permit controls, informational devices
In Situ Treatment	Immobilization	Solidification/stabilization (small scale only, via jet-grouting)
Removal	Excavation	Excavation
Off-Site Treatment and/or Disposal	Recycle/Reuse Extraction Disposal	Fuel blending/co-burn in utility boiler, Low-temperature thermal desorption solid waste landfill

Table 4-5
Retained Groundwater Technologies

GRA	Technology Type	Technology Process Option
No Action	No Action	No action
Institutional Controls	Institutional Controls	Deed restrictions, groundwater use restrictions, enforcement and permit controls, informational devices
In Situ Treatment	Biological Treatment	Groundwater monitoring, enhanced biodegradation

Table 4-6
Retained NAPL Technologies

GRA	Technology Type	Technology Process Option
No Action	No Action	No action
Institutional Controls	Institutional Controls	Deed restrictions, environmental land use restrictions, enforcement and permit controls, informational devices
In Situ Containment/Controls	Containment	Sheet pile wall, slurry wall, HDPE liner
In Situ Treatment	Immobilization	Solidification/stabilization (small scale only, via jet-grouting)

Removal	NAPL Removal	Active removal, passive removal, collection trenches
Off-Site Treatment and/or Disposal	NAPL Disposal	Discharge to a privately owned/commercially operated treatment facility

4.7 Assembly of Site-Wide Remedial Alternatives

This section uses the retained technology types and process options presented in Section 4.5 to develop site-wide remedial alternatives capable of addressing the site-specific RAOs. DER-10 (NYSDEC 2010a) and the USEPA's, "Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA" (USEPA 1988b) both require an evaluation of the following alternatives:

- The "No-Action" alternative
- An alternative that would restore the site to pre-disposal conditions

Additional alternatives were developed in accordance with the remedy selection considerations presented in DER-10 and include those based on:

- Current, intended, and reasonably anticipated future site uses
- Removal of source areas of contamination
- Containment of contamination

These additional alternatives require varying levels of remediation but provide protection of public health and the environment by preventing or minimizing exposure to the COCs using ICs; removing COCs to the extent possible thereby minimizing the need for long-term management; and treating the COCs but varying the degree of treatment employed and long-term management needed.

Remedial alternatives that have been assembled and developed for addressing the impacted media are presented in Sections 4.7.1 through 4.7.7. Detailed technical descriptions of the remedial alternatives are presented in Section 5 as part of the detailed remedial alternative evaluations.

4.7.1 Alternative 1–No Action

No remedial activities would be completed under this alternative.

4.7.2 Alternative 2–NAPL Recovery, Groundwater Monitoring, and Institutional Controls

Under this alternative, potentially mobile NAPL on the former MGP property and in the off-site area would be collected and recovered via the installation of NAPL collection points to facilitate the recovery of mobile NAPL. NAPL collection points could include wells, trenches, or other subsurface structures that would collect and contain mobile NAPL and facilitate NAPL recovery for off-site treatment/disposal. For the purpose of developing this alternative, it has been assumed NAPL collection would be conducted using NAPL collection wells placed at local low points in the top of till surface and other locations where NAPL has historically accumulated (i.e., monitoring wells MW-11, MW-19, and MW-20). The exact number, location, and construction details of the NAPL collection points would be determined during the design of this remedial alternative. NAPL recovery activities would be conducted passively via periodically gauging and manually bailing/pumping collection wells that contain NAPL. If NAPL recovery rates are significant, NAPL recovery via an automated pumping system could be a cost-effective option. Additionally, low-flow groundwater pumping could potentially be implemented to enhance the rate of NAPL collection. Appropriate collection and recovery (i.e., passive or active) methods would be evaluated based on the rate of NAPL recovery after the collection points have been installed.

Alternative 2 would also include conducting annual groundwater monitoring to document the extent of dissolved-phase impacts and the potential trends in COC concentrations. New groundwater monitoring wells would be installed to replace damaged/destroyed wells and establish an appropriate downgradient groundwater monitoring network. Institutional controls (such as deed restrictions) would be established on the properties that comprise the former MGP as well as the off-site properties with proposed NAPL recovery and groundwater monitoring wells. The ICs would limit the future development and use of these areas (including groundwater), as well as limit the permissible invasive (i.e., subsurface) activities at the site.

4.7.3 Alternative 3–Utility Corridor Soil Removal, NAPL Recovery, Groundwater Monitoring, and Institutional Controls

Alternative 3 would include the same NAPL collection/recovery, groundwater monitoring, and institutional control components as Alternative 2. Alternative 3 would also include excavation activities to address NAPL-impacted soil and portions of former MGP structures at a depth up to 20 feet below grade in the utility corridor extending along the northern curb and sidewalk area north of Fulton Street near Canal Street.

Excavation support systems would be evaluated and developed during the design of this alternative. Material excavated from the former MGP property would be transported off-site for treatment/disposal via LTTD, and material not suitable for LTTD (e.g., concrete, debris) would be disposed of as construction and demolition (C&D) debris. Excavation areas would be backfilled to the previously existing grade with clean fill materials to provide a clean corridor for potential future subsurface utility work. A low-permeability barrier (e.g., sheetpile wall, slurry wall, HDPE liner, low-permeability backfill) would be installed along the upgradient edge of the utility corridor excavation to prevent potential contamination of clean backfill material from potentially mobile NAPL that would remain on the former MGP property. A demarcation layer would be placed within the bottom and along the sidewalls of the removal areas prior to restoration. All disturbed surfaces would be restored to pre-existing conditions.

4.7.4 *Alternative 4–Shallow Soil Removal at the Former MGP Property, NAPL Recovery, Groundwater Monitoring, and Institutional Controls*

Alternative 4 would include the same NAPL collection/recovery, groundwater monitoring, and institutional control components as Alternative 3. In addition to the removal of soil from the utility corridor (i.e., addressed under Alternative 3), Alternative 4 would also include excavating shallow soil containing visual MGP-related impacts and former MGP structures within the former MGP property up to a depth of 10 feet below grade. Excavation activities would be completed to a depth of up to 10 feet below grade to minimize the potential need to implement the Site Management Plan (SMP) on the former MGP property. Soil and former MGP structures located at depths greater than 10 feet below grade and soil beneath the automotive shops would not be removed. Excavated material would be transported off-site for treatment/disposal via LTTD. Excavation support systems would be evaluated and developed during the design of this alternative. Like Alternative 3, a demarcation layer would be placed within the bottom and along the sidewalls of the removal areas prior to restoration. Disturbed surfaces would be restored to pre-existing conditions.

4.7.5 *Alternative 5–Targeted Soil Removal at the Former MGP Property, NAPL Recovery, Groundwater Monitoring, and Institutional Controls*

Alternative 5 would include the same NAPL collection/recovery, groundwater monitoring, and institutional control components as Alternatives 3 and 4. Proposed soil removal activities under Alternative 5 would include the same excavation footprint on the former MGP property as Alternative 4. However, excavation activities at the former MGP property would be conducted to depths up to 20 feet below grade (i.e., to the top of the till surface) to remove accessible, visibly impacted soil and former structures. Soil and former MGP structures located beneath the automotive shops (which would remain under this alternative) would not be removed. Material excavated from this area would be transported off-site for treatment/disposal via LTTD. Excavation support systems would be evaluated and developed during the design of this alternative. Like Alternatives 3 and 4, a demarcation layer would be placed within the bottom and along the sidewalls of the removal areas prior to restoration. Disturbed surfaces would be restored to pre-existing conditions.

4.7.6 *Alternative 6-Slurry-Supported Soil Removal at the Former MGP Property, Utility Corridor Stabilization, NAPL Recovery, Groundwater Monitoring, and Institutional Controls*

Alternative 6 would include the same NAPL collection/recovery, groundwater monitoring, and institutional control components as Alternatives 3, 4 and 5. Proposed soil removal activities under Alternative 6 would include an expanded excavation footprint on the former MGP property as compared to Alternatives 4 and 5 and would be conducted to depths up to 20 feet below grade (i.e., to the top of the till surface) to remove accessible, NAPL-impacted soils, and former structures using slurry-supported construction techniques. Soil and former MGP structures located beneath the former MGP property (which would remain under this alternative) would not be removed. Soils beneath the utility corridor would be stabilized to provide a physical and permanent barrier between the utility corridor and MGP-related DNAPL located beneath the utility corridor. Material excavated from this area would be transported off-site for treatment/disposal via LTTD.

4.7.7 Alternative 7–Removal to 6 NYCRR Part 375-6 Unrestricted Use SCOs, NAPL Recovery, Groundwater Monitoring, and Institutional Controls

Alternative 7 would include the same NAPL collection/recovery, groundwater monitoring, and institutional control components as Alternatives 3-6. Prior to conducting remedial activities, a portion of the buildings on this property would be demolished.

Alternative 7 would include excavation of soil containing MGP-related COCs at concentrations greater than 6 NYCRR Part 375-6 unrestricted use SCOs (including all visually-impacted soils) to depths up to the top of the till surface, which was estimated to be 20 feet below grade on the former MGP site and up to 15 feet below grade in the off-site area. Note that this alternative does not include attempting to remove MGP-related COCs that may have migrated into the till layer via fractures within the till surface or MGP-related COCs within the Fulton Street right-of-way. As such, this alternative may not achieve the "track 1" objective of restoring the site to a pre-disposal condition.

Excavated material would be transported off-site for treatment/disposal via LTTD. Excavation support systems would be evaluated and developed during the design of this alternative. A demarcation layer would be placed within the bottom and along the sidewalls of the USPS post office and off-site grocery store property excavations prior to restoration. Sidewalks and roadways would be restored to pre-existing conditions.

5 Detailed Evaluation of Remedial Alternatives

5.1 General

This section presents detailed descriptions of the remedial alternatives developed to address site impacts. Each of the retained remedial alternatives is evaluated with respect to the criteria presented in 6 NYCRR Part 375 and DER-10. The results of the detailed evaluation of remedial alternatives are used to aid in the recommendation of a preferred remedial alternative for addressing impacted site media.

5.2 Description of Evaluation Criteria

The detailed evaluation of remedial alternatives presented in this section consists of an evaluation of each assembled alternative (presented in Section 4.6) against the following criteria:

- Short-term impacts and effectiveness
- Long-term effectiveness and permanence
- Land use
- Reduction of toxicity, mobility, or volume through treatment
- Implementability
- Compliance with SCGs
- Overall protection of public health and the environment
- Cost effectiveness

These evaluation criteria encompass statutory requirements and include other gauges such as overall feasibility. Descriptions of the evaluation criteria are presented in the following sections. Additional criteria, including community acceptance, will be addressed following submittal of this FS Report.

Per DER-10, sustainability and green remediation will also be considered in the remedial evaluation with the goal of improving the sustainability of the selected remedy. The evaluation will consider the alternative's ability to minimize energy use; reduce greenhouse gas and other emissions; maximize reuse/recycling of materials; and preserve, enhance, or create natural habitats. Sustainability and green remediation will be discussed under the short-term impacts and effectiveness criterion.

5.2.1 Short-Term Impacts and Effectiveness

The short-term effectiveness of the remedial alternative is evaluated relative to its potential effect on public health and the environment during implementation of the alternative. The evaluation of each alternative with respect to its short-term effectiveness will consider the following:

- Potential short-term adverse impacts and nuisances to which the public and environment may be exposed during implementation of the alternative

- Potential impacts to workers during implementation of the remedial actions and the effectiveness and reliability of protective measures
- The sustainability and use of green remediation practices used during implementation of the remedy
- Amount of time required until protection of public health and the environment is achieved

5.2.2 Long-Term Effectiveness and Permanence

The evaluation of each remedial alternative relative to its long-term effectiveness and permanence is made by considering the risks that may remain following completion of the remedial alternative. The following factors will be assessed in the evaluation of the alternative's long-term effectiveness and permanence:

- Potential impacts to public health and the environment from untreated waste or treatment residuals remaining at the completion of the remedial alternative
- The adequacy and reliability of controls (if any) that will be used to manage treatment residuals or remaining untreated impacted media

5.2.3 Land Use

This criterion evaluates the current and intended future land use of the site relative to the SCOs of the remedial alternative when unrestricted use cleanup levels would not be achieved. This evaluation considers local zoning laws, proximity to residential property, accessibility to infrastructure, and proximity to natural resources, including groundwater drinking supplies.

5.2.4 Reduction of Toxicity, Mobility, or Volume through Treatment

This evaluation criterion addresses the degree to which the remedial alternative will permanently and significantly reduce the toxicity, mobility, or volume of the COCs present in the site media. The evaluation will consider the following factors:

- The treatment process and the amount of materials to be treated
- The anticipated ability of the treatment process to reduce the toxicity, mobility, or volume of site impacts
- The nature and quantity of treatment residuals that will remain after treatment
- The degree to which the treatment is irreversible

5.2.5 Implementability

This criterion addresses the technical and administrative feasibility of implementing the remedial alternative, including the availability of the various services and materials required for implementation. The following factors will be considered during the implementability evaluation:

- Technical Feasibility–This factor refers to the relative ease of implementing or completing the remedial alternative based on site-specific constraints. In addition, the remedial alternative's constructability and operational reliability are also considered, as well as the ability to monitor the effectiveness of the remedial alternative.
- Administrative Feasibility–This factor refers to the availability of necessary personnel and material, along with potential difficulties in obtaining approvals for long-term operation of treatment systems, access agreements for construction, and acquiring necessary approvals and permits for remedial construction.

5.2.6 Compliance with Standards, Criteria, and Guidelines

This criterion evaluates the remedial alternative's ability to comply with SCGs that were identified in Section 2. Compliance with the following items are considered during evaluation of the remedial alternative:

- Chemical-specific SCGs
- Action-specific SCGs
- Location-specific SCGs

Applicable chemical-, action-, and location-specific SCGs are presented in Tables 2-1, 2-2, and 2-3, respectively.

5.2.7 Overall Protection of Public Health and the Environment

This criterion evaluates whether the remedial alternative provides adequate protection of public health and the environment. This evaluation assesses how exposure pathways are eliminated, reduced, or controlled through removal, treatment, engineering controls, or ICs. This evaluation also considers the ability of the remedial alternative to meet the RAOs.

5.2.8 Cost Effectiveness

This criterion evaluates the overall cost of the alternative relative to the effectiveness of the alternative or remedy. The estimated total cost to implement the remedial alternative is based on a present worth analysis of the sum of the direct capital costs (e.g., materials, equipment, and labor), indirect capital costs (e.g., engineering, licenses/permits, and contingency allowances), and O&M costs. O&M costs may include operating labor, energy, chemicals, and sampling and analysis. These costs will be estimated with an anticipated accuracy between -30% to +50% in accordance with

NYSDEC guidance. A 20% contingency factor is included to cover unforeseen costs incurred during implementation of the remedial alternative. Present-worth costs are calculated for alternatives expected to last more than 2 years. A 4% discount rate (before taxes and after inflation) is used to determine the present-worth factor.

5.3 Detailed Evaluation of Site-Wide Remedial Alternatives

This section presents the detailed analysis of each of the site-wide alternatives previously identified in Section 4.

- Alternative 1–No Action
- Alternative 2–NAPL Recovery, Groundwater Monitoring, and Institutional Controls
- Alternative 3–Utility Corridor Soil Removal, NAPL Recovery, Groundwater Monitoring, and Institutional Controls
- Alternative 4–Shallow Soil Removal at the Former MGP Property, NAPL Recovery, Groundwater Monitoring, and Institutional Controls
- Alternative 5–Targeted Soil Removal at the Former MGP Property, NAPL Recovery, Groundwater Monitoring, and Institutional Controls
- Alternative 6–Slurry-Supported Soil Removal at the Former MGP Property, Utility Corridor Stabilization, NAPL Recovery, Groundwater Monitoring, and Institutional Controls
- Alternative 7–Removal to 6 NYCRR Part 375-6 Unrestricted Use SCOs, NAPL Recovery, Groundwater Monitoring, and Institutional Controls

Each alternative is evaluated against the evaluation criteria described above (as indicated, public acceptance will be evaluated following submittal of this FS Report).

5.3.1 Alternative 1 – No Action

The "No Action" alternative was retained for evaluation at the site as required by DER-10. The "No Action" alternative serves as the baseline for comparison of the overall effectiveness of the other remedial alternatives. The "No Action" alternative would not involve implementation of any remedial activities to address the COCs in the environmental media. The site would be allowed to remain in its current condition, and no effort would be made to change or monitor the current site conditions.

5.3.1.1 Short-Term Impacts and Effectiveness–Alternative 1

No remedial actions would be implemented for the impacted environmental media. Therefore, there would be no short-term environmental impacts or risks associated with remedial activities posed to the community.

5.3.1.2 Long-Term Effectiveness and Permanence–Alternative 1

Under the "No Action" alternative, the COCs in site media or the potential for on-going releases and/or migration of impacts would not be addressed. As a result, this alternative is not considered effective on a long-term basis.

5.3.1.3 Land Use–Alternative 1

The current and foreseeable future use of the site is a mixed commercial/residential urban setting. The current zoning for the site is DMU-1, which allows for retail, commercial, government, professional and residential (second floor or higher) uses. Based on the current and anticipated land use of the former MGP property and off-site area, the potential for property occupant exposure to MGP-related residual materials or soil containing MGP-related COCs is minimal. Most of the site is covered with asphalt, concrete, buildings, or vegetated soil, and there is little to no need to conduct subsurface activities. Additionally, drinking water is currently and will continue to be provided via a public water supply. Therefore, groundwater containing MGP-related COCs is not and will not be used for potable (or other) purposes.

No remedial actions would be completed under this alternative, and the site would remain in its current condition. Because routine site activities do not include exposure to MGP-related impacts in soil and groundwater, the "No Action" alternative would not alter the anticipated future intended use of the site.

5.3.1.4 Reduction of Toxicity, Mobility, or Volume through Treatment–Alternative 1

Under the "No Action" alternative, environmental media would not be treated (other than by natural processes), recycled, or destroyed. Therefore, the toxicity, mobility, and volume of the COCs in the impacted environmental media would not be reduced.

5.3.1.5 Implementability–Alternative 1

The "No Action" alternative does not require implementation of any remedial activities; therefore, it is technically and administratively implementable.

5.3.1.6 Compliance with SCGs–Alternative 1

- Chemical-Specific SCGs: Because removal or treatment is not included as part of this alternative, the chemical-specific SCGs would not be met by this alternative.
- Action-Specific SCGs: This alternative does not involve implementation of any remedial activities; therefore, the action-specific SCGs are not applicable.
- Location-Specific SCGs: Because no remedial activities would be conducted under this alternative, the location-specific SCGs are not applicable.

5.3.1.7 Overall Protection of Public Health and the Environment–Alternative 1

The "No Action" alternative does not address the toxicity, mobility, or volume of impacted environmental media and is not effective on a long-term basis for eliminating potential migration or potential exposure to impacts. Therefore, the "No Action" alternative would be ineffective and would not meet the RAOs established for the site.

5.3.1.8 Cost Effectiveness–Alternative 1

The "No Action" alternative does not involve implementation of any active remedial activities or monitoring of conditions; therefore, there are no costs associated with this alternative.

5.3.2 Alternative 2–NAPL Recovery, Groundwater Monitoring, and Institutional Controls

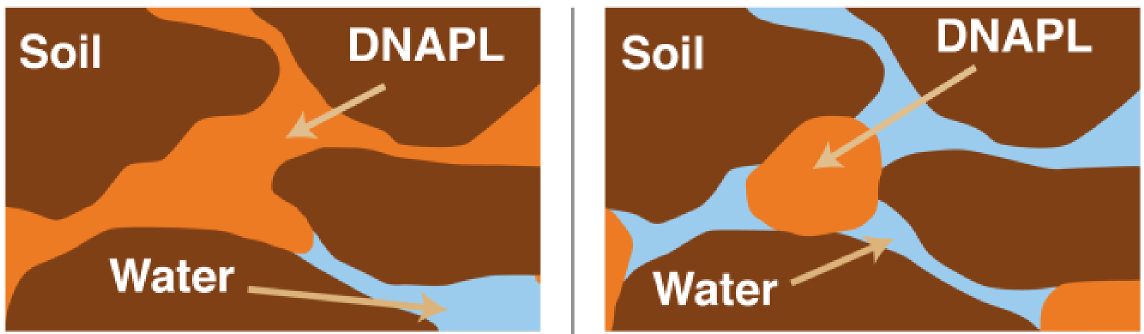
Alternative 2 includes the following major components:

- Conducting NAPL recovery.
- Conducting long-term groundwater monitoring.
- Developing an SMP.
- Establishing ICs.

This alternative would address the potential for exposure to subsurface soil and groundwater containing MGP-related COCs through the implementation of ICs. Alternative 2 also includes NAPL collection/recovery to facilitate the removal of mobile NAPL from the subsurface. Inaccessible immobile NAPL would remain in subsurface soil and would not be directly addressed by this remedial alternative. This alternative also includes long-term groundwater monitoring to document the extent of dissolved-phase impacts and potential trends in COC concentrations.

For NAPL to be recoverable, the target material needs to be "mobile" (so that the NAPL can move into the recovery well). Mobile NAPL occurs under certain conditions as described on the following page (Figure 5-1).

Figure 5-1
Mobility Characteristics of DNAPL: Mobile, Potentially Mobile, and Immobile



Mobile DNAPL
DNAPL body is continuous and its capillary pressure is high enough to exceed groundwater pore entry pressure, displace groundwater, and migrate through the subsurface.

Potentially Mobile DNAPL
DNAPL body is continuous, but its capillary pressure is not high enough to exceed groundwater pore entry pressure; under current conditions, it will not displace groundwater and migrate. If conditions change (for example, drilling through a potentially mobile DNAPL body, soil fracturing), potentially mobile DNAPL may mobilize and begin migrating.

Immobile Residual Phase DNAPL
"Droplets" of DNAPL called ganglia are present in the pore spaces but are not connected to other DNAPL ganglia. They are immobile because they cannot exceed the capillary pressure and displace groundwater in the formation.

Source: https://www.itrcweb.org/DNAPL-ISC_tools-selection/Content/2%20Types%20of%20DNAPLS%20and%20DNAPL.htm

Alternative 2 would include the installation of NAPL collection points to facilitate the recovery of mobile NAPL. NAPL collection points could potentially consist of collection wells or collection trenches constructed to contain and facilitate NAPL recovery (e.g., via a sump). The final number, location, type, and construction of the NAPL collection points would be determined during the remedial design of this alternative. The NAPL collection point locations would be installed to depths within the alluvium (or till) where measurable quantities of NAPL have collected in existing monitoring wells or in areas where continuous DNAPL bodies were observed during prior investigation activities. Attached Figure 5-2 presents a conceptual layout of Remedial Alternative 2. As shown on Figure 5-2, NAPL collection wells are assumed to be installed at the following locations:

- The former MGP property where DNAPL has been observed in remaining MGP structure foundations

- Local low points in the top of till surface where DNAPL has historically been encountered in groundwater monitoring wells throughout the off-site area

To develop this alternative, the NAPL collection wells are assumed to consist of 8-inch diameter stainless-steel wells, equipped with a 5-foot-long sump, installed to an average depth of 30 feet below grade. Following installation of the collection wells, NAPL recovery may be conducted passively by periodic manual bailing or by periodically pumping (with a portable pump) NAPL from the collection wells. If warranted based on the rate of NAPL recovery, NAPL could be removed via an automated pumping system. Low-flow groundwater pumping could also be conducted in an attempt to enhance the rate of NAPL collection within the wells (or other NAPL collection points). Low-flow groundwater pumping would generate impacted groundwater that would require storage, treatment, and disposal, as appropriate. Under an automated pumping scenario, NAPL would be pumped from the wells and stored within a structure(s) that would have to be constructed near the wells (either above or below grade).

For the purpose of developing a cost estimate for this alternative, the NAPL recovery activities are assumed to consist of passive NAPL collection with manual recovery conducted for 30 years. NAPL collection wells would be initially monitored on a semi-annual basis. If no recoverable quantities of NAPL are observed during multiple consecutive NAPL monitoring events (e.g., four consecutive semi-annual monitoring events), O&R may request to conduct NAPL monitoring/recovery less frequently or cease NAPL monitoring altogether.

As indicated in Section 1, site groundwater contains BTEX and PAHs at concentrations greater than NYSDEC Class GA groundwater standards and guidance values. Although there are no current users of groundwater or exposures to impacted groundwater, this alternative would also include conducting annual groundwater monitoring to document potential changes in site groundwater conditions. Based on the current state of several groundwater monitoring wells (i.e., destroyed, damaged, or otherwise not found), new groundwater monitoring wells would be installed at the approximate locations shown in Figure 5-2. The new monitoring wells would be used to confirm groundwater flow direction (via water level measurements) and to monitor dissolved-phase COC concentrations (via groundwater sample collection and analysis). Annual groundwater monitoring activities would include collecting groundwater samples from up to 22 new and existing groundwater monitoring wells. The exact location of new wells and the specific wells to be sampled would be determined during the remedial design for this alternative. Groundwater samples would be submitted for laboratory analysis for BTEX, PAHs, and cyanide. Analytical results would be used to document the extent of dissolved-phase impacts and potential trends in COC concentrations. The results of the groundwater monitoring would be presented to NYSDEC in an annual report. Based on the results of the monitoring activities, O&R may request to modify the quantity of wells sampled or the frequency of sampling events. However, for the purpose of developing a cost estimate for this alternative, it has been assumed annual groundwater monitoring activities would be conducted for 30 years.

Alternative 2 would also include establishing ICs on the properties that comprise the site (e.g., the former MGP property and the USPS post office property) as well as the off-site properties with proposed NAPL recovery and groundwater monitoring wells. The ICs would limit the future development and use of these areas (including groundwater), as well as control intrusive (i.e., subsurface) activities that could result in potential exposures to subsurface soil and groundwater containing MGP-related impacts at concentrations greater than applicable standards and guidance values. The ICs would also establish requirements for additional investigation activities (e.g., subsurface soil sampling) and/or remedial actions (e.g., excavation) if the building on the autobody, sales, and automotive repair shop property were to be demolished. Although potable water is provided by a municipal supply, the ICs would also prohibit (or limit as practicable for properties that are off-site or are publicly-owned) the use of non-treated groundwater on affected properties. An annual report would be submitted to NYSDEC to document that ICs are maintained and remain effective.

This alternative would include preparation of an SMP to document the following information:

- The ICs that have been established and will be maintained
- Requirements for notifications of the presence of MGP-related impacts in soil and groundwater that would be provided to those requesting utility clearance for intrusive activities on the former MGP property or in the off-site area
- Known locations of soil containing COCs at concentrations greater than 6 NYCRR Part 375-6 commercial SCOs
- Protocols (including health and safety requirements) for conducting invasive (i.e., subsurface) activities and managing potentially impacted material encountered during these activities
- Protocols and requirements for conducting semi-annual NAPL monitoring and annual groundwater monitoring
- Protocols for addressing significant changes in COC concentrations in groundwater based on the results of the annual monitoring activities

5.3.2.1 Short-Term Impacts and Effectiveness–Alternative 2

Implementation of this alternative could result in short-term exposure to the surrounding community and field personnel. Potential short-term exposures to impacted soil, groundwater, and/or NAPL could occur during installation of new groundwater monitoring wells and NAPL collection wells that would be installed throughout the site. Potential exposure mechanisms would include ingestion of or dermal contact with impacted soil, groundwater, and/or inhalation of volatile organic vapors.

Potential exposures to field personnel would be minimized using proper training and personal protective equipment (PPE), as specified in a site-specific health and safety plan (HASP) that would be developed as part of the remedial design for this alternative. Air monitoring would be performed during well installation activities to confirm volatile organic vapors are within acceptable levels (to be specified in the site-specific HASP). Potentially impacted soil and groundwater generated during well installation activities would be properly managed to minimize potential exposures to the surrounding community. Potential risks to the community could occur during periodic groundwater monitoring or NAPL recovery activities via exposure to purged groundwater, groundwater samples, and/or NAPL. Potential exposures to the community could be associated with generation of dust during NAPL recovery well installation or generation of volatile organic vapors during the NAPL recovery activities. Potential exposures would be minimized by following appropriate procedures and protocols that would be described in the SMP.

Although this alternative does not employee green remediation practices, implementation of this alternative would utilize minimal non-renewable resources and is not anticipated to negatively impact the environment (i.e., consume non-renewable resources and energy). The relative carbon footprint of Alternative 2 (compared to the other alternatives) is considered minimal. The greatest contribution to greenhouse gases would occur because of equipment used during well installation activities.

Well installation activities could be completed in approximately 1 month, and monitoring would be conducted during an assumed 30-year period.

5.3.2.2 Long-Term Effectiveness and Permanence–Alternative 2

Under Alternative 2, impacted site soil and groundwater would not actively be addressed. However, Alternative 2 includes NAPL recovery to reduce the volume of mobile NAPL present at the site and groundwater monitoring to evaluate and document the extent of dissolved-phase impacts and trends in COC concentrations. Potential exposures to field personnel and the community during long-term monitoring activities would be minimized by following appropriate procedures and protocols that would be established in the SMP to be prepared as part of this alternative.

Most of the surface cover at the site consists of paved roadways/parking areas and buildings, which provide a physical barrier to subsurface impacts. Additionally, NAPL and impacted soil are generally encountered at depths greater than 5 feet to 7 feet below grade on the former MGP property and at depths generally greater than 15 feet below grade in the off-site area. Based on the current and foreseeable future use of the site and surrounding properties as a mixed industrial/commercial/ residential area (i.e., USPS post office, autobody, sales, and automotive repair shops, supermarket, and Southeast Towers) site workers, patrons, and nearby residents do not routinely conduct activities that would potentially result in exposure to impacted site media (located at depths greater than

5 feet below grade). If subsurface activities (e.g., new utility installation) were to be conducted at the site, the former MGP property and the off-site area contain a minimum of 5 and 15 feet (respectively) of urban fill above soil containing visual MGP-related impacts. Notifications of the presence of soil and groundwater containing MGP-related impacts would be provided to those requesting utility clearance, and work activities (including handling potentially impacted material) would be conducted in accordance with the procedures described in the SMP to minimize the potential for exposures to impacted site media. Additionally, the use of non-treated groundwater on affected properties would be prohibited. Annual verification of the ICs would be completed to document that the controls are maintained and remain effective.

Active NAPL recovery and low-flow pumping (if utilized to enhance NAPL recovery) would create a greater potential for exposures to MGP-related materials on a long-term basis when compared to passive NAPL recovery. Active NAPL recovery would require construction of structures to store recovered NAPL. If low-flow groundwater pumping was implemented, and assuming each of the NAPL collection wells would be pumped at a constant rate of 1 gallon per minute (gpm), more than 20,000 gallons of impacted groundwater would be generated each day. A water treatment system capable of treating up to 25 gpm would have to be constructed on each property that contains NAPL collection points to pre-treat the groundwater prior to discharge to a local sanitary sewer for further treatment and disposal. Because O&R does not own property in the immediate vicinity of the site, O&R would have to negotiate with the current property owners or purchase property to construct the water treatment systems in support of low-flow pumping systems and/or storage structures that would be required for an active recovery system. The presence of the water treatment and NAPL storage systems would increase the potential for long-term exposures to the surrounding community (e.g., during routine system operation or repair activities, system malfunctions, or vandalism of the structures and systems).

In contrast, passive collection activities could be conducted during non-peak hours, and NAPL collected during passive recovery activities would be transported off-site for treatment/disposal following collection, significantly reducing the potential for long-term exposures to the surrounding public. Based on this rationale, active NAPL removal and low-flow groundwater pumping would decrease the long-term effectiveness and permanence of this alternative.

5.3.2.3 Land Use–Alternative 2

The current and foreseeable future use of the site is a mixed commercial/residential urban setting. The current zoning for the site is DMU-1, which allows for retail, commercial, government, professional and residential (second floor or higher) uses. Based on the current and anticipated land use of the former MGP property and off-site area, the potential for property occupant exposure to MGP-related residual materials or soil containing MGP-related COCs is minimal. Most of the site is covered with asphalt, concrete, buildings, or vegetated soil, and there is little to no need to conduct subsurface activities. Additionally, drinking water is currently and will continue to be provided via a public water supply. Therefore, groundwater containing MGP-related COCs is not and will not be used for potable (or other) purposes.

Alternative 2 would be consistent with the current land use at the site and should not interfere with redevelopment of this area under the current zoning. Institutional controls (such as deed restrictions and/or environmental easements) would be established on site as well as the off-site properties with proposed NAPL recovery and groundwater monitoring wells. Based on the proposed long-term groundwater monitoring and NAPL monitoring/recovery components of this remedy, the redevelopment of the properties that contain groundwater monitoring wells and NAPL collection points may require coordination with the developers to maintain the wells or to make provisions to access/repair/reinstall the wells as needed.

5.3.2.4 Reduction of Toxicity, Mobility, or Volume through Treatment–Alternative 2

Alternative 2 does not include direct treatment or containment of impacted site media. However, this alternative does include the installation of NAPL collection wells, periodic NAPL monitoring, and passive recovery of mobile NAPL that may collect in the wells. Through the NAPL recovery activities, the volume of mobile NAPL would be permanently reduced, thereby reducing the potential for further downgradient migration of mobile NAPL. NAPL removal would also reduce the volume of material that is serving as a source to dissolved-phase groundwater impacts. This removal would reduce the flux of COCs from source material to groundwater, which would reduce the toxicity and volume of dissolved-phase groundwater impacts. Alternative 2 also includes annual groundwater monitoring to document the extent and potential long-term reduction (i.e., toxicity and volume) of dissolved-phase groundwater impacts.

5.3.2.5 Implementability–Alternative 2

This remedial alternative would be technically and administratively implementable. From a technical implementability aspect, equipment and personnel qualified to install groundwater monitoring and NAPL collection wells and conduct groundwater and NAPL monitoring activities are readily available. A pre-design investigation may be performed to identify areas where NAPL is present in sufficient volume and saturation to be potentially recoverable.

Prior to installing the NAPL collection and groundwater monitoring wells, subsurface utilities would be identified to ensure utilities are not damaged during well installation. The groundwater monitoring wells and NAPL collection wells would be secured in lockable subsurface vaults to prevent access by unauthorized personnel. NAPL collection and recovery methods would also be assessed during the design of this alternative. Active NAPL recovery (i.e., automated pumping) and low-flow groundwater pumping (to enhance NAPL collection) would be more difficult to implement, when compared to passive NAPL collection and manual recovery, because automated recovery would require on-site NAPL storage structures and low-flow groundwater pumping would require construction and operation of on-site water treatment systems. Construction of storage structures and water treatment systems in a public area is not considered readily implementable or practicable.

Administratively, ICs would be established for the former MGP and USPS post office properties, which would require O&R to negotiate with the current property owners and require coordination with state agencies (i.e., NYSDEC and NYSDOH). Additionally, access agreements would need to be secured by O&R to conduct the periodic NAPL and groundwater monitoring activities at the former MGP property and off-site area.

5.3.2.6 Compliance with SCGs–Alternative 2

The alternative's ability to comply with applicable federal, state, and local criteria, advisories, and guidance in presented below.

5.3.2.6.1 Chemical-Specific SCGs

Chemical-specific SCGs are presented in Table 2-1. Potentially applicable chemical-specific SCGs for soil include 6 NYCRR Part 375-6 SCOs and 40 CFR Part 261 and 6 NYCRR Part 371 regulations for the identification of hazardous materials. Potentially applicable chemical-specific SCGs for groundwater include NYSDEC Class GA standards and guidance values:

- Alternative 2 would not address soil containing COCs at concentrations greater than 6 NYCRR Part 375-6 commercial SCOs. Soil containing MGP-related impacts would remain in place beneath non-impacted surface materials (i.e., pavement, concrete, buildings, and vegetated surfaces). Process residuals generated during the implementation of this alternative (e.g., drilling waste and development/purge water from well installation) would be managed and characterized in accordance with 40 CFR Part 261 and 6 NYCRR Part 371 to determine off-site treatment/disposal requirements. NYS LDRs would apply to any materials that are characterized as a hazardous waste.
- As indicated in Section 1, site groundwater contains VOCs and SVOCs at concentrations greater than NYSDEC Class GA standards and guidance values. As this alternative does not include removal activities to address soil containing MGP-related impacts (i.e., a source of dissolved-phase impacts), this alternative would likely not achieve groundwater SCGs within a determinate period.

5.3.2.6.2 Action-Specific SCGs

Action-specific SCGs are presented in Table 2-2. Potentially applicable action-specific SCGs include health and safety requirements and regulations associated with handling impacted media. Work activities would be conducted in accordance with OSHA requirements that specify general industry standards, safety equipment and procedures, and record-keeping and reporting regulations.

Compliance with these action-specific SCGs would be accomplished by following a site-specific HASP:

- Process residuals would be subject to USDOT requirements for packaging, labeling, manifesting, and transporting hazardous or regulated materials. Compliance with these requirements would be achieved by following a NYSDEC-approved Remedial Design/Remedial Action Work Plan and using licensed waste transporters and permitted disposal facilities. If any of the materials are characterized as a hazardous waste, NYS LDRs could be applicable.

5.3.2.6.3 Location-Specific SCGs

Location-specific SCGs are presented in Table 2-3. Potentially applicable location-specific SCGs generally include regulations on conducting construction activities on floodplains. Compliance with these SCGs would be achieved by obtaining a joint U.S. Army Corps of Engineers (USACE) and NYSDEC permit prior to conducting site activities. Additionally, remedial activities would be conducted in accordance with Middletown building/construction codes and/ordinances.

5.3.2.7 Overall Protection of Public Health and the Environment–Alternative 2

Alternative 2 would mitigate the potential for long-term exposures to impacted subsurface soil and groundwater by recovering mobile NAPL, monitoring groundwater, and implementing ICs. This alternative would not use containment, treatment, or removal to address subsurface soil or groundwater containing MGP-related COCs at concentrations greater than applicable standards and guidance values. Inaccessible and/or immobile NAPL and impacted soil would remain in the subsurface and would not be addressed through active containment, treatment, or removal.

This alternative would prevent exposures (i.e., direct contact, ingestion, and inhalation) to MGP–related impacts in subsurface soil and groundwater (soil RAOs #1 and #2 and groundwater RAOs #1 and #2) through the implementation of ICs. However, potentially complete exposure pathways would remain under this alternative and the reduction of potential exposures would only occur by adhering to the ICs and the procedures to be presented in the SMP.

Alternative 2 would partially address MGP-related COCs that could cause impacts to groundwater (soil RAO #3) through the recovery of mobile NAPL. Periodic monitoring would be completed to document the extent of dissolved-phase impacts and potential trends in COC concentrations. Although mobile NAPL would be permanently removed under Alternative 2, the majority of NAPL-impacted soil at the site (including subsurface soils with NAPL droplets or partial saturation) would remain; therefore, this alternative is not expected to restore groundwater to pre-disposal/pre-release conditions (groundwater RAO #3) nor address all sources of groundwater impacts (groundwater RAO #4) because potentially mobile NAPL may remain in former MGP structures and inaccessible and/or immobile NAPL would remain in subsurface soil.

5.3.2.8 Cost Effectiveness–Alternative 2

The estimated costs associated with Alternative 2 are presented in Table 5-1. The total estimated 30-year present worth cost for this alternative is approximately $3,400,000. The estimated capital cost, including costs for installing NAPL collection wells and groundwater monitoring wells and establishing ICs, is approximately $900,000. The estimated 30-year present worth cost of O&M activities associated with this alternative, including conducting semi-annual NAPL monitoring and annual groundwater monitoring, is approximately $2,500,000.

5.3.3 Alternative 3–Utility Corridor Soil Removal, NAPL Recovery, Groundwater Monitoring, and Institutional Controls

Alternative 3 includes the following major components:

- Excavating accessible impacted soil and former MGP structures within the Fulton Street utility corridor.
- Conducting NAPL recovery.
- Conducting long-term groundwater monitoring.
- Developing an SMP.
- Establishing ICs.

This alternative has been developed under the assumption that O&R would occupy (e.g., lease) the former MGP property for the duration of the remedial construction. This alternative would address the potential for exposures to NAPL-impacted soil and portions of former MGP structures in the utility corridor near the westbound lanes of Fulton Street through excavation. This alternative would also address the potential for exposure to remaining subsurface soil and groundwater containing MGP-related COCs through the implementation of ICs. Alternative 3 also includes NAPL recovery to facilitate the removal of mobile NAPL from the subsurface and long-term groundwater monitoring to document the extent of dissolved-phase impacts and potential trends in COC concentrations.

This alternative would include removal of NAPL-impacted soil and portions of former MGP structures in the utility corridor extending beneath the northern curb and sidewalk area north of Fulton Street near Canal Street to provide a clean corridor for potential future subsurface utility work in this area. Approximate removal limits are shown in Figure 5-3. Removal activities would include the excavation of approximately 1,700 cubic yards (CY) of soil to a depth of up to 10 feet below grade to address approximately 450 CY of soil with visible MGP impacts and former MGP structures. Based on the visual characterization of soil samples previously collected from this area, anthropogenic material (e.g., urban fill and debris) excavated from 0 feet to 2 feet below grade would be transported off-site for disposal as C&D debris or recycled at an appropriate facility; soil from 2 feet to 10 feet below grade would be transported off-site for treatment/disposal via LTTD. None of the excavated soil from this area is expected to be suitable for reuse as backfill based on the nature of urban fill material and the presence of former MGP structures/foundations.

Excavation activities would be conducted using conventional construction equipment such as backhoes, excavators, front-end loaders, dump trucks, etc. Based on the proposed extent of excavation activities, excavation support (assumed to be steel sheet pile walls equipped with internal bracing) is anticipated to be required for the proposed excavation activities. To accommodate sheeting installation, the excavation would extend approximately 10 feet into Fulton Street. An excavation enclosure (e.g., Sprung structure) equipped with a vapor collection and treatment system would also be constructed over the proposed excavation area to reduce the potential for off-site migration of vapors and nuisance odors during excavation activities. Use of an excavation enclosure would require the overhead utilities on the north side of Fulton Street to be relocated prior to the implementation of remedial construction activities. The final excavation plan would be developed as part of a remedial design. Water generated during excavation area dewatering activities would be collected, treated on-site via a temporary water treatment system, and discharged under a permit to the local POTW via a nearby sanitary sewer.

A low-permeability barrier would be installed along the upgradient edge of the utility corridor excavation area to minimize the potential for recontamination of backfill material from potentially mobile NAPL that would remain on the former MGP property. Potential barrier options include a steel sheet pile wall, slurry wall, HDPE liners, and low-permeability backfill. For the purpose of this FS, we assumed that the low- permeability barrier would consist of an HDPE liner "hung" along the upgradient excavation side walls. The HDPE liner would be installed to prevent migration of potentially mobile NAPL that would remain upgradient of the removal area to the clean fill material used to backfill the excavation. Additionally, the liner would potentially enhance NAPL collection in the wells that would be installed immediately upgradient of the low-permeability barrier following completion of the excavation and backfilling activities.

Prior to restoring the soil removal areas, a demarcation layer (e.g., geotextile fabric, snow fence) would be placed along excavation area bottoms and side walls to denote soil removal limits. Removal areas would be restored with imported clean fill material and/or other engineered backfills (e.g., controlled low-strength material), as appropriate, to match the previously existing lines and grades, and all disturbed surfaces would be replaced in kind. Backfill materials and surface restoration details would be developed as part of the remedial design for this alternative.

Alternative 3 would also include the same NAPL recovery, groundwater monitoring, and IC components as Alternative 2. As indicated for Alternative 2, NAPL collection points could potentially consist of collection wells or collection trenches. The final number, location, type, and construction details of the NAPL collection points would be determined during the remedial design of this alternative and based on the results of the 2016 NAPL monitoring activities. For the purpose of developing a cost estimate for this alternative, it has been assumed up to 13 NAPL collection wells would be installed. NAPL collection wells would be installed at the same locations described under Alternative 2 (see attached Figure 5-3) and NAPL collection wells would be periodically (i.e., semi-annually) monitored to facilitate the passive recovery of mobile NAPL. NAPL could be potentially recovered by using an active recovery system, depending on the rate of NAPL collection following installation of the collection points. Low-flow groundwater pumping could also be considered to potentially enhance the rate of NAPL collection.

Like Alternative 2, Alternative 3 would also include installing new groundwater monitoring wells and conducting groundwater monitoring to confirm groundwater flow direction and verify the extent and concentrations of dissolved-phase COCs. Groundwater samples would be collected and submitted for laboratory analysis for BTEX, PAHs, and cyanide to document the extent of dissolved-phase impacts and potential trends in COC concentrations.

Alternative 3 would also include establishing ICs on the properties that comprise the site (e.g., the former MGP property and the USPS post office property) as well as the off-site properties with proposed NAPL recovery and groundwater monitoring wells. The ICs would limit the future development and use of these areas (including groundwater), as well as control intrusive (i.e., subsurface) activities that could result in potential exposures to subsurface soil and groundwater containing MGP-related impacts at concentrations greater than applicable standards and guidance values. The ICs would also establish requirements for additional investigation activities (e.g., subsurface soil sampling) and/or remedial actions (e.g., excavation) if the building on the autobody, sales, and automotive repair shop property were to be demolished. Although potable water is provided by a municipal supply, the ICs would also prohibit (or limit as practicable for properties that are off-site or are publicly-owned) the use of non-treated groundwater on affected properties. An annual report would be submitted to NYSDEC to document that ICs are maintained and remain effective.

This alternative would include preparation of an SMP to document the following information:

- The ICs that have been established and will be maintained
- Requirements for notifications of the presence of MGP-related impacts in soil and groundwater that would be provided to those requesting utility clearance for intrusive activities on the former MGP property or in the off-site area
- Known locations of remaining soil that contains COCs at concentrations greater than 6 NYCRR Part 375-6 commercial SCOs
- Protocols (including health and safety requirements) for conducting invasive (i.e., subsurface) activities and managing potentially impacted material encountered during these activities
- Protocols and requirements for conducting semi-annual NAPL monitoring and annual groundwater monitoring

- Protocols for addressing significant changes in COC concentrations in groundwater based on the results of the annual monitoring activities

The potential need to implement the SMP within the utility corridor would be reduced through the excavation activities that would be conducted under this alternative.

5.3.3.1 Short-Term Impacts and Effectiveness–Alternative 3

Implementation of this alternative could result in short-term exposure of the surrounding community and site workers to site-related COCs as a result of excavation, material handling, and off-site transportation activities. Additionally, field personnel may be exposed to impacted soil, groundwater, and/or NAPL during excavation, and groundwater monitoring well and NAPL collection well installation activities. Potential exposure mechanisms would include ingestion and dermal contact with NAPL, impacted soil, and/or groundwater and inhalation of volatile organic vapors or dust containing COCs during remedial construction.

Potential exposure of remedial workers would be minimized using appropriately trained field personnel and PPE, as specified in a site-specific HASP that would be developed as part of the remedial design. A CAMP would be prepared, and community air monitoring would be performed during excavation and backfilling activities to evaluate the need for additional engineering controls (e.g., use of water sprays to suppress dust and modify the rate of excavation). Community access to excavation areas would be restricted by temporary security fencing and the excavation enclosure. Implementation of this alternative would cause a temporary disruption of the surrounding community. At a minimum, the westbound lane of Fulton Street, as well as Canal Street would be closed during excavation, backfilling, and site restoration activities for 2 to 3 months. Pedestrian and vehicle traffic would be re-directed to avoid to the work area. Based on the proposed excavation limits, the autobody shop and automotive sales office on the western portion of the former MGP property would have to be closed during intrusive activities.

Additional worker safety concerns include working with and around large construction equipment, noise generated from installing sheeting and operating construction equipment, and increased vehicle traffic associated with transportation of excavated material from the site and delivery of fill materials. These concerns would be minimized by using engineering controls and appropriate health and safety practices. Off-site transportation of excavated material and importation of clean fill materials would result in approximately 250 roundtrips by a tri-axle truck (assuming 14 CY per truck). Transportation activities would be managed to minimize en-route risks to the community.

Potentially impacted soil and groundwater generated during well installation activities would be properly managed to minimize potential exposures to the surrounding community. In addition, closure of a portion of Fulton Street to accommodate the utility corridor excavation would be disruptive to traffic patterns.

Potential risks to the community could occur during periodic groundwater monitoring or NAPL recovery activities via exposure to purged groundwater, groundwater samples, and/or NAPL. Potential exposures to the community could be associated with generation of dust during NAPL recovery well installation or generation of volatile organic vapors during the NAPL recovery activities. Potential exposures would be minimized by following appropriate procedures and protocols that would be described in the SMP.

For the purpose of this FS, it has been assumed all excavated material would be transported for off-site treatment and/or disposal. The relative carbon footprint of Alternative 3 (as compared to the other alternatives) is considered moderate. The greatest contribution to greenhouse gases would occur as a result of equipment operation during excavation, backfilling, and transportation activities.

Soil excavation, backfilling, restoration and well installation activities could be completed in approximately four months and monitoring would be conducted throughout an assumed 30-year period.

5.3.3.2 Long-Term Effectiveness and Permanence–Alternative 3

Under Alternative 3, NAPL-impacted soil and portions of former MGP structures in the utility corridor near the westbound lanes of Fulton Street would be excavated and transported off-site for treatment/disposal. However, impacted soil and inaccessible and/or immobile NAPL would remain throughout the site under this alternative. Alternative 3 also includes NAPL recovery to reduce the volume of potentially mobile NAPL present at the site and groundwater monitoring to evaluate and document the extent of dissolved-phase impacts and potential trends in COC concentrations. Through the removal of impacted soil and recovery of mobile NAPL, the concentrations and extent of dissolved-phase impacts could be reduced over time. Potential exposures to field personnel and the community during long-term monitoring activities would be minimized by following appropriate procedures and protocols that would be established in the SMP to be prepared as part of this alternative.

Although the majority of NAPL-impacted subsurface soil would not be addressed by this alternative, most of the surface cover at the site consists of paved roadways/parking areas and buildings, which provide a physical barrier to subsurface impacts. Additionally, soil containing visual impacts is generally encountered at depths greater than 5 feet to 7 feet below grade on the former MGP property and at depths of 15 feet and greater in the off-site area. Based on the current and foreseeable future use of the site and surrounding properties as a mixed commercial/residential area (i.e., USPS post office, autobody, sales, and automotive repair shops, supermarket, and Southeast Towers), site workers, patrons, and nearby residents do not routinely conduct activities that would potentially result in exposure to impacted site media (located at depths greater than 5 feet below grade). The area most likely to be subject to subsurface activities (i.e., the Fulton Street utility corridor) would be addressed through excavation of impacted material and installation of a low-permeability barrier. If subsurface activities (e.g., new utility installation) were to be conducted at the site, the former MGP property and off-site area contain a minimum of 5 feet and 15 feet (respectively) of urban fill above soil containing visual MGP-related impacts. Notifications of the presence of soil and groundwater containing MGP-related impacts would be provided to those requesting utility clearance. Work activities (including handling potentially impacted material) would be conducted in accordance with the procedures described in the SMP to minimize the potential for exposures to impacted site media. Additionally, the use of non-treated groundwater on affected properties would be prohibited through deed restrictions or environmental easements (as appropriate). Annual verification of the ICs would be completed to document that the controls are maintained and remain effective.

Active NAPL recovery and low-flow pumping would create a greater potential for exposures of site workers and the surrounding public to MGP-related materials on a long-term basis when compared to passive NAPL collection and manual recovery. Active NAPL recovery would require construction of structures to store recovered NAPL. If low-flow groundwater pumping was implemented to enhance NAPL collection, assuming each of the NAPL collection wells would be pumped at a constant rate of 1 gpm, more than 20,000 gallons of impacted groundwater would be generated each day. A water treatment system capable of treating up to 25 gpm would have to be constructed on each property that contains NAPL collection points, and treated water would have to be discharged to a local sanitary sewer for further treatment and disposal. Because O&R does not own property in the immediate vicinity of the site, O&R would have to negotiate with the current property owners or purchase property to construct the water treatment systems in support of low-flow pumping systems and/or storage structures that would be required for an active recovery system. The presence of the water treatment and NAPL storage systems would increase the potential for long-term exposures to the surrounding community (i.e., during routine system operation or repair activities, system malfunctions, or vandalism of the structures and systems).

In contrast, passive collection activities could be conducted during non-peak hours, and NAPL collected during passive recovery activities would be immediately transported off-site for treatment/disposal, significantly reducing the potential for long-term exposures to the surrounding public. Based on this rationale, active NAPL removal and low-flow groundwater pumping would decrease the long-term effectiveness and permanence of this alternative.

5.3.3.3 Land Use–Alternative 3

The current and foreseeable future use of the site is a mixed commercial/residential urban setting. The current zoning for the site is DMU-1, which allows for retail, commercial, government, professional and residential (second floor or higher) uses. Based on the current and anticipated land use of the former MGP property and off-site area, the potential for property occupant exposure to

MGP-related residual materials or soil containing MGP-related COCs is minimal. Most of the site is covered with asphalt, concrete, buildings, or vegetated soil, and there is little to no need to conduct subsurface activities. Additionally, drinking water is currently and will continue to be provided via a public water supply. Therefore, groundwater containing MGP-related COCs is not and will not be used for potable (or other) purposes.

In general, Alternative 3 would be consistent with the current land use at the site and should not interfere with redevelopment of this area under the current zoning. The proposed excavation within the utility corridor would create a short-term disruption to the surrounding community, and the disturbed area would be restored to match existing site conditions. Institutional controls would be placed on the site properties as well as the off-site properties with proposed NAPL recovery and groundwater monitoring wells. Based on the proposed long-term groundwater monitoring and NAPL monitoring/recovery components of this remedy, the redevelopment of the properties that contain groundwater monitoring wells and NAPL collection points may require coordination with the redeveloper to maintain the wells or to make provisions to access/repair/reinstall the wells as needed. Active NAPL recovery would not be consistent with the current land use based on the need for the management and storage of hazardous materials in a public area. Even with security fencing and locked gates, active pumping is not optimal under current land use.

5.3.3.4 Reduction of Toxicity, Mobility, or Volume through Treatment–Alternative 3

Alternative 3 would include the excavation of approximately 1,700 CY of material to address approximately 450 CY of soil with visible MGP impacts and former MGP structures from the former MGP property. Excavated material would be permanently transported off-site for treatment and/or disposal. Additionally, a low-permeability barrier would be installed along the upgradient edge of the utility corridor excavation to minimize the potential for recontamination of backfill in the corridor, as well as potentially enhance NAPL collection in the wells that would be installed in this area.

Alternative 3 also includes the installation of NAPL collection wells and periodic NAPL monitoring/passive recovery of mobile NAPL that may collect in the wells. Through the NAPL monitoring/recovery activities, the volume of mobile NAPL would be reduced, thereby reducing the potential for further downgradient migration of mobile NAPL at the site. Additionally, NAPL removal would reduce the volume of material that is serving as a source to dissolved-phase groundwater impacts. This removal would reduce the flux of COCs from source material to groundwater, which would reduce the toxicity and volume of dissolved-phase groundwater impacts. Alternative 3 also includes annual groundwater monitoring to document the extent and potential long-term reduction (i.e., toxicity and volume) of dissolved-phase groundwater impacts.

5.3.3.5 Implementability–Alternative 3

This remedial alternative would be technically and administratively implementable. Removal and off-site disposal of soil is technically feasible, although conducting soil removal activities in an urban public setting presents numerous logistical challenges. There is limited space at the site for material handling and staging and for the construction equipment that would be required to conduct the removal activities. Based on the limits of excavation, at a minimum, portions of Fulton Street (between Canal and South streets) and Canal Street would have to be closed during remedial construction, and local traffic would have to be rerouted for approximately 3 months. Transportation planning would be conducted prior to the remedial activities. Tractor trailers would likely not be used based on the larger turning radius required from 6-axle vehicles. Additionally, soil removal activities would have to be conducted in a manner as to not jeopardize the health and safety of or cause a nuisance to the patrons that use the USPS post office, autobody, sales, and automotive repair shops, and adjacent roadways. Soil-loading conditions from nearby buildings and roadways would have to be evaluated as part of the remedial design. An excavation enclosure would likely be used for the utility corridor excavation to minimize potential exposures to the surrounding community. Overhead utilities (e.g., electric and telecommunication lines) would have to be relocated prior to the remedial construction activities. Relocation of the overhead electric and telecommunication lines would require extensive pre-design planning, potential acquisition of new rights of way for bypass pole installation and would likely be costly. Underground utilities (e.g., water, stormwater, sanitary, and gas lines) located beneath Fulton Street would have to be re-routed, bypassed, and/or protected as appropriate during implementation of this alternative.

From a technical implementability aspect, equipment and personnel qualified to install groundwater monitoring and NAPL collection wells and conduct groundwater and NAPL monitoring activities are readily available. Prior to conducting excavation activities and installing the NAPL recovery and groundwater monitoring wells, subsurface utilities would be identified to reduce the potential of damaging utilities during intrusive activities. The groundwater monitoring wells and NAPL collection wells would be secured in lockable subsurface vaults to prevent access by unauthorized personnel. NAPL recovery methods would also be assessed during the design of this alternative. Active NAPL recovery (i.e., automated pumping) and low-flow groundwater pumping to enhance NAPL collection would be more difficult to implement, when compared to passive NAPL collection and manual recovery, as active recovery would require on-site NAPL storage structures and low-flow groundwater pumping would require construction and O&M of on-site water treatment systems. Construction and O&M of NAPL storage structures and groundwater treatment systems in a public area is not considered readily implementable or practicable.

Administratively, ICs would be established for the former MGP and post office properties, which would require O&R to negotiate with the current property owners and would require coordination with state agencies (i.e., NYSDEC and NYSDOH). Access agreements would have to be secured with the automotive repair shops to conduct the excavation activities. Based on the limits of the proposed excavation activities and the likely use of an excavation enclosure, the autobody shop and the auto sales business (on the western portion of the former MGP property) would have to be closed during remedial construction activities. O&R would have to negotiate an access agreement with the current owner of the property in order to implement the remedy. This alternative assumes that O&R would occupy the former MGP property during the implementation of the remedial activity. O&R would have to consider providing rental property at an alternate location in Middletown to allow businesses leasing the buildings on this property to continue to operate and potentially compensating the property owner for loss of a tenant(s) during the remedial construction period. Additionally, access agreements would need to be secured by O&R to install new wells and conduct the periodic NAPL and groundwater monitoring activities at the former MGP property and off-site area.

5.3.3.6 Compliance with SCGs–Alternative 3

The alternative's ability to comply with applicable federal, state, and local criteria, advisories, and guidance in presented below.

5.3.3.6.1 Chemical-Specific SCGs

Chemical-specific SCGs are presented in Table 2-1. Potentially applicable chemical-specific SCGs for soil include 6 NYCRR Part 375-6.8 SCOs, 40 CFR Part 261, and 6 NYCRR Part 371 regulations for the identification of hazardous materials. Potentially applicable chemical-specific SCGs for groundwater include 6 NYCRR Part 703.5 water quality standards and guidance values for NYSDEC Class GA groundwater:

- Alternative 3 would include the removal of NAPL-impacted soil and portions of former MGP structures in the utility corridor extending beneath Fulton Street. Other locations of soil containing COCs at concentrations greater than 6 NYCRR Part 375-6.8(b) restricted use SCOs would not be addressed by this alternative. Soil containing MGP-related impacts would remain in place beneath non-impacted surface materials (i.e., pavement, concrete, buildings, and vegetated surfaces). All excavated material and process residuals would be managed and characterized in accordance with 40 CFR Part 261 and 6 NYCRR Part 371 regulations to determine off-site treatment/disposal requirements. NYS LDRs would apply to any materials that are characterized as a hazardous waste.
- As indicated in Section 1, site groundwater contains VOCs and SVOCs at concentrations greater than NYSDEC Class GA standards and guidance values. Because this alternative does not include removal activities to address all soil containing MGP-related impacts (i.e., a source of dissolved-phase COCs to groundwater), this alternative would likely not achieve groundwater SCGs within a determinate period.

5.3.3.6.2 Action-Specific SCGs

Action-specific SCGs are presented in Table 2-2. Potentially applicable action-specific SCGs include health and safety requirements and regulations associated with handling impacted media. Work activities would be conducted in accordance with OSHA requirements that specify general industry standards, safety equipment and procedures, and record-keeping and reporting regulations. Compliance with these action-specific SCGs would be accomplished by following a site-specific HASP:

- Excavated soil and process residuals would be subject to USDOT requirements for packaging, labeling, manifesting, and transporting hazardous or regulated materials. Compliance with these requirements would be achieved by following a NYSDEC-approved Remedial Design/Remedial Action Work Plan and using licensed waste transporters and permitted disposal facilities. Excavated material from a former MGP site that is characteristically hazardous for benzene only (D018) is conditionally exempt from hazardous waste management requirements when destined for thermal treatment (e.g., LTTD). All excavated material would be disposed of in accordance with applicable NYS LDRs.

5.3.3.6.3 Location-Specific SCGs

Location-specific SCGs are presented in Table 2-3. Potentially applicable location-specific SCGs generally include regulations on conducting construction activities on floodplains. Compliance with these SCGs would be achieved by obtaining a joint USACE and NYSDEC permit prior to conducting site activities. Additionally, remedial activities would be conducted in accordance with Middletown building/construction codes and/ordinances, and necessary street work permits would be obtained prior to initiating the remedial activities.

5.3.3.7 Overall Protection of Public Health and the Environment–Alternative 3

Alternative 3 would mitigate the potential for long-term exposures to some of the impacted subsurface soil and groundwater by removing NAPL-impacted soil and portions of former MGP structures in the utility corridor near the westbound lanes of Fulton Street, recovering potentially mobile NAPL, monitoring groundwater, and implementing ICs. This alternative addresses most of the likely future exposures that could occur at the site. The potential for construction workers to be exposed to MGP-related impacts while conducting utility work within Fulton Street would be mitigated through the removal of impacted soil and former MGP structures in this area and the installation of a low-permeability barrier and NAPL recovery points immediately upgradient of excavation area. Inaccessible and/or immobile NAPL and impacted soils would remain in the subsurface through the site (at depths greater than 5 feet to 7 feet below grade on the former MGP property and at depths generally greater than 15 feet below grade in the off-site area) and would not be addressed through active containment, treatment, or removal.

This alternative would prevent exposures (i.e., direct contact, ingestion, and inhalation) to MGP-related impacts in subsurface soil and groundwater (soil RAOs #1 and #2 and groundwater RAOs #1 and #2) through the implementation of ICs and removal of NAPL-impacted soil and portions of former MGP structures in the utility corridor near Fulton Street. However, potentially compete exposure pathways would remain under this alternative, and the reduction of potential exposures would only occur by adhering to the ICs and the procedures set forth in the SMP.

Alternative 3 would partially address MGP-related COCs and materials that could cause impacts to groundwater (soil RAO #3) through excavation and recovery of mobile NAPL. Periodic monitoring would be completed to document the extent of dissolved-phase impacts and potential trends in COC concentrations. Although mobile NAPL would be permanently removed through soil excavation and NAPL recovery, impacted soil (i.e., a source to dissolved-phase impacts) would remain throughout the site; therefore, this alternative is not expected to restore groundwater to pre-disposal/pre-release conditions (groundwater RAO #3) nor address all sources of groundwater impacts (groundwater RAO #4) because there is the potential for mobile NAPL to remain in former MGP structures and inaccessible and/or immobile NAPL would remain in subsurface soil.

5.3.3.8 Cost Effectiveness–Alternative 3

The estimated costs associated with Alternative 3 are presented in Table 5-2. The total estimated 30-year present worth cost for this alternative is approximately $8,500,000. The estimated capital cost, including costs for conducting soil removal activities, installing NAPL collection wells and groundwater monitoring wells, and establishing ICs, is approximately $6,000,000. The estimated 30-year present worth cost of O&M activities associated with this alternative, including conducting semi-annual NAPL monitoring and annual groundwater monitoring, is approximately $2,500,000.

5.3.4 Alternative 4–Shallow Soil Removal at the Former MGP Property, NAPL Recovery, Groundwater Monitoring, and Institutional Controls

Alternative 4 includes the following major components:

- Excavating the top 10 feet of soil in accessible areas on the former MGP property.
- Conducting NAPL recovery.
- Conducting long-term groundwater monitoring.
- Developing an SMP.
- Establishing ICs.

This alternative would address the potential for exposures to shallow NAPL-impacted soil and former MGP structures in the vicinity of the former MGP through excavation. This alternative would also address the potential for exposure to remaining subsurface soil and groundwater containing MGP-related COCs through the implementation of ICs. Like Alternatives 2 and 3, Alternative 4 also includes NAPL recovery to facilitate the removal of mobile NAPL from the subsurface and long-term groundwater monitoring to document the extent of dissolved-phase impacts and potential trends in COC concentrations.

Alternative 4 would include removal of shallow (i.e., the upper 10 feet) accessible (i.e., not below the autobody, sales, and automotive repair shops) NAPL-impacted soil and former MGP structures within the former MGP property at the eastern corner of Fulton and Canal streets (including the utility corridor excavation component of Alternative 3) to create a 10-foot-thick non-impacted zone for potential future subsurface activities. Approximate removal limits are shown in Figure 5-4.

Approximately 3,400 CY of soil would be excavated from the former MGP property to address approximately 1,000 CY of soil with visible MGP impacts and former MGP structures. Soil and former MGP structures located at depths below 10 feet and below the automotive shops (which would remain under this alternative) would not be removed. Based on the visual characterization of soil samples previously collected from this area and for the purpose of developing a cost estimate, it has been assumed soil from 0 feet to 2 feet below grade would be transported off-site for disposal as C&D debris and soil from 2 feet to 10 feet below grade would be transported off-site for treatment/disposal via LTTD. None of the excavated soil from this area is expected to be suitable for reuse as backfill based on the nature of urban fill material and presence of former MGP structures/foundations.

Excavation activities would be conducted using conventional construction equipment such as backhoes, excavators, front-end loaders, and dump trucks. Based on the proposed extent of excavation activities, excavation support is anticipated to be required for this alternative (assumed to be steel sheetpile walls equipped with internal bracing). To accommodate sheeting installation, the excavation of the utility corridor would extend approximately 10 feet into Fulton Street. Additionally, it is anticipated an excavation enclosure (e.g., Sprung structure) equipped with a vapor collection and treatment system would be constructed over the proposed excavation area to reduce the potential for exposures and off-site migration of vapors and odors during excavation activities. Use of an excavation enclosure would require the overhead utilities on the north side of Fulton Street to be relocated prior to the implementation of remedial construction activities. The final excavation plan would be developed as part of a remedial design, and a stormwater pollution prevention plan (SWPPP) would be developed as part of the remedial design. Water generated during excavation area dewatering activities would be collected, treated on-site via a temporary water treatment system, and discharged under a permit to the local POTW via a nearby sanitary sewer.

A low-permeability barrier would be installed along the upgradient edge of the excavation area to minimize the potential for recontamination of backfill material from potentially mobile NAPL that would remain on the former MGP property. Potential barrier options include a steel sheetpile wall, slurry wall, HDPE liners, and low-permeability backfill. For the purpose of developing this alternative, it has been assumed HDPE would be "hung" along the upgradient excavation side walls. The HDPE liner would prevent migration of potentially mobile NAPL that would remain upgradient of the removal area to the clean fill material used to backfill the excavation. Additionally, the liner would potentially enhance NAPL collection in the wells that would be installed immediately upgradient of the low-permeability barrier following completion of the excavation and backfilling activities.

Prior to restoring the soil removal areas, a demarcation layer (e.g., geotextile fabric, snow fence) would be placed along excavation area bottoms and side walls to denote soil removal limits. Removal areas would be restored with imported clean fill material and/or other engineered backfills (e.g., controlled-low strength material), as appropriate, to match the previously existing lines and grades, and all disturbed surfaces would be replaced in kind. Backfill materials and surface restoration details would be developed as part of the remedial design for this alternative.

Alternative 4 would also include the same NAPL recovery, groundwater monitoring, and IC components as Alternatives 2 and 3. As indicated for Alternative 2, potential NAPL collection points could consist of collection wells or collection trenches. The final number, location, type, and construction details of the NAPL collection points would be determined during the remedial design of this alternative. For the purpose of developing this alternative, it has been assumed NAPL recovery would be completed at up to 13 NAPL collection wells installed at locations and appropriate depths (i.e., within the alluvium or till) where measurable quantities of NAPL have historically been observed in monitoring wells and during the completion of soil borings. NAPL collection wells would be periodically (i.e., semi-annually) monitored to facilitate the passive recovery of mobile NAPL. NAPL could be potentially recovered by utilizing an active recovery system depending on the rate of NAPL collection following installation of the collection points. Low-flow groundwater pumping could also be considered to potentially enhance the rate of NAPL collection.

As with the other alternatives, Alternative 4 would also include installing new groundwater monitoring wells and conducting groundwater monitoring to confirm groundwater flow direction and verify the extent and concentrations of dissolved-phase COCs. Groundwater samples would be collected and submitted for laboratory analysis for BTEX, PAHs, and cyanide to document the extent of dissolved-phase impacts and potential trends in COC concentrations.

Alternative 4 would also include establishing ICs on the properties that comprise the site (e.g., the former MGP property and the USPS post office property) as well as the off-site properties with proposed NAPL recovery and groundwater monitoring wells. The ICs would limit the future development and use of these areas (including groundwater), as well as control intrusive (i.e., subsurface) activities that could result in potential exposures to subsurface soil and groundwater containing MGP-related impacts at concentrations greater than applicable standards and guidance values. The ICs would also establish requirements for additional investigation activities (e.g., subsurface soil sampling) and/or remedial actions (e.g., excavation) if the building on the autobody, sales, and automotive repair shop property were to be demolished. Although potable water is provided by a municipal supply, the ICs would also prohibit (or limit as practicable for properties that are off-site or are publicly-owned) the use of non-treated groundwater on affected properties. An annual report would be submitted to NYSDEC to document that ICs are maintained and remain effective.

This alternative would include preparation of an SMP to document the following:

- The ICs that have been established and will be maintained for the site
- Known locations of remaining soil that contains COCs at concentrations greater than 6 NYCRR Part 375-6 commercial SCOs
- Requirements for notifications of the presence of MGP-related impacts in soil and groundwater that would be provided to those requesting utility clearance for intrusive activities on the former MGP property or in the off-site area
- Protocols (including health and safety requirements) for conducting invasive (i.e., subsurface) activities and managing potentially impacted material encountered during these activities
- Protocols and requirements for conducting semi-annual NAPL monitoring and annual groundwater monitoring
- Protocols for addressing significant changes in COC concentrations in groundwater based on the results of the annual monitoring activities

The potential need to implement the SMP at the former MGP property (including the utility corridor) would be reduced through the shallow soil excavation activities that would be conducted under this alternative.

5.3.4.1 Short-Term Impacts and Effectiveness–Alternative 4

Implementation of this alternative could result in short-term exposure of the surrounding community and site workers to site-related COCs as a result of excavation, material handling, and off-site transportation activities. Additionally, field personnel may be exposed to impacted soil, groundwater, and/or NAPL during groundwater monitoring well and NAPL collection well installation activities. Potential exposure mechanisms would include ingestion and dermal contact with NAPL, impacted soil, and/or groundwater and inhalation of volatile organic vapors or dust containing COCs during remedial construction.

Potential exposure of remedial workers would be minimized using appropriately trained field personnel and PPE, as specified in a site-specific HASP that would be developed as part of the remedial design. A CAMP would be prepared, and community air monitoring would be performed during excavation and backfilling activities to evaluate the need for additional engineering controls (e.g., use of water sprays to suppress dust and modify the rate of excavation). Community access to excavation areas would be restricted by temporary security fencing and the excavation enclosure.

Implementation of this alternative would temporarily cause a disruption to the surrounding community. At a minimum, the westbound lanes of Fulton and Canal streets would be closed for approximately four months, or more, depending on the rate of excavation activities within the excavation enclosure. Pedestrian and vehicle traffic would be re-directed to avoid to the work area. Based on the proposed excavation limits, at a minimum, the autobody, sales, and automotive repair shop located on the western portion of the former MGP property would have to be closed during intrusive activities.

Additional worker safety concerns include working with and around large construction equipment, noise generated from installing sheeting and operating construction equipment, and increased vehicle traffic associated with transportation of excavated material from the site and delivery of fill materials. These concerns would be minimized by using engineering controls and appropriate health and safety practices. Off-site transportation of excavated material and importation of clean fill materials would result in approximately 470 roundtrips be tri-axle trucks (assuming 14 CY per truck). Transportation activities would be managed to minimize en-route risks to the community.

Potentially impacted soil and groundwater generated during well installation activities would be properly managed to minimize potential exposures to the surrounding community. In addition, closure of a portion of Fulton Street to accommodate the utility corridor excavation would be disruptive to traffic patterns.

Potential risks to the community could occur during periodic groundwater monitoring or NAPL recovery activities via exposure to purged groundwater, groundwater samples, and/or NAPL. Potential exposures to the community could be associated with generation of dust during NAPL recovery well installation or generation of volatile organic vapors during the NAPL recovery activities. Potential exposures would be minimized by following appropriate procedures and protocols that would be described in the SMP.

The relative carbon footprint of Alternative 4 (as compared to the other alternatives) is considered moderate. The greatest contribution to greenhouse gases would occur as a result of equipment operation during excavation, backfilling, and transportation activities.

Soil excavation, backfilling, site restoration and well installation activities could be completed in approximately six months, and monitoring would be conducted throughout an assumed 30-year period.

5.3.4.2 Long-Term Effectiveness and Permanence–Alternative 4

Under Alternative 4, shallow accessible NAPL-impacted soil and former MGP structures in the vicinity of the former MGP would be excavated and transported off-site for treatment/disposal. Removal of visually impacted soil (generally encountered at depths greater than 5 feet to 7 feet below grade) from the top 10 feet of the former MGP property and utility corridor would provide a 10-foot-thick clean zone of soil; reduce the potential need to implement the SMP on the former MGP property; and reduce the potential for exposure to soil containing MGP-related impacts in this area.

Inaccessible NAPL-impacted soil would remain at depths greater than 10 feet below grade and beneath the autobody, sales and automotive repair shops at the former MGP property and at depths generally greater than 15 feet below grade throughout the off-site area under this alternative. Alternative 4 also includes NAPL recovery to reduce the volume of mobile NAPL present at the site and groundwater monitoring to document the extent of dissolved-phase impacts and potential trends in COC concentrations. Through the removal of shallow impacted soil and recovery of mobile NAPL, the concentrations and extent of dissolved-phase impacts could be reduced over time. Potential exposures to field personnel and the community during long-term monitoring activities would be minimized by following appropriate procedures and protocols that would be established in the SMP to be prepared as part of this alternative.

Most of the surfaces at the site are currently covered by buildings and asphalt pavement, which provide a physical barrier to impacted soils and NAPL that would remain beneath the site. Disturbed areas would be restored consistent with their current condition (e.g., currently paved areas that are disturbed during remedial construction would be paved as part of the site restoration). Excavation activities would be conducted to a depth of approximately 10 feet below grade on the former MGP property and within the utility corridor. Impacted material would remain at depths greater than 10 feet below grade on the former MGP property, and NAPL and impacted soil in the off-site area is generally encountered at depths greater than 15 feet below grade. Alternative 4 addresses the area most likely to be subject to future subsurface activities (i.e., the Fulton Street utility corridor and shallow soil on the former MGP property) through excavation of impacted material and installation of a low-permeability barrier. Based on the current and foreseeable future use of the site and surrounding properties as a mixed industrial/commercial/residential area (i.e., USPS post office, autobody, sales, and automotive repair shops, supermarket, and Southeast Towers) site workers, patrons, and nearby residents do not routinely conduct activities that would potentially result in exposure to impacted site media (i.e., remaining impacted soil would at depths of 10 feet below grade on the former MGP property and generally 15 feet below grade and deeper in the off-site area).

However, Alternative 4 would still include establishing ICs for the former MGP and USPS post office properties to limit permissible intrusive activities that could result in potential exposures to impacted subsurface soil and groundwater. Notifications of the presence of soil and groundwater containing MGP-related impacts would be provided to those requesting utility clearance, and work activities (including handling potentially impacted material) would be conducted in accordance with the procedures described in the SMP to minimize the potential for exposures to impacted site media.

Additionally, the use of non-treated groundwater on affected properties would be prohibited. Annual verification of the ICs would be completed to document that the controls are maintained and remain effective.

Active NAPL recovery and low-flow pumping would create a greater potential for exposures to MGP-related materials on a long-term basis when compared to passive NAPL recovery. Active NAPL recovery would require construction of structures to store recovered NAPL. If low-flow groundwater pumping was implemented to enhance NAPL collection, assuming each of the NAPL collection wells would be pumped at a constant rate of 1 gpm, more than 20,000 gallons of impacted groundwater would be generated each day. A water treatment system capable of treating up to 25 gpm would have to be constructed on each property that contains NAPL collection points, and treated water would have to be discharged to a local sanitary sewer for further treatment and disposal. Because O&R does not own property in the immediate vicinity of the site, O&R would have to negotiate with the current property owners or purchase property to construct the water treatment systems in support of low-flow pumping systems and/or storage structures that would be required for an active recovery system. The presence of the water treatment and NAPL storage systems would increase the potential for long-term exposures to the surrounding community (i.e., during routine system operation or repair activities, system malfunctions, or vandalism of the structures and systems).

In contrast, passive collection activities could be conducted during non-peak hours and NAPL collected during passive recovery activities would be immediately transported off-site for treatment/disposal, significantly reducing the potential for long-term exposures to the surrounding public. Based on this rationale, active NAPL removal and low-flow groundwater pumping would decrease the long-term effectiveness and permanence of this alternative.

5.3.4.3 Land Use–Alternative 4

The current and foreseeable future use of the site is a mixed commercial/residential urban setting. The current zoning for the site is DMU-1, which allows for retail, commercial, government, professional and residential (second floor or higher) uses. Based on the current and anticipated land use of the former MGP property and off-site area, the potential for property occupant exposure to MGP-related residual materials or soil containing MGP-related COCs is minimal. Most of the site is covered with asphalt, concrete, buildings, or vegetated soil, and there is little to no need to conduct subsurface activities. Additionally, drinking water is currently and will continue to be provided via a public water supply. Therefore, groundwater containing MGP-related COCs is not and will not be used for potable (or other) purposes.

Alternative 4 would be consistent with the current land use at the site and should not interfere with redevelopment of this area under the current zoning. The proposed excavation within the utility corridor and on the former MGP property would create a relatively short-term disruption to the surrounding community, and the disturbed area would be restored to match existing site conditions. The proposed activities would require temporary shutdown of at least the autobody shop and the automotive sales business. However, following implementation, land use should not be impacted by this remedy. Institutional controls would be place on the site properties as well as the off-site properties with proposed NAPL recovery and groundwater monitoring wells. Based on the proposed long-term groundwater monitoring and NAPL monitoring/recovery components of this remedy, the redevelopment of the properties that contain groundwater monitoring wells and NAPL collection points may require coordination with the redeveloper to maintain the wells or to make provisions to access/repair/reinstall the wells as needed.

5.3.4.4 Reduction of Toxicity, Mobility, or Volume through Treatment–Alternative 4

Alternative 4 would include the excavation of approximately 3,400 CY of material from the former MGP property and utility corridor to address approximately 1,000 CY of soil with visible MGP impacts and former MGP structures from the former MGP property. Excavated soil would be permanently transported off-site for treatment/disposal. The excavation activities would create a clean 10-foot cover of clean fill on the former MGP property. Additionally, a low-permeability barrier would be installed along the upgradient edge of the former MGP property excavation to minimize the potential for recontamination of backfill, as well as potentially enhance NAPL collection in the wells that would be installed in this area.

Alternative 4 also includes the installation of NAPL collection wells and periodic NAPL monitoring/passive recovery of mobile NAPL that may collect in the wells. Through the NAPL monitoring/recovery activities, the volume of mobile NAPL would be reduced, thereby reducing the potential for further downgradient migration of mobile NAPL at the site. Additionally, NAPL removal would reduce the volume of material that is serving as a source to dissolved-phase groundwater impacts. This removal would reduce the flux of COCs from source material to groundwater, which would reduce the toxicity and volume of dissolved-phase groundwater impacts. Alternative 4 also includes annual groundwater monitoring to document the extent and potential long-term reduction (i.e., toxicity and volume) of dissolved-phase groundwater impacts.

5.3.4.5 Implementability–Alternative 4

This remedial alternative would be technically and administratively implementable. Removal and off-site disposal of soil is technically feasible, although conducting soil removal activities in an urban public setting presents numerous logistical challenges. There is limited or no available space at the site for material handling and staging, and small construction equipment would be required to conduct the removal activities. Based on the limits of excavation, all or portions of Fulton Street (between Canal and South streets) and Canal Street would have to be closed during remedial construction, and local traffic would have to be rerouted for approximately 5 months. Transportation planning would be conducted prior to the remedial activities. Tractor trailers would likely not be used based on the larger turning radius required from 6-axle vehicles. Additionally, soil removal activities would have to be conducted in a manner as to not jeopardize the health and safety of or cause a nuisance to the patrons that use the USPS post office, automotive shops, and adjacent roadways. Soil-loading conditions from nearby buildings and roadways would have to be evaluated as part of the remedial design. An excavation enclosure would be used to minimize potential exposures to the surrounding community. Overhead utilities (e.g., electric and telecommunication lines) would have to be relocated prior to the remedial construction activities. Underground utilities (e.g., water, stormwater, sanitary, and gas lines) located along the northern westbound lane beneath Fulton Street would have to be re-routed, bypassed, and/or protected as appropriate during implementation of this alternative.

From a technical implementability aspect, equipment and personnel qualified to install groundwater monitoring and NAPL collection wells and conduct groundwater and NAPL monitoring activities are readily available. Prior to conducting excavation activities and installing the NAPL recovery and groundwater monitoring wells, subsurface utilities would be identified to reduce the potential of damaging utilities during intrusive activities. The groundwater monitoring wells and NAPL collection wells would be secured in lockable subsurface vaults to prevent access by unauthorized personnel. NAPL removal methods would also be assessed during the design of this alternative. Active NAPL recovery (i.e., automated pumping) and low-flow groundwater pumping would be more difficult to implement, when compared to passive NAPL collection and manual recovery, because active recovery would require on-site NAPL storage structures and low-flow groundwater pumping would require construction and operation of on-site water treatment systems. Construction of storage structures and water treatment systems in a public area is not considered readily implementable or practicable.

Administratively, ICs would be established for the former MGP and USPS post office properties, which would require O&R to negotiate with the current property owners and would require coordination with state agencies (i.e., NYSDEC and NYSDOH). Access agreements would have to be secured with the autobody, sales, and automotive repair shops to conduct the excavation activities. Based on the limits of the proposed excavation activities and the likely use of an excavation enclosure, the autobody, sales, and automotive repair shop on the western portion of the former MGP property would have to be closed during remedial construction activities. O&R would have to negotiate with the current owner to obtain access to the property in order to implement this alternative. This alternative assumes O&R would occupy the former MGP property during the implementation of the remedial activity. O&R would have to consider providing rental property at an alternate location in Middletown to allow businesses leasing the buildings on this property to continue to operate and potentially compensating the property owner for loss of a tenant(s) during the remedial construction period. Additionally, access agreements would need to be secured by O&R

to install new wells and conduct the periodic NAPL and groundwater monitoring activities on the former MGP property and off-site area.

5.3.4.6 Compliance with SCGs–Alternative 4

The alternative's ability to comply with applicable federal, state, and local criteria, advisories, and guidance in presented below.

5.3.4.6.1 Chemical-Specific SCGs

Chemical-specific SCGs are presented in Table 2-1. Potentially applicable chemical-specific SCGs for soil include 6 NYCRR Part 375-6 SCOs and 40 CFR Part 261 and 6 NYCRR Part 371 regulations for the identification of hazardous materials. Potentially applicable chemical-specific SCGs for groundwater include NYSDEC Class GA standards and guidance values:

- Alternative 4 would include the removal shallow NAPL-impacted soil and portions of former MGP structures on the former MGP property, as well as the utility corridor beneath the westbound of Fulton Street. Other locations of soil containing COCs at concentrations greater than 6 NYCRR Part 375-6 commercial SCOs would not be addressed by this alternative. Soil containing MGP-related impacts would remain in place beneath existing surface materials (i.e., pavement, concrete, buildings) and/or a minimum 10 feet of existing or imported fill. All excavated material and process residuals would be managed and characterized in accordance with 40 CFR Part 261 and 6 NYCRR Part 371 regulations to determine off-site treatment/disposal requirements. NYS LDRs would apply to any materials that are characterized as a hazardous waste.
- As indicated in Section 1, site groundwater contains VOCs and SVOCs at concentrations greater than NYSDEC Class GA standards and guidance values. Because this alternative does not include removal activities to address all soil containing MGP-related impacts (i.e., a source of dissolved-phase impacts), this alternative would likely not achieve groundwater SCGs within a determinate period.

5.3.4.6.2 Action-Specific SCGs

Action-specific SCGs are presented in Table 2-2. Potentially applicable action-specific SCGs include health and safety requirements and regulations associated with handling impacted media. Work activities would be conducted in accordance with OSHA requirements that specify general industry standards, safety equipment and procedures, and record-keeping and reporting regulations. Compliance with these action-specific SCGs would be accomplished by following a site-specific HASP:

- Excavated soil and process residuals would be subject to USDOT requirements for packaging, labeling, manifesting, and transporting hazardous or regulated materials. Compliance with these requirements would be achieved by following a NYSDEC-approved Remedial Design/Remedial Action Work Plan and using licensed waste transporters and permitted disposal facilities. Per DER-4 (NYSDEC 2002), excavated material from a former MGP site that is characteristically hazardous for benzene only (D018) is conditionally exempt from hazardous waste management requirements when destined for thermal treatment (e.g., LTTD). All excavated material would be disposed of in accordance with applicable NYS LDRs.

5.3.4.6.3 Location-Specific SCGs

Location-specific SCGs are presented in Table 2-3. Potentially applicable location-specific SCGs generally include regulations on conducting construction activities on floodplains. Compliance with these SCGs would be achieved by obtaining a joint USACE and NYSDEC permit prior to conducting site activities. Additionally, remedial activities would be conducted in accordance with Middletown building/construction codes, and/ordinances, and necessary street work permits would be obtained prior to initiating the remedial activities.

5.3.4.7 Overall Protection of Public Health and the Environment–Alternative 4

Alternative 4 would mitigate the potential for long-term exposures to impacted subsurface soil and groundwater by excavating shallow accessible NAPL-impacted soil and former MGP structures in the vicinity of the former MGP, recovering mobile NAPL, monitoring groundwater, and implementing ICs. This alternative addresses the most likely potential future exposures that could occur at the site. The potential for construction workers to be exposed to MGP-related impacts while conducting subsurface utility work within Fulton Street or at the former MGP property would be mitigated through the removal of shallow impacted soil and former MGP structures in this area and the installation of a low-permeability barrier and NAPL recovery points immediately upgradient of excavation area. Impacted soils and inaccessible and/or immobile NAPL would remain at depths greater than 10 feet below grade and beneath buildings at the former MGP property and at depths of 15 feet below grade and deeper in the off-site area and would not be addressed through active containment, treatment, or removal.

This alternative would prevent exposures (i.e., direct contact, ingestion, and inhalation) to MGP-related impacts in subsurface soil and groundwater (soil RAOs #1 and #2 and groundwater RAOs #1 and #2) through the implementation of ICs and removal of shallow soil in the vicinity of the former MGP. However, potentially complete exposure pathways would remain under this alternative, and the reduction of potential exposures would only occur by adhering to the ICs and the procedures to be presented in the SMP.

Alternative 4 would partially address MGP-related COCs that could cause impacts to groundwater (soil RAO #3) through soil excavation and the recovery of mobile NAPL. Periodic monitoring would be completed to document the extent of dissolved-phase impacts and potential trends in COC concentrations. Although mobile NAPL would be permanently removed through excavation and passive recovery, impacted soil (i.e., source material for dissolved-phase impacts) would remain through the site; therefore, this alternative is not expected to restore groundwater to pre-disposal/pre-release conditions (groundwater RAO #3) nor address all sources of groundwater impacts (groundwater RAO #4) because potentially mobile NAPL may remain in former MGP structures and inaccessible and/or immobile NAPL would remain in subsurface soil at depths greater than 10 feet below grade on the former MGP property and 15 feet below grade in the off-site area.

5.3.4.8 Cost–Alternative 4

The estimated costs associated with Alternative 4 are presented in Table 5-3. The total estimated 30-year present worth cost for this alternative is approximately $10,400,000. The estimated capital cost, including costs for conducting soil removal activities, installing NAPL collection wells and groundwater monitoring wells, and establishing ICs, is approximately $7,900,000. The estimated 30-year present worth cost of O&M activities associated with this alternative, including conducting semi-annual NAPL monitoring and annual groundwater monitoring, is approximately $2,500,000.

5.3.5 Alternative 5–Targeted Soil Removal at the Former MGP Property, NAPL Recovery, Groundwater Monitoring, and Institutional Controls

Alternative 5 includes the following major components:

- Excavating accessible impacted soil and former MGP structures.
- Conducting NAPL recovery.
- Conducting long-term groundwater monitoring.
- Developing an SMP.
- Establishing ICs.

Accessible soils are defined as those soils that could be excavated using standard materials and equipment (e.g., sheetpile and excavators) without undermining or demolishing existing buildings or major infrastructure (that could not be temporarily bypassed or taken out of service).

This alternative would address the potential for exposures to accessible NAPL-impacted soil and former MGP structures in the vicinity of the former MGP through excavation. This alternative would also address the potential for exposure to remaining subsurface soil and groundwater containing MGP-related COCs through the implementation of ICs. Alternative 5 also includes NAPL recovery to facilitate the removal of mobile NAPL from the subsurface and long-term groundwater monitoring to document the extent of dissolved-phase impacts and potential trends in COC concentrations.

Alternative 5 would include removal of accessible NAPL-impacted soil and former MGP structures within the former MGP property at the eastern corner of Fulton and Canal streets (including the utility corridor excavation component of Alternative 3). Approximate removal limits are shown in attached Figure 5-5. Excavation activities would be conducted up to depths of approximately 20 feet below grade (i.e., to the top of the till surface) to remove visibly impacted soil and former MGP structures. Approximately 6,700 CY of material would be excavated from this area to address approximately 3,600 CY of soil with visible MGP impacts and former MGP structures. Soil and former MGP structures located below the autobody, sales and automotive repair shops (which would remain under this alternative) would not be removed. Based on the visual characterization of soil samples previously collected from this area and for the purpose of developing a cost estimate, it has been assumed soil from 0 feet to 2 feet below grade would be transported off-site for disposal as C&D debris and soil from 2 feet to 20 feet below grade would transported off-site for treatment/disposal via LTTD. None of the excavated soil from this area is expected to be suitable for reuse as backfill based on the nature of urban fill material and presence of former MGP structures/foundations.

As indicated under Alternatives 3 and 4, excavation activities would be conducted using conventional construction equipment such as backhoes, excavators, front-end loaders, and dump trucks. Based on the proposed extent of excavation activities, excavation support is anticipated to be required for this alternative (assumed to be steel sheetpile walls equipped with internal bracing). To accommodate sheeting installation as part of the utility corridor excavation, the excavation area would extend approximately 10 feet into Fulton Street. Additionally, it is anticipated an excavation enclosure (e.g., Sprung structure) equipped with a vapor collection and treatment system would be constructed over the proposed excavation area to reduce the potential for exposures and off-site migration of vapors and odors during excavation activities. Use of an excavation enclosure would require the overhead utilities on the north side of Fulton Street to be relocated prior to the implementation of remedial construction activities. The final excavation plan and an SWPPP would be developed as part of the remedial design. Water generated during excavation area dewatering activities would be collected, treated on-site using a temporary water treatment system, and discharged under a permit to the local POTW via a nearby sanitary sewer.

A low-permeability barrier would be installed along the upgradient edge of the utility corridor excavation area to minimize the potential for recontamination of backfill material from inaccessible, potentially mobile NAPL that would remain beneath the autobody, sales, and automotive repair shops. Potential barrier options include a steel sheetpile wall, slurry wall, and HDPE liners. For the purpose of developing this alternative, it has been assumed HDPE would be "hung" along the upgradient excavation side walls. The HDPE liner would prevent migration of potentially mobile NAPL that would remain upgradient of the removal area to the clean fill material used to backfill the excavation. Additionally, the liner would potentially enhance NAPL collection in the wells that would be installed immediately upgradient of the low-permeability barrier following completion of the excavation and backfilling activities.

Prior to restoring the soil removal areas, a demarcation layer (e.g., geotextile fabric, snow fence) would be placed along excavation area bottoms and side walls to denote soil removal limits. Removal areas would be restored with imported clean fill material and/or other engineered backfill (e.g., controlled-low strength material), as appropriate, to match the previously existing lines and grades, and all disturbed surfaces would be replaced in kind. Backfill materials and surface restoration details would be developed as part of the remedial design for this alternative.

Alternative 5 would also include establishing ICs on the properties that comprise the site (e.g., the former MGP property and the USPS post office property) as well as the off-site properties with proposed NAPL recovery and groundwater monitoring wells. The ICs would limit the future development and use of these areas (including groundwater), as well as control intrusive (i.e., subsurface) activities that could result in potential exposures to subsurface soil and groundwater containing MGP-related impacts at concentrations greater than applicable standards and guidance values. The ICs would also establish requirements for additional investigation activities (e.g., subsurface soil sampling) and/or remedial actions (e.g., excavation) if the building on the autobody, sales, and automotive repair shop property were to be demolished. Although potable water is provided by a municipal supply, the ICs would also prohibit (or limit as practicable for properties that are off-site or are publicly-owned) the use of non-treated groundwater on affected properties. An annual report would be submitted to NYSDEC to document that ICs are maintained and remain effective.

As with the other alternatives, Alternative 5 would also include installing new groundwater monitoring wells and conducting groundwater monitoring to confirm groundwater flow direction and verify the extent and concentrations of dissolved-phase COCs. Groundwater samples would be collected and submitted for laboratory analysis for BTEX, PAHs, and cyanide to document the extent of dissolved-phase impacts and potential trends in COC concentrations.

Additionally, Alternative 5 would also include establishing ICs, such as deed restrictions and/or environmental easements, on the properties that comprise the site (e.g., the former MGP property and the USPS post office property) as well as the off-site properties with proposed NAPL recovery and groundwater monitoring wells. The ICs would limit the future development and use of these areas (including groundwater), as well as control intrusive (i.e., subsurface) activities that could result in potential exposures to subsurface soil and groundwater containing MGP-related impacts at concentrations greater than applicable standards and guidance values. The ICs would also establish requirements for additional investigation activities (e.g., subsurface soil sampling) and/or remedial actions (e.g., excavation) if the building on the autobody, sales, and automotive repair shop property were to be demolished. The ICs would also prohibit the use of non-treated groundwater on affected properties. Annual verification of the controls would be submitted to NYSDEC to document that ICs are maintained and remain effective.

This alternative would include preparation of an SMP to document the following:

- The ICs that have been established and will be maintained for the site
- Known locations of remaining soil that contains COCs at concentrations greater than 6 NYCRR Part 375-6 commercial SCOs
- Requirements for notifications of the presence of MGP-related impacts in soil and groundwater that would be provided to those requesting utility clearance for intrusive activities on the former MGP property or in the off-site area
- Protocols (including health and safety requirements) for conducting invasive (i.e., subsurface) activities and managing potentially impacted material encountered during these activities
- Protocols and requirements for conducting semi-annual NAPL monitoring and annual groundwater monitoring
- Protocols for addressing significant changes in COC concentrations in groundwater based on the results of the annual monitoring activities

The potential need to implement the SMP at the former MGP property (including the utility corridor) would be reduced through the excavation of accessible visually impacted soil that would be removed under this alternative.

5.3.5.1 Short-Term Impacts and Effectiveness–Alternative 5

Implementation of this alternative could result in short-term exposure of the surrounding community and site workers to site-related COCs as a result of excavation, material handling, and off-site transportation activities. Additionally, field personnel may be exposed to impacted soil, groundwater, and/or NAPL during groundwater monitoring well and NAPL collection well installation activities. Potential exposure mechanisms would include ingestion and dermal contact with NAPL, impacted soil, and/or groundwater and inhalation of volatile organic vapors or dust containing COCs during remedial construction.

Potential exposure of remedial workers would be minimized using appropriately trained field personnel and PPE, as specified in a site-specific HASP that would be developed as part of the remedial design. A CAMP would be prepared, and community air monitoring would be performed during excavation and backfilling activities to evaluate the need for additional engineering controls (e.g., use of water sprays to suppress dust, and modify the rate of excavation). Community access to excavation areas would be restricted by temporary security fencing and the excavation enclosure. Implementation of this alternative would temporarily cause a disruption to the surrounding community. At a minimum, the westbound lanes of Fulton Street, as well as the entire width of Canal Street would be closed for approximately seven months. Pedestrian and vehicle traffic would be re-directed to avoid the work area, which may also impact pedestrian and automotive access to the USPS post office. Based on the proposed excavation limits, the autobody, sales, and automotive repair shop located on the western portion of the former MGP property would have to be closed during intrusive activities.

Additional worker safety concerns include working with and around large construction equipment, noise generated from installing sheeting and operating construction equipment, and increased vehicle traffic associated with transportation of excavated material from the site and delivery of fill materials. These concerns would be minimized by using engineering controls and appropriate health and safety practices. Off-site transportation of excavated material and importation of clean fill materials would result in approximately 950 roundtrips by tri-axle trucks (assuming 14 CY per truck). Transportation activities would be managed to minimize en-route risks to the community.

Potentially impacted soil and groundwater generated during well installation activities would be properly managed to minimize potential exposures to the surrounding community. In addition, closure of a portion of Fulton Street to accommodate the utility corridor excavation would be disruptive to traffic patterns.

Potential risks to the community could occur during periodic groundwater monitoring or NAPL recovery activities via exposure to purged groundwater, groundwater samples, and/or NAPL. Potential exposures to the community could be associated with generation of dust during NAPL recovery well installation or generation of volatile organic vapors during the NAPL recovery activities. Potential exposures would be minimized by following appropriate procedures and protocols that would be described in the SMP.

The relative carbon footprint of Alternative 5 (as compared to the other alternatives) is considered significant. The greatest contribution to greenhouse gases would occur as a result of equipment operation during excavation, backfilling, and transportation activities.

Soil excavation, backfilling, restoration and well installation activities could be completed in approximately eight months and monitoring would be conducted throughout an assumed 30-year period.

5.3.5.2 Long-Term Effectiveness and Permanence–Alternative 5

The potential for future long-term impacts from and exposures to MGP-related COCs in site media would be reduced through the implementation of this alternative. Under Alternative 5, accessible NAPL-impacted soil and former MGP structures in the vicinity of the former MGP would be excavated and transported off-site for treatment/disposal. However, inaccessible immobile NAPL would remain below the automotive shops and impacted soil would remain in the off-site area at depths generally greater than 15 feet below grade. Alternative 5 also includes NAPL recovery to reduce the volume of mobile NAPL present at the site and groundwater monitoring to document the extent of dissolved-phase impacts and potential trends in COC concentrations. Through the removal of impacted soil and recovery of mobile NAPL, the concentrations and extent of dissolved-phase impacts could be reduced over time. Potential exposures to field personnel and the community during long-term monitoring activities would be minimized by following appropriate procedures and protocols that would be established in the SMP prepared as part of this alternative.

This alternative includes the removal of NAPL-impacted materials on the former MGP property to the top of the till surface (presumed to be 20 feet). However, NAPL-impacted soils would remain at depths generally deeper than 15 feet below grade in the off-site area. Most of the surfaces at the site are currently covered by buildings and asphalt pavement, which provide a physical barrier to impacted soils and NAPL that would remain at the site. Disturbed areas would be restored consistent with their current condition (e.g., currently paved areas that are disturbed during remedial construction would be paved as part of the site restoration). Based on the current and foreseeable future use of the site and surrounding properties as a mixed use commercial/residential area (i.e., USPS post office, autobody, sales, and automotive repair shops, supermarket, and Southeast Towers), site workers, patrons, and nearby residents do not routinely conduct activities that would potentially result in exposure to impacted site that would remain following the remedial activities.

However, Alternative 5 would still include establishing ICs for the former MGP and USPS post office properties to limit permissible intrusive activities that could result in potential exposures to impacted subsurface soil and groundwater. Notifications of the presence of soil and groundwater containing MGP-related impacts would be provided to those requesting utility clearance, and work activities (including handling potentially impacted material) would be conducted in accordance with the procedures described in the SMP to minimize the potential for exposures to impacted site media. Additionally, the use of non-treated groundwater on affected properties would be prohibited. Annual verification of the ICs would be completed to document that the controls are maintained and remain effective.

Active NAPL recovery and low-flow pumping would create a greater potential for exposures to MGP-related materials on a long-term basis when compared to passive NAPL collection and manual recovery. Active NAPL recovery would require construction of structures to store recovered NAPL. If low-flow groundwater pumping was implemented to enhance NAPL collection, assuming each of the NAPL collection wells would be pumped at a constant rate of one gpm, more than 20,000 gallons of impacted groundwater would be generated each day. A water treatment system capable of treating up to 25 gpm would have to be constructed on each property that contains NAPL collection points, and treated water would have to be discharged to a local sanitary sewer for further treatment and disposal. Because O&R does not own property in the immediate vicinity of the site, O&R would have to negotiate with the current property owners or purchase property to construct the water treatment systems in support of low-flow pumping systems and/or storage structures that would be required for an active recovery system. The presence of the water treatment and NAPL storage systems would increase the potential for long-term exposures to the surrounding community (i.e., during routine system operation or repair activities, system malfunctions, or vandalism of the structures and systems).

In contrast, passive collection activities could be conducted during non-peak hours and NAPL collected during passive recovery activities would be immediately transported off-site for treatment/disposal, significantly reducing the potential for long-term exposures to the public. Based on this rationale, active NAPL removal and low-flow groundwater pumping would decrease the long-term effectiveness and permanence of this alternative.

5.3.5.3 Land Use–Alternative 5

The current and foreseeable future use of the site is a mixed commercial/residential urban setting. The current zoning for the site is DMU-1, which allows for retail, commercial, government, professional and residential (second floor or higher) uses. Based on the current and anticipated land use of the former MGP property and off-site area, the potential for property occupant exposure to MGP-related residual materials or soil containing MGP-related COCs is minimal. Most of the site is covered with asphalt, concrete, buildings, or vegetated soil, and there is little to no need to conduct subsurface activities. Additionally, drinking water is currently and will continue to be provided via a public water supply. Therefore, groundwater containing MGP-related COCs is not and will not be used for potable (or other) purposes.

Alternative 5 would be consistent with the current land use at the site and should not interfere with redevelopment of this area under the current zoning. The proposed excavation within the utility corridor and on the former MGP property would create a relatively short-term disruption to the surrounding community and the disturbed area would be restored like match existing site conditions. The proposed activities would require temporary shutdown of the autobody shop and automotive sales business. Following implementation, land use should not be impacted based on the implementation of this remedy. Institutional controls would be placed on the site properties as well as the off-site properties with proposed NAPL recovery and groundwater monitoring wells. Based on the proposed long-term groundwater monitoring and NAPL monitoring/recovery components of this remedy, the redevelopment of the properties that contain groundwater monitoring wells and NAPL collection points may require coordination with the redeveloper to maintain the wells or to make provisions to access/repair/reinstall the wells as needed.

5.3.5.4 Reduction of Toxicity, Mobility, or Volume through Treatment–Alternative 5

Alternative 5 would include the excavation of approximately 6,700 CY of material from the former MGP property and utility corridor to address approximately 3,600 CY of soil with visible MGP impacts and former MGP structures from the former MGP property. Excavated material would be permanently transported off site for treatment/disposal. These removal activities would address the most accessible impacted soil at the site. NAPL and NAPL-impacted soils would remain at depths generally more than 15 feet below grade in the off-site area. Additionally, a low-permeability barrier would be installed along the upgradient edge of the former MGP property excavation to minimize the potential for recontamination of backfill, as well as potentially enhance NAPL collection in the wells that would be installed in this area.

Alternative 5 also includes the installation of NAPL collection wells and periodic NAPL monitoring and passive recovery of mobile NAPL that may collect in the wells. Through the NAPL monitoring/recovery activities, the volume of mobile NAPL would be reduced, thereby reducing the potential for further downgradient migration of mobile NAPL at the site. Additionally, NAPL removal would reduce the volume of material that is serving as a source to dissolved-phase groundwater impacts. This removal would reduce the flux of COCs from source material to groundwater, which would reduce the toxicity and volume of dissolved-phase groundwater impacts. Alternative 5 also includes annual groundwater monitoring to document the extent and potential long-term reduction (i.e., toxicity and volume) of dissolved-phase groundwater impacts.

5.3.5.5 Implementability–Alternative 5

This remedial alternative has potentially significant implementability challenges from a technical and administrative standpoint. Removal and off-site disposal of soil is technically feasible, although conducting soil removal activities in an urban public setting presents numerous logistical challenges. Conducting excavation activities to depths of 20 feet below grade may be difficult given the urban setting. There is limited or no available space at the site for material handling and staging, and small construction equipment would be required to conduct the removal activities. The presence of existing utilities and infrastructure cause additional challenges for implementing this alternative. Based on the limits of excavation, all or portions of Fulton Street (between Canal and South Streets) and Canal Street would have to be closed during remedial construction, and local traffic would have to be rerouted for approximately 7 months. Transportation planning would be conducted prior to the remedial activities. Tractor trailers would likely not be used based on the larger turning radius required for 6-axle vehicles. Additionally, soil removal activities would have to be conducted in a manner as to not jeopardize the health and safety of or cause a nuisance to the patrons that use the USPS post office, automotive shops, and adjacent roadways. Soil-loading conditions from nearby buildings and roadways would have to be evaluated as part of the remedial design. An excavation enclosure would likely be used to minimize potential exposures to the surrounding community. Overhead utilities (e.g., electric and telecommunication lines) would have to be relocated prior to the remedial construction activities on the former MGP property. Underground utilities (e.g., water, stormwater, sanitary, and gas lines) located beneath Fulton Street would have to be re-routed, bypassed, and/or protected as appropriate during implementation of this alternative.

From a technical implementability aspect, equipment and personnel qualified to install groundwater monitoring and NAPL collection wells and conduct groundwater and NAPL monitoring activities are readily available. Prior to conducting excavation activities and installing the NAPL recovery and groundwater monitoring wells, subsurface utilities would be identified to reduce the potential for damaging utilities during intrusive activities. The groundwater monitoring wells and NAPL collection wells would be secured in lockable subsurface vaults to prevent access by unauthorized personnel. NAPL removal methods would also be assessed during the design of this alternative. Active NAPL recovery (i.e., automated pumping) and low-flow groundwater pumping would be more difficult to implement, when compared to passive NAPL collection and manual recovery, because active recovery would require on-site NAPL storage structures and low-flow groundwater pumping would require construction and operation of on-site water treatment systems. Construction of storage structures and water treatment systems in a public area is not considered readily implementable or practicable.

Administratively, ICs would be established for the former MGP and USPS post office properties, which would require O&R to negotiate with the current property owners and would require coordination with state agencies (i.e., NYSDEC and NYSDOH). Access agreements would have to be secured with the autobody, sales, and automotive repair shops to conduct the excavation activities in these areas. This alternative assumes O&R would occupy the former MGP property during the implementation of the remedial activity. O&R would have to consider providing rental property at an alternate location in Middletown to allow businesses leasing the buildings on this property to continue to operate and they would have to potentially compensate the property owner for loss of a tenant(s) during the remedial construction period. Additionally, access agreements would need to be secured by O&R to install new wells and conduct the periodic NAPL and groundwater monitoring activities on the former MGP property and off-site area.

5.3.5.6 Compliance with SCGs–Alternative 5

The alternative's ability to comply with applicable federal, state, and local criteria, advisories, and guidance in presented below.

5.3.5.6.1 Chemical-Specific SCGs

Chemical-specific SCGs are presented in Table 2-1. Potentially applicable chemical-specific SCGs for soil include 6 NYCRR Part 375-6 SCOs and 40 CFR Part 261 and 6 NYCRR Part 371 regulations for the identification of hazardous materials. Potentially applicable chemical-specific SCGs for groundwater include NYSDEC Class GA standards and guidance values:

- Alternative 5 would include the removal of accessible visually NAPL-impacted soil and former MGP structures on the former MGP property. Other locations of soil containing COCs at concentrations greater than 6 NYCRR Part 375-6 commercial SCOs would not be addressed by this alternative. Soil containing MGP-related impacts would remain in place beneath surface materials (i.e., pavement, concrete, buildings) and existing fill material. All excavated material and process residuals would be managed and characterized in accordance with 40 CFR Part 261 and 6 NYCRR Part 371 regulations to determine off-site treatment/disposal requirements. NYS LDRs would apply to any materials characterized as a hazardous waste.

- As indicated in Section 1, site groundwater contains VOCs and SVOCs at concentrations greater than NYSDEC Class GA standards and guidance values.
- Alternative 5 would include the excavation of accessible visually impacted soil and NAPL on the former MGP property and only inaccessible residual NAPL would remain beneath the autobody, sales, and automotive repair shops. Based on the extent of the removal activities in this area, groundwater SCGs may be achieved at the former MGP property. Because this alternative does not include removal activities to address soil containing MGP-related impacts (i.e., a source of dissolved-phase impacts) in the off-site area, this alternative would likely not achieve groundwater SCGs in the off-site area within a determinate period.

5.3.5.6.2 Action-Specific SCGs

Action-specific SCGs are presented in Table 2-2. Potentially applicable action-specific SCGs include health and safety requirements and regulations associated with handling impacted media. Work activities would be conducted in accordance with OSHA requirements that specify general industry standards, safety equipment and procedures, and record-keeping and reporting regulations. Compliance with these action-specific SCGs would be accomplished by following a site-specific HASP:

- Excavated soil and process residuals would be subject to USDOT requirements for packaging, labeling, manifesting, and transporting hazardous or regulated materials. Compliance with these requirements would be achieved by following a NYSDEC-approved Remedial Design/Remedial Action Work Plan and using licensed waste transporters and permitted disposal facilities. Excavated material from a former MGP site that is characteristically hazardous for benzene only (D018) is conditionally exempt from hazardous waste management requirements when destined for thermal treatment (e.g., LTTD). All excavated material would be disposed of in accordance with applicable NYS LDRs.

5.3.5.6.3 Location-Specific SCGs

Location-specific SCGs are presented in Table 2-3. Potentially applicable location-specific SCGs generally include regulations on conducting construction activities on floodplains. Compliance with these SCGs would be achieved by obtaining a joint USACE and NYSDEC permit prior to conducting site activities. Additionally, remedial activities would be conducted in accordance with Middletown building/construction codes and/ordinances, and necessary street work permits would be obtained prior to initiating the remedial activities.

5.3.5.7 Overall Protection of Public Health and the Environment–Alternative 5

Alternative 5 would mitigate the potential for long-term exposures to impacted subsurface soil and groundwater by excavating accessible NAPL-impacted soil and former MGP structures in the vicinity of the former MGP; recovering mobile NAPL; monitoring groundwater; and implementing ICs. This alternative addresses the most likely potential future exposures that could occur at the site. The potential for construction workers to be exposed to MGP-related impacts while conducting subsurface work at the former MGP property or within the utility corridor would be significantly mitigated through the removal of accessible impacted soil and former MGP structures in these areas and the installation of a low-permeability barrier and NAPL recovery points immediately upgradient of excavation area. Inaccessible immobile NAPL and impacted soils would remain in the subsurface beneath the autobody, sales, and automotive repair shops on the former MGP property and at depths generally greater than 15 feet below grade in the off-site area and would not be addressed through active containment, treatment, or removal.

This alternative would prevent exposures (i.e., direct contact, ingestion, and inhalation) to MGP-related impacts in subsurface soil and groundwater (soil RAOs #1 and #2 and groundwater RAOs #1 and #2) through the implementation of ICs and removal of accessible NAPL-impacted soil and former MGP structures in the vicinity of the former MGP. However, potentially complete exposure pathways would remain under this alternative and the reduction of potential exposures would only occur by adhering to the ICs and the procedures to be presented in the SMP.

Alternative 5 would work toward addressing MGP-related COCs and material that could cause impacts to groundwater (soil RAO #3) through the recovery of mobile NAPL and removal of MGP-impacted soil from the former MGP. Periodic monitoring would be completed to document the extent of dissolved-phase impacts and potential trends in COC concentrations.

Although Alternative 5 includes the removal of accessible visually impacted soil and former MGP structures on the former MGP property, NAPL would remain in the till. Therefore, Alternative 5 would work toward, but likely not achieve, restoring groundwater to pre-disposal/pre-release conditions (groundwater RAO #3) or addressing sources of groundwater impacts (groundwater RAO #4) on the former MGP property. Although NAPL recovery would be conducted in the off-site area, Alternative 5 is not expected to restore groundwater to pre-disposal/pre-release conditions (groundwater RAO #3) nor address all the sources of groundwater impacts (groundwater RAO #4) as impacted soil (i.e., a source to dissolved-phase impacts) would remain in subsurface soil in the off-site area.

5.3.5.8 Cost–Alternative 5

The estimated costs associated with Alternative 5 are presented in Table 5-4. The total estimated 30-year present worth cost for this alternative is approximately $12,100,000. The estimated capital cost, including costs for conducting soil removal activities, installing NAPL collection wells and groundwater monitoring wells, and establishing ICs, is approximately $9,600,000. The estimated 30-year present worth cost of O&M activities associated with this alternative, including conducting semi-annual NAPL monitoring and annual groundwater monitoring, is approximately $2,500,000.

5.3.6 Alternative 6–Slurry-Supported Soil Removal at the Former MGP Property, Utility Corridor Stabilization, NAPL Recovery, Groundwater Monitoring, and Institutional Controls

Alternative 6 includes the following major components:

- Excavating accessible impacted soil and former MGP structures located in the southwestern corner of the former MGP.
- Performing in situ stabilization via jet grouting of soils underlying existing utilities adjacent to the autobody, sales, and automotive shops located on the former MGP.
- Conducting NAPL recovery in the vicinity of the USPS post office property.
- Conducting long-term groundwater monitoring.
- Developing an SMP.
- Establishing ICs.

Figure 5-6 presents a conceptual layout of this alternative.

Accessible soils are defined as those soils that could be excavated under a cement-bentonite slurry, without undermining or demolishing existing buildings or deactivation of utility infrastructure.

This alternative would address the potential for exposures to residual materials associated with select former MGP structures and remove a significant portion of impacted soils in the site area with the most prevalent observations of NAPL in soil borings. In addition, this alternative would include removal of portions of former MGP structures in the utility corridor and in situ stabilization of NAPL-impacted- soil within the corridor, extending beneath the northern curb and sidewalk area north of Fulton Street near Canal Street, to provide a clean corridor for potential future subsurface utility work in this area. The utility corridor area targeted by this remedy is shown in Figure 5-6.

This alternative would also address the potential for exposure to remaining subsurface soil and groundwater containing MGP-related constituents of concern (COCs) through the implementation of ICs. Alternative 6 also includes NAPL recovery to facilitate the removal of mobile NAPL from the subsurface and long-term groundwater monitoring to document the extent of dissolved-phase impacts and potential trends in COC concentrations.

Alternative 6 would include removal of accessible NAPL-impacted soil and select former MGP structures on the former MGP property at the eastern corner of Fulton and Canal streets. Approximate removal limits are shown in Figure 5-6. Excavation activities would be conducted up to a maximum depth of 20 feet below grade to remove visibly impacted soil and former MGP structures.

Under this alternative, approximately 3,200 CY of material would be excavated from this area and approximately 600 CY of soils would be removed and/or treated via jet grouting from the utility corridor area. The remedy will address approximately 2,200 CY of soil with visible MGP impacts and former MGP structures. Soil and former MGP structures located below the autobody, sales, and automotive repair shops would not be removed.

The proposed excavation methods (and associated limits of excavation) would be designed to allow for the excavation activities to be performed in a manner that would not disrupt the businesses currently operating at the former MGP property. To achieve this objective, the excavation work would generally proceed under the following steps:

1. Close off the portion of the parking lot to be excavated using jersey barriers or similar barriers.
2. Close the west side of Fulton Street and establish traffic controls.
3. Temporarily relocate or shield (as needed) the overhead electric lines located adjacent to the former MGP site.
4. Mobilize and set up a grout plant, jet grouting equipment, excavators, and staging and decontamination pads.
5. Pre-excavate to 4 feet bgs to remove obstructions and visually confirm location of subsurface utilities within the excavation and utility corridor areas.
6. Jet grout the soils underlying the utility corridor using angle drilling methods. Up to 6 feet of soil beneath the subsurface utilities will be jet grouted to create a barrier between the utilities and deeper, MGP-impacted soils along Fulton Street. Jet-grouting consists of applying a cement bentonite grout mixture into a column of soil using high pressure injection equipment (i.e., without excavation of soil). The high-pressure injection breaks the soil structure and mixes the soil and grout in-situ, thereby creating a homogeneous mixture, which subsequently solidifies into a weakly-cemented material. Jet-grouting is generally considered a replacement technology and would require management of spoils generated during the process. Spoil volume for the jet-grouting is estimated as approximately 100% of the treated soil volume.
7. Excavate the impacted soils in the parking lot area using a cement-bentonite slurry for sidewall support. The excavation would be performed by installing a single slurry trench to a maximum depth of 20 feet bgs each day. At the end of the workday, the slurry trench would be terminated and allowed to solidify. The next workday, a new trench would be started. The trenches would be staggered so no area would be excavated adjacent to the prior day’s excavation area to allow additional time for solidification and strength gain.

8. Restore the disturbed surfaces.

The cement-bentonite slurry excavation approach provides the following benefits: 1) the excavation can be performed without use of sheetpile support; 2) the slurry will suppress odors during excavation obviating the need for a temporary structure; 3) excavation dewatering/water treatment is not required; and 4) the solidified slurry serves as excavation backfill, which limits the need to import clean fill and shortens the time needed to complete the remedial activities.

Alternative 6 would also include the NAPL recovery, groundwater monitoring, and IC components like Alternatives 2, 3, 4, and 5. As indicated for Alternative 2, potential NAPL collection points could consist of collection wells or collection trenches. The final number, location, type, and construction of the NAPL collection points would be determined during the remedial design of this alternative. For the purpose of developing the cost estimate for this alternative, up to 11 NAPL recovery wells would be installed at locations and appropriate depths (i.e., within the alluvium or till) where measurable quantities of NAPL have been historically observed in monitoring wells and during the completion of soil borings. NAPL collection wells would be periodically (i.e., semi-annually) monitored to facilitate the passive recovery of mobile NAPL. NAPL could be potentially recovered by using an active recovery system, depending on the rate of NAPL collection following installation of the collection points.

As with the other alternatives, Alternative 6 would also include installing new groundwater monitoring wells and conducting groundwater monitoring to confirm groundwater flow direction and verify the extent and concentrations of dissolved-phase COCs. Groundwater samples would be collected and submitted for laboratory analysis for BTEX, PAHs, and cyanide to document the extent of dissolved-phase impacts and potential trends in COC concentrations.

Alternative 6 would also include establishing ICs on the properties that comprise the site (e.g., the former MGP property and the USPS post office property) as well as the off-site properties with proposed NAPL recovery and groundwater monitoring wells. The ICs would limit the future development and use of these areas (including groundwater), as well as control intrusive (i.e., subsurface) activities that could result in potential exposures to subsurface soil and groundwater containing MGP-related impacts at concentrations greater than applicable standards and guidance values. The ICs would also establish requirements for additional investigation activities (e.g., subsurface soil sampling) and/or remedial actions (e.g., excavation) if the building on the autobody, sales, and automotive repair shop property were to be demolished. Although potable water is provided by a municipal supply, the ICs would also prohibit (or limit as practicable for properties that are off-site or are publicly-owned) the use of non-treated groundwater on affected properties. An annual report would be submitted to NYSDEC to document that ICs are maintained and remain effective.

This alternative would include preparation of an SMP to document the following information:

- The ICs that have been established and will be maintained for the site
- Known locations of remaining soil that contains COCs at concentrations greater than associated soil cleanup objectives
- Requirements for notifications of the presence of MGP-related impacts in soil and groundwater that would be provided to those requesting utility clearance for intrusive activities on the former MGP property or in the off-site area
- Protocols (including health and safety requirements) for conducting invasive (i.e., subsurface) activities and managing potentially impacted material encountered during these activities
- Protocols and requirements for conducting semi-annual NAPL monitoring and annual groundwater monitoring
- Protocols for addressing significant changes in COC concentrations in groundwater based on the results of the annual monitoring activities

5.3.6.1 Short-Term Impacts and Effectiveness–Alternative 6

Implementation of this alternative could result in short-term exposure of the surrounding community and site workers to site-related COCs as a result of excavation, material handling, and off-site transportation activities. Additionally, field personnel may be exposed to impacted soil, groundwater, and/or NAPL during groundwater monitoring well and NAPL collection well installation activities. Potential exposure mechanisms would include ingestion and dermal contact with NAPL, impacted soil, and/or groundwater, as well as inhalation of volatile organic vapors or dust containing COCs during remedial construction.

Potential exposure of remedial workers would be minimized using appropriately trained field personnel and PPE, as specified in a site-specific HASP that would be developed as part of the remedial design. A CAMP would be prepared, and community air monitoring would be performed during excavation and backfilling activities to evaluate the need for additional engineering controls (e.g., use of water sprays to suppress dust or modify the rate of excavation). Community access to excavation areas would be restricted by temporary security fencing and the excavation enclosure. Implementation of this alternative would temporarily cause a disruption to the surrounding community. At a minimum, the westbound lanes of Fulton Street, as well as the entire width of Canal Street would be closed for approximately 3 months. Pedestrian and vehicle traffic would be re-directed to avoid the work area, which may also impact pedestrian and automotive access to the USPS post office. Based on the proposed excavation limits, the autobody, sales, and automotive repair shops located on the western portion of the former MGP property would remain open during the intrusive activities; however, the autobody and sales shops may need to relocate stored vehicles.

Additional worker safety concerns include working with and around large construction equipment, noise generated from operating construction equipment, and increased vehicle traffic associated with transportation of excavated material from the site and delivery of reagents for the slurry materials. These concerns would be minimized by using engineering controls and appropriate health and safety practices. Off-site transportation of excavated material and importation of clean fill materials would result in approximately 250 roundtrips by tri-axle trucks (assuming 14 CY per truck). Transportation activities would be managed to minimize en-route risks to the community. Because the excavation areas would be replaced by cement bentonite slurry, limited fill would need to be imported for restoration purposes.

Potentially impacted soil and groundwater generated during well installation activities would be properly managed to minimize potential exposures to the surrounding community. Potential risks to the community could occur during periodic groundwater monitoring or NAPL recovery activities via exposure to purged groundwater, groundwater samples, and/or NAPL. Potential exposures to the community could be associated with generation of dust during monitoring well or NAPL recovery well installation or generation of volatile organic vapors during the NAPL recovery activities. Potential exposures would be minimized by following appropriate procedures and protocols that would be described in the SMP.

The relative carbon footprint of Alternative 6 (as compared to the other alternatives) is considered comparable to Alternatives 3 and 4. The greatest contribution to greenhouse gases would occur as a result of equipment operation during excavation, backfilling, and transportation activities.

Soil excavation, backfilling, and well installation activities could be completed in approximately 3 months, and monitoring would be conducted throughout an assumed 30-year period.

5.3.6.2 Long-Term Effectiveness and Permanence–Alternative 6

The potential for future long-term impacts from and exposures to MGP-related COCs in site media would be reduced through the implementation of this alternative. Under Alternative 6, accessible NAPL-impacted soil and former MGP structures in the vicinity of the former MGP would be excavated and transported off-site for treatment/disposal. NAPL remaining at depths greater than 20 feet on the former MGP property, or NAPL remaining below the utility corridor, would be isolated by the cement-bentonite slurry used to support the excavation and perform the jet grouting operations.

Inaccessible NAPL (if present) would remain below the autobody, sales and automotive repair shops, and NAPL-impacted soil would remain in the off-site area at depths generally greater than 15 feet below grade. Alternative 6 also includes NAPL recovery to reduce the volume of mobile NAPL present at the site and groundwater monitoring to document the extent of dissolved-phase impacts and potential trends in COC concentrations. Through the removal of impacted soil and recovery of mobile NAPL, the concentrations and extent of dissolved-phase impacts could be reduced over time. Potential exposures to field personnel and the community during long-term monitoring activities would be minimized by following appropriate procedures and protocols that would be established in the SMP prepared as part of this alternative.

This alternative includes the removal of NAPL-impacted materials on the former MGP property to the top of the till surface. However, NAPL and impacted soils would remain at depths generally deeper than 15 feet below grade in the off-site area. Most of the surfaces at the site are currently covered by buildings and asphalt pavement, which provide a physical barrier to impacted soils and NAPL that would remain at the site. Disturbed areas would be restored consistent with their current condition (e.g., currently paved areas that are disturbed during remedial construction would be paved as part of the site restoration). Based on the current and foreseeable future use of the site and surrounding properties as a commercial/residential area (i.e., USPS post office, autobody, sales, and automotive repair shops, supermarket, and Southeast Towers), site workers, patrons, and nearby residents do not routinely conduct activities that would potentially result in exposure to impacted site media (i.e., remaining visually impacted soil at depths generally greater than 15 feet below grade in the off-site area).

However, Alternative 6 would still include establishing ICs for the former MGP and USPS post office properties to limit permissible intrusive activities that could result in potential exposures to impacted subsurface soil and groundwater. Notifications of the presence of soil and groundwater containing MGP-related impacts would be provided to those requesting utility clearance, and work activities (including handling potentially impacted material) would be conducted in accordance with the procedures described in the SMP to minimize the potential for exposures to impacted site media. Additionally, the use of non-treated groundwater on affected properties would be prohibited. Annual verification of the ICs would be completed to document that the controls are maintained and remain effective.

Active NAPL recovery and low-flow pumping would create a greater potential for exposures to MGP related- materials on a long-term basis when compared to passive NAPL collection and manual recovery. Active NAPL recovery would require construction of structures to store recovered NAPL. If low-flow groundwater pumping was implemented to enhance NAPL collection, assuming each of the NAPL collection wells would be pumped at a constant rate of 1 gpm, more than 20,000 gallons of impacted groundwater would be generated each day. A water treatment system capable of treating up to 25 gpm would have to be constructed on each property that contains NAPL collection points, and treated water would have to be discharged to a local sanitary sewer for further treatment and disposal. Because O&R does not own property in the immediate vicinity of the site, O&R would have to negotiate with the current property owners or purchase property to construct the water treatment systems in support of low-flow pumping systems and/or storage structures that would be required for an active recovery system. The presence of the water treatment and NAPL storage systems would increase the potential for long-term exposures to the surrounding community (i.e., during routine system operation or repair activities, system malfunctions, or vandalism of the structures and systems).

In contrast, passive collection activities could be conducted during non-peak hours and NAPL collected during passive recovery activities would be immediately transported off-site for treatment/disposal, significantly reducing the potential for long-term exposures to the public. Based on this rationale, active NAPL removal and low-flow groundwater pumping would decrease the long term- effectiveness and permanence of this alternative.

5.3.6.3 Land Use–Alternative 6

The current and foreseeable future use of the site is a mixed commercial/residential urban setting. The current zoning for the site is DMU-1, which allows for retail, commercial, government, professional and residential (second floor or higher) uses. Based on the current and anticipated land use of the former MGP property and off-site area, the potential for property occupant exposure to MGP-related residual materials or soil containing MGP-related COCs is minimal. Most of the site is covered with asphalt, concrete, buildings, or vegetated soil, and there is little to no need to conduct subsurface activities. Additionally, drinking water is currently and will continue to be provided via a public water supply. Therefore, groundwater containing MGP-related COCs is not and will not be used for potable (or other) purposes.

Alternative 6 would be consistent with the current land use at the site and should not interfere with redevelopment of this area under the current zoning. The proposed excavation within the utility corridor and on the former MGP property would create a relatively short-term disruption to the surrounding community, and the disturbed area would be restored similarly to existing site conditions. The proposed activities would require temporary shutdown of at least the automotive sales business at the former MGP property, but following implementation, land use should not be impacted based on the implementation of this remedy. Institutional controls would be placed on the site properties as well as the off-site properties with proposed NAPL recovery and groundwater monitoring wells. Based on the proposed long-term groundwater monitoring and NAPL monitoring/recovery components of this remedy, the redevelopment of the properties that contain groundwater monitoring wells and NAPL collection points may require coordination with the redeveloper to maintain the wells or to make provisions to access/repair/reinstall the wells as needed.

5.3.6.4 Reduction of Toxicity, Mobility, or Volume through Treatment–Alternative 6

Alternative 6 would include the excavation of approximately 3,200, CY of material from the former MGP property to address approximately 2,200 CY of soil with visible MGP impacts and former MGP structures from the former MGP property. Excavated material would be permanently transported off site for treatment/disposal. These removal activities would address the most accessible impacted soil at the site. NAPL and NAPL-impacted soils would remain at depths generally more than 15 feet below grade in the off-site area. Additionally, the solidified cement bentonite slurry would serve as a barrier to residual MGP materials (if present upgradient of the excavation area or beneath the MGP property buildings) and potentially enhance NAPL collection in the wells that would be installed upgradient of the excavation area.

Alternative 6 also includes the installation of NAPL collection wells and periodic NAPL monitoring and passive recovery of mobile NAPL that may collect in the wells. Through the NAPL monitoring/recovery activities, the volume of mobile NAPL would be reduced, thereby reducing the potential for further downgradient migration of mobile NAPL at the site. Additionally, NAPL removal would reduce the volume of material that is serving as a source to dissolved-phase groundwater impacts. This removal would reduce the flux of COCs from source material to groundwater, which would reduce the toxicity and volume of dissolved-phase groundwater impacts. Alternative 6 also includes annual groundwater monitoring to document the extent and potential long-term reduction (i.e., toxicity and volume) of dissolved-phase groundwater impacts.

5.3.6.5 Implementability–Alternative 6

This remedial alternative has potentially significant implementability challenges from a technical and administrative standpoint. Removal and off-site disposal of soil is technically feasible, although conducting soil removal activities in an urban public setting presents numerous logistical challenges. Conducting excavation activities to depths of 20 feet below grade may be difficult given the urban setting. There is limited available space at the former MGP property for material handling and staging, and small construction equipment would be required to conduct the removal activities. The presence of existing utilities and infrastructure cause additional challenges for implementing this alternative. Based on the limits of excavation, all or portions of Fulton Street (between Canal and South Streets) and Canal Street would have to be closed during remedial construction, and local traffic would have to be rerouted for approximately three months. Transportation planning would be conducted prior to the remedial activities. Tractor trailers would likely not be used based on the larger turning radius required for 6-axle vehicles. Additionally, soil removal activities would have to be conducted in a manner as to not jeopardize the health and safety of or cause a nuisance to the patrons that use the USPS post office, autobody, sales and automotive repair shops, and adjacent roadways. Soil-loading conditions from nearby buildings and roadways would have to be evaluated as part of the remedial design. The slurry used to support the excavation activities would likely minimize potential odors and associated exposures to the surrounding community. Overhead utilities (e.g., electric and telecommunication lines) would have to be shielded and/or protected prior to the remedial construction activities on the former MGP property. Underground utilities (e.g., water, stormwater, sanitary, and gas lines) located within the utility corridor would be exposed and remain visually accessible during the jet grouting operations to document that the jet grouting occurs below the utilities. As practicable, active lines will be temporarily deactivated during the jet grouting phase of this alternative.

From a technical implementability aspect, equipment and personnel qualified to install groundwater monitoring and NAPL collection wells and conduct groundwater and NAPL monitoring activities are readily available. Prior to conducting excavation activities and installing the NAPL recovery and groundwater monitoring wells, subsurface utilities would be identified to reduce the potential for damaging utilities during intrusive activities. The groundwater monitoring wells and NAPL collection wells would be secured in lockable subsurface vaults to prevent access by unauthorized personnel. NAPL removal methods would also be assessed during the design of this alternative. Active NAPL recovery (i.e., automated pumping) and low-flow groundwater pumping would be more difficult to implement, when compared to passive NAPL collection and manual recovery, because active recovery would require on-site NAPL storage structures and low-flow groundwater pumping would require construction and operation of on-site water treatment systems. Construction of storage structures and water treatment systems in a public area is not considered readily implementable or practicable.

Administratively, ICs would be established for the former MGP and USPS post office properties, which would require O&R to negotiate with the current property owners and would require coordination with state agencies (i.e., NYSDEC and NYSDOH). Access agreements would have to be secured with the autobody, sales, and automotive repair shops to conduct the excavation activities in these areas. This alternative assumes O&R would occupy the former MGP property during the implementation of the remedial activity. O&R would have to consider providing rental property at an alternate location in Middletown to allow businesses leasing the buildings on this property to continue to operate. O&R would have to potentially compensate the property owner for loss of a tenant(s) during the remedial construction period. Additionally, access agreements would need to be secured by O&R to install new wells and conduct the periodic NAPL and groundwater monitoring activities on the former MGP property and off-site area.

5.3.6.6 Compliance with SCGs–Alternative 6

The alternative's ability to comply with applicable federal, state, and local criteria, advisories, and guidance in presented below.

5.3.6.6.1 Chemical-Specific SCGs

Chemical-specific SCGs are presented in Table 2-1. Potentially applicable chemical-specific SCGs for soil include 6 NYCRR Part 375-6 SCOs and 40 CFR Part 261 and 6 NYCRR Part 371 regulations for the identification of hazardous materials. Potentially applicable chemical-specific SCGs for groundwater include NYSDEC Class GA standards and guidance values:

- Alternative 6 would include the removal of accessible visually NAPL-impacted soil and former MGP structures on the former MGP property. Other locations of soil containing COCs at concentrations greater than 6 NYCRR Part 375-6 commercial SCOs would not be addressed by this alternative. Soil containing MGP-related impacts would remain in place beneath surface materials (i.e., pavement, concrete, buildings) and existing fill material. All excavated material and process residuals would be managed and characterized in accordance with 40 CFR Part 261 and 6 NYCRR Part 371 regulations to determine off-site treatment/disposal requirements. NYS LDRs would apply to any materials characterized as a hazardous waste.
- As indicated in Section 1, site groundwater contains VOCs and SVOCs at concentrations greater than NYSDEC Class GA standards and guidance values.
- Alternative 6 would include the excavation of accessible visually impacted soil and NAPL on the former MGP property and only inaccessible residual NAPL would remain beneath the autobody, sales, and automotive repair shops. Based on the extent of the removal activities in this area, groundwater SCGs may be achieved at the former MGP property. Because this alternative does not include removal activities to address soil containing MGP-related impacts (i.e., a source of dissolved-phase impacts) in the off-site area, this alternative would likely not achieve groundwater SCGs in the off-site area within a determinate period.

5.3.6.6.2 Action-Specific SCGs

Action-specific SCGs are presented in Table 2-2. Potentially applicable action-specific SCGs include health and safety requirements and regulations associated with handling impacted media. Work activities would be conducted in accordance with OSHA requirements that specify general industry standards, safety equipment and procedures, and record-keeping and reporting regulations. Compliance with these action-specific SCGs would be accomplished by following a site-specific HASP:

- Excavated soil and process residuals would be subject to USDOT requirements for packaging, labeling, manifesting, and transporting hazardous or regulated materials. Compliance with these requirements would be achieved by following a NYSDEC-approved Remedial Design/Remedial Action Work Plan and using licensed waste transporters and permitted disposal facilities. Excavated material from a former MGP site that is characteristically hazardous for benzene only (D018) is conditionally exempt from hazardous waste management requirements when destined for thermal treatment (e.g., LTTD). All excavated material would be disposed of in accordance with applicable NYS LDRs.

5.3.6.6.3 Location-Specific SCGs

Location-specific SCGs are presented in Table 2-3. Potentially applicable location-specific SCGs generally include regulations on conducting construction activities on floodplains. Compliance with these SCGs would be achieved by obtaining a joint USACE and NYSDEC permit prior to conducting site activities. Additionally, remedial activities would be conducted in accordance with Middletown building/construction codes and/ordinances, and necessary street work permits would be obtained prior to initiating the remedial activities.

5.3.6.7 Overall Protection of Public Health and the Environment–Alternative 6

Alternative 6 would mitigate the potential for long-term exposures to impacted subsurface soil and groundwater by excavating accessible NAPL-impacted soil and former MGP structures in the vicinity of the former MGP; recovering mobile NAPL; monitoring groundwater; and implementing ICs. This alternative addresses the most likely potential future exposures that could occur at the site. The potential for construction workers to be exposed to MGP-related impacts while conducting subsurface work at the former MGP property or within the utility corridor would be significantly mitigated through the removal of accessible impacted soil and former MGP structures in these areas and the installation of a low-permeability barrier and NAPL recovery points immediately upgradient of excavation area. Inaccessible immobile NAPL and impacted soils would remain in the subsurface beneath the autobody, sales, and automotive repair shops on the former MGP property and at depths generally greater than 15 feet below grade off-site area and would not be addressed through active containment, treatment, or removal.

This alternative would prevent exposures (i.e., direct contact, ingestion, and inhalation) to MGP related impacts in subsurface soil and groundwater (soil RAOs #1 and #2 and groundwater RAOs #1 and #2) through the implementation of ICs and removal of accessible NAPL-impacted soil and former MGP structures in the vicinity of- the former MGP. However, potentially complete exposure pathways would remain under this alternative, and the reduction of potential exposures would only occur by adhering to the ICs and the procedures to be presented in the SMP.

Alternative 6 would work toward addressing MGP-related COCs and material that could cause impacts to groundwater (soil RAO #3) through the recovery of mobile NAPL and removal of impacted soil hydraulically upgradient of the Monhagen Brook culvert. Periodic monitoring would be completed to document the extent of dissolved-phase impacts and potential trends in COC concentrations.

Although Alternative 6 includes the removal of accessible visually impacted soil and former MGP structures on the former MGP property, NAPL would remain in the till. Therefore, Alternative 6 would work toward, but likely not achieve, restoring groundwater to pre-disposal/pre-release conditions (groundwater RAO #3) or addressing sources of groundwater impacts (groundwater RAO #4) on the former MGP property. Although NAPL recovery would be conducted in the off-site area, Alternative 6 is not expected to restore groundwater to pre-disposal/pre-release conditions (groundwater RAO #3) nor address all the sources of groundwater impacts (groundwater RAO #4) because impacted soil (i.e., a source to dissolved-phase impacts) would remain in subsurface soil in the off-site area.

5.3.6.8 Cost–Alternative 6

The estimated costs associated with Alternative 6 are presented in Table 5-5. The total estimated 30-year present worth cost for this alternative is approximately $7,100,000. The estimated capital cost, including costs for conducting soil removal activities, installing NAPL collection wells and groundwater monitoring wells, and establishing ICs, is approximately $4,900,000. The estimated 30-year present worth cost of O&M activities associated with this alternative, including conducting semi-annual NAPL monitoring and annual groundwater monitoring, is approximately $2,200,000.

5.3.7 Alternative 7–Removal to 6 NYCRR Part 375-6 Unrestricted Use SCOs, NAPL Recovery, Groundwater Monitoring, and Institutional Controls

Alternative 7 includes the following major components:

- Demolishing the autobody shop and automotive sales business portions of the building located on the former MGP property.
- Excavating soil containing MGP-related COCs at concentrations greater than 6 NYCRR Part 375-6 unrestricted use SCOs (including visually impacted soils) at a depth up to 20 feet below grade on the former MGP property and at depths up to 15 below grade in the off-site area.
- Conducting NAPL recovery.
- Conducting long-term groundwater monitoring.
- Developing an SMP.
- Establishing ICs.

This alternative would address the potential for exposure to soil containing COCs at concentrations greater than 6 NYCRR Part 375-6 unrestricted use SCOs through excavation. The limits of the proposed soil removal areas under this alternative are based on existing analytical site data. Note that shallow subsurface soil (i.e., at depths up to 7 feet bgs) in the off-site area that contains individual PAHs at concentrations only slightly exceeding unrestricted use SCOs has not been included within the removal areas associated with this alternative. These PAH exceedances are attributed to the urban fill present throughout the site and not with potential MGP-related source materials. As indicated in Section 1, MGP-related impacts encountered in the off-site area generally are located at depths of 15 feet below grade and deeper. However, Alternative 7 includes the removal of soil containing MGP-related impacts encountered at depths less than 15 feet below grade at the following locations in the off-site area:

- Corner of Wawayanda Avenue and Fulton Street–This soil removal area is based on BTEX and PAH exceedances in soil samples collected from soil borings on USPS post office property near the intersection of Wawayanda Avenue and Fulton Street. Soil borings SB-09, SG-23, and SG-24 contained BTEX compounds and/or PAHs at concentrations that exceeded 6 NYCRR

Part 375-6 unrestricted use SCOs. Additionally, soil boring SG-24 and monitoring well MW-12 contained visual indications of coal tar. This area is bounded by soil boring SG-25 and monitoring well MW-1. Soil boring SG-25 contained fill at a depth up to 9 feet below grade and native soil at deeper depths. No odors or visual impacts were noted at depths below 15 feet below grade in soil boring SG-25. Monitoring well MW-1 was installed to a depth of 14 feet below grade, and no obvious odors or visual impacts were noted during installation of the well.

- Downgradient of the Former Naphtha Tank–This soil removal area is based on the presence of impacts encountered in soil boring SB-65. Soil samples collected between 10 feet and 15 feet below grade in soil boring SB-65 contained sheens, as well as BTEX compounds and PAHs at concentrations that exceeded 6 NYCRR Part 375-6 unrestricted use SCOs.
- Supermarket Property–This soil removal area is based on BTEX and PAH exceedances in a soil sample collected from soil boring SB-47. BTEX compounds and PAHs were detected at concentrations greater than 6 NYCRR Part 375-6 unrestricted use SCOs in a soil sample collected from 12.5 feet to 13.5 feet below grade. As indicated in the log for soil boring SB-47, "residual product" was observed starting at approximately 10 feet below grade at soil boring SB-47.

This alternative would also reduce the potential for exposure to remaining subsurface soil and groundwater containing MGP-related COCs through the implementation of ICs. Alternative 7 also includes NAPL recovery to facilitate the removal of potentially mobile NAPL that would remain below the excavation limits and long-term groundwater monitoring to document the extent of dissolved-phase impacts and potential trends in COC concentrations.

This alternative has been developed under the assumption that O&R would occupy (e.g., lease, purchase) the former MGP property during the remedial construction. Prior to conducting the remedial activities, the autobody and sales portion of the building (located in the western portion of the former MGP property) would be demolished. Following demolition of the autobody shop and sales office, impacted soil containing COCs at concentrations greater than 6 NYCRR Part 375-6 unrestricted use SCOs and former MGP structures within the former MGP property (including the utility corridor excavation component of Alternative 3 and impacted soil and former MGP structures beneath the demolished building) would be excavated to a depth of up to 20 feet below grade (i.e., to the top of till surface). Proposed excavation limits for the former MGP property (are shown in Figure 5-7. A total of approximately 26,200 CY of soil would be excavated, including approximately 6,150 CY of NAPL-impacted soil under this alternative.

Soil excavation activities would be conducted in the off-site area at depths up to 15 feet below grade to address soil containing COCs at concentrations greater than 6 NYCRR Part 375-6 unrestricted use SCOs. Proposed excavation limits shown in Figure 5-7 are based on existing analytical site data (as discussed above). Soil excavation activities would be conducted to a depth of 15 feet below grade west and northwest of the USPS post office and on the supermarket property. For the purpose of developing a cost estimate, it has been assumed soil from 0 feet to 2 feet below grade would be transported off-site for disposal (or recycled as appropriate) because C&D debris and soil from depths greater than 2 feet below grade would be transported off-site for treatment/disposal via LTTD. Based on visual characterization of soil samples collected from the off-site area, NAPL and visually impacted soil are generally encountered at depths of more than 15 feet below grade.

Like Alternatives 3, 4, and 5, excavation activities would be conducted using conventional construction equipment such as backhoes, excavators, front-end loaders, and dump trucks. Based on the proposed extent of excavation activities, excavation support (assumed to be steel sheetpile walls equipped with internal bracing) is anticipated to be required to complete excavations 15 feet below grade and deeper on the former MGP, USPS post office, and supermarket properties. Shallow excavations (i.e., less than 7 feet deep) are not anticipated to require sheeting and could be completed via sloping and benching excavations or using trench boxes. Additionally, it is anticipated an excavation enclosure (e.g., Sprung structure) equipped with a vapor collection and treatment system would be constructed during the proposed excavation areas to reduce the potential for exposures and off-site migration of vapors and odors during excavation activities. Use of excavation enclosures would require relocation of the overhead utilities on the north side of Fulton Street prior to the implementation of remedial construction activities at the former MGP property. The final excavation plan and an SWPPP would be developed as part of the remedial design. Water generated during excavation area dewatering and soil staging activities would be collected, treated on-site via a temporary water treatment system, and discharged under a permit to the local POTW via a nearby sanitary sewer.

Prior to restoring excavations in the off-site area, a demarcation layer (e.g., geotextile fabric, snow fence) would be placed along excavation area bottom and side walls to denote soil removal limits. Backfill material for the USPS post office excavation would be supplemented with groundwater amendment such as a slow-oxygen-releasing compound to address potential dissolved-phase groundwater impacts downgradient of the USPS post office excavation area (i.e., below the USPS post office). Removal areas would be restored with imported clean fill material and/or other engineered backfills (e.g., controlled-low strength material), as appropriate, to match the previously existing lines and grades. All disturbed roadways and sidewalks would be replaced in kind. Final site restoration materials would depend on future redevelopment needs. Backfill materials and surface restoration details would be developed as part of the remedial design for this alternative.

Alternative 7 would also include similar NAPL recovery, groundwater monitoring, and institutional control components as Alternatives 2 through 5. As indicated for Alternative 2, potential NAPL collection points could consist of collection wells or collection trenches. The final number, location, type, and construction of the NAPL collection points would be determined during the remedial design of this alternative. For the purpose of developing this alternative, it has been assumed NAPL recovery would be completed at up to nine NAPL collection wells installed at locations and appropriate depths (i.e., within the alluvium or till) where measurable quantities of NAPL have been historically observed in monitoring wells and during the completion of soil borings in the off-site area. NAPL collection points would not be installed on the former MGP property, because this alternative includes removal of all visually impacted soil from the former MGP property to the top of the till unit. NAPL could potentially be recovered by using an active recovery system, depending on the rate of NAPL collection following installation of the collection points. Low-flow groundwater pumping could also be considered to enhance the rate of NAPL collection.

As with the other alternatives, Alternative 7 would also include installing new groundwater monitoring wells and conducting groundwater monitoring to confirm groundwater flow direction and verify the extent and concentrations of dissolved-phase COCs. Groundwater samples would be collected and submitted for laboratory analysis for BTEX and PAHs to document the extent of dissolved-phase impacts and potential trends in COC concentrations.

Additionally, Alternative 7 would include establishing ICs on the properties not addressed by this remedy (specifically the USPS Post Office property and the off-site properties with proposed NAPL recovery and groundwater monitoring wells). The ICs would limit, as practicable, the future development and use of these areas, as well as control intrusive activities that could result in potential exposures to subsurface soil and groundwater containing MGP-related impacts. Although potable water is provided by a municipal supply, the ICs would also prohibit (or limit as practicable for properties that are off-site or are publicly-owned) the use of non-treated groundwater on affected properties. An annual report would be submitted to NYSDEC to document that ICs are maintained and remain effective.

This alternative would include preparation of an SMP to document the following:

- The ICs that have been established and will be maintained for the site
- Known locations of remaining soil that contains COCs at concentrations greater than 6 NYCRR Part 375-6 commercial SCOs
- Protocols and requirements for conducting semi-annual NAPL monitoring and annual groundwater monitoring
- Protocols for addressing significant changes in COC concentrations in groundwater based on the results of the annual monitoring activities

5.3.7.1 Short-Term Impacts and Effectiveness–Alternative 7

Implementation of this alternative could result in short-term exposure of the surrounding community and site workers to site-related COCs as a result of excavation, material handling, and off-site transportation activities. Implementation of this alternative would cause significant disruption to the surrounding community throughout a prolonged period based on the extent of the soil removal, the building demolition, quantity of waste materials to be generated and transported off site, and the anticipated duration of the remedial construction. Additionally, field personnel may be exposed to impacted soil, groundwater, and/or NAPL during groundwater monitoring well and NAPL collection well installation activities. Potential exposure mechanisms would include ingestion and dermal contact with NAPL, impacted soil, and/or groundwater and inhalation of volatile organic vapors or dust containing COCs during remedial construction.

Potential exposure of remedial workers would be minimized using appropriately trained field personnel and PPE, as specified in a site-specific HASP that would be developed as part of the remedial design. A CAMP would be prepared, and community air monitoring would be performed during excavation and backfilling activities to evaluate the need for additional engineering controls (e.g., use of water sprays to suppress dust, and modify the rate of construction). Community access to excavation areas would be restricted by temporary security fencing and excavation enclosures. Fulton Street, Canal Street, and Wawayanda Avenue would be closed for up to 18 months during remedial construction activities. Pedestrian and vehicle traffic would be re-routed to avoid the work area.

Additional worker safety concerns include working with and around large construction equipment, noise generated from installing sheeting and operating construction equipment, and increased vehicle traffic associated with transportation of excavated material from the site and delivery of fill materials. These concerns would be minimized by using engineering controls and appropriate health and safety practices. Off-site transportation of excavated material and importation of clean fill materials would result in approximately 3,650 roundtrips by tri-axle trucks (assuming 14 CY per truck). Transportation activities would be managed to minimize en-route risks to the community.

Potentially impacted soil and groundwater generated during well installation activities would be properly managed to minimize potential exposures to the surrounding community. Potential risks to the community could occur during periodic groundwater and NAPL monitoring activities via exposure to purged groundwater, groundwater samples, and/or NAPL. Potential exposures to the community would be minimized by following appropriate procedures and protocols that would be described in the SMP.

Under this alternative, excavated material would not be used for site backfill. The relative carbon footprint of Alternative 7 (as compared to the other alternatives) is considered significant. The greatest contribution to greenhouse gases would occur as a result of equipment operation during excavation, backfilling, and transportation activities.

Implementation of this alternative would cause significant disruptions to the surrounding community (i.e., increased truck traffic, road closures, increased noise, and visual nuisances associated with the remedial construction), as well as a significant increase in the potential for exposures to impacted media for nearly 18 months. Although Alternative 7 consists of the greatest amount of removal, monitoring would still be conducted within the off-site area throughout an assumed 30-year period based on the nature and extent of impacts that would remain following remedial construction.

5.3.7.2 Long-Term Effectiveness and Permanence–Alternative 7

The potential for future long-term impacts from and exposures to MGP-related COCs in site media would be reduced through the implementation of this alternative. Under Alternative 7, soil containing COCs at concentrations greater than 6 NYCRR Part 375-6 unrestricted use SCOs (including visually impacted soil and soil within the Fulton Street utility corridor) would be excavated to depths up to 20 feet below grade (i.e., top of till surface). Alternative 7 would also include excavation of soil containing MGP-related COCs at concentrations greater than 6 NYCRR Part 375-6 unrestricted use SCOs in the off-site area to depths up to 15 feet below grade. Implementation of this alternative would pose a substantial disruption to the community in the vicinity of the construction area. Additionally, although this alternative would remove a substantial amount of NAPL-impacted material (i.e., all NAPL-impacted soil north of Fulton Street to the top of till), NAPL and impacted soils would still be present at depths greater than 15 feet below grade on the south side of Fulton St. Excavations would be backfilled with clean imported fill, thereby reducing the potential for exposures during future site redevelopment activities. Excavated materials would be transported off-site for treatment/disposal.

Alternative 7 also includes NAPL recovery to reduce the volume of mobile NAPL that would remain in the off-site area at depths below 15 feet below grade and groundwater monitoring to document the extent of dissolved-phase impacts and potential trends in COC concentrations. Through the removal of impacted soil and recovery of mobile NAPL, the concentrations and extent of dissolved-phase impacts could be reduced over time. Potential exposures to field personnel and the community during long-term monitoring activities would be minimized by following appropriate procedures and protocols that would be established in the SMP to be prepared as part of this alternative.

Soil containing COCs at concentrations greater than 6 NYCRR Part 375 unrestricted use SCOs would be removed to the top of till at the former MGP property and to depths up to 15 feet below grade from the off-site area. The excavations would be backfilled with clean imported fill and the surface cover (e.g., asphalt, grass, and concrete) would be restored with materials consistent with the pre-construction conditions. NAPL and visually impacted soil in the off-site area are generally encountered at depths greater than 15 feet below grade, and the area most likely to be subject to subsurface activities during site redevelopment (i.e., the top 15 feet of all site soils) would be addressed through excavation, as appropriate. Alternative 7 would still include establishing ICs for the USPS post office property to limit permissible intrusive activities that could result in potential exposures to impacted subsurface soil and groundwater. Additionally, the use of non-treated groundwater on affected properties would be prohibited. Annual verification of the ICs would be completed to document that the controls are maintained and remain effective.

Active NAPL recovery and low-flow groundwater pumping would create a greater potential for exposures to MGP-related materials on a long-term basis when compared to passive NAPL recovery. Active NAPL recovery would require construction of structures to store recovered NAPL. If low-flow groundwater pumping was implemented to enhance the rate of NAPL collection, assuming each of the NAPL collection wells would be pumped at a constant rate of 1 gpm, more than 20,000 gallons of impacted groundwater would be generated each day. A water treatment system capable of treating up to 25 gpm would have to be constructed on each property that contains NAPL collection points, and treated water would have to be discharged to a local sanitary sewer for further treatment and disposal. The presence of the water treatment and NAPL storage systems would increase the potential for long-term exposures to the surrounding community (i.e., during routine system operation or repair activities, system malfunctions, or vandalism of the structures and systems).

In contrast, passive collection activities could be conducted during non-peak hours and NAPL collected during passive recovery activities would be immediately transported off-site for treatment/disposal, significantly reducing the potential for long-term exposures to the surrounding public. Based on this rationale, active NAPL removal and low-flow groundwater pumping would decrease the long-term effectiveness and permanence of this alternative.

5.3.7.3 Land Use–Alternative 7

The current and foreseeable future use of the site is a mixed commercial/residential urban setting. The current zoning for the site is DMU-1, which allows for retail, commercial, government, professional and residential (second floor or higher) uses. Based on the current and anticipated land use of the former MGP property and off-site area, the potential for property occupant exposure to MGP-related residual materials or soil containing MGP-related COCs is minimal. Additionally, drinking water is currently and will continue to be provided via a public water supply. Therefore, groundwater containing MGP-related COCs is not and will not be used for potable (or other) purposes.

Alternative 7 would be extremely disruptive to the businesses and land use within and nearby the area to be remediated. The total length of time required to implement this remedial alternative would be approximately 18 months, which could impact local businesses and the land use in this area for an extended amount of time following the completion of the remedial activities. Following implementation, the remediated area would be restored like the current condition, which should support the current land use and zoning. Deed restrictions would still be required for the USPS post office property. Based on the proposed long-term groundwater monitoring and NAPL monitoring/recovery components of this remedy, future use of properties that contain groundwater monitoring wells and NAPL collection points may require coordination with the future site owners to maintain the wells or to make provisions to access, repair, or re-install the wells as needed.

5.3.7.4 Reduction of Toxicity, Mobility, or Volume through Treatment–Alternative 7

Alternative 7 would include the off-site treatment and/or disposal of approximately 26,200 CY of soil removed from the former MGP property (including approximately 6,150 CY of NAPL-impacted soil) and approximately 5,000 CY of soil containing MGP-related COCs at concentrations greater than 6 NYCRR Part 375-6 unrestricted use SCOs from the off-site area. Alternative 7 also includes the installation of NAPL collection wells, periodic NAPL monitoring, and recovery of potentially mobile NAPL that would remain in the off-site area.

Through the excavation activities at the former MGP property and NAPL monitoring/recovery activities in the off-site area, the volume of potentially mobile NAPL would be reduced, thereby reducing the potential for further downgradient migration of mobile NAPL at the site. Additionally, NAPL removal would reduce the volume of material that is serving as a source to dissolved-phase groundwater impacts. This removal would reduce the flux of COCs from source material to groundwater, which would reduce the toxicity and volume of dissolved-phase groundwater impacts. Alternative 7 also includes annual groundwater monitoring to document the potential long-term reduction (i.e., toxicity and volume) of dissolved-phase groundwater impacts.

5.3.7.5 Implementability–Alternative 7

This remedial alternative has significant implementability challenges from a technical and administrative standpoint. From a technical implementability perspective, the extent of the excavation activities given the urban setting would cause a serve disruption to the surrounding community. Removal and off-site disposal of soil is technically feasible, although conducting the extensive soil removal activities associated with this alternative in an urban public setting presents numerous logistical challenges. During the implementation of this remedial alternative, traffic patterns will be disrupted for extended durations on the portions of Fulton Street, Canal Street, Wawayanda Avenue, and South Street near the remedial construction activities.

The disruption of traffic could temporarily affect postal traffic and emergency vehicle routes through Middletown. Excavation enclosures would likely be used to minimize potential exposures to the surrounding community. Overhead utilities (e.g., electric and telecommunication lines) would have to be relocated prior to the remedial construction activities on the former MGP property. Underground utilities (e.g., water, stormwater, sanitary, and gas lines) located beneath Fulton Street would have to be re-routed, bypassed, and/or protected as appropriate during implementation of this alternative. Additionally, multiple treatment/disposal facilities and borrow sources capable of handling more than 25,500 CY of impacted material and providing an equal volume of fill material would have to be identified prior to the implementation of this alternative. Based on the limits of the excavation, local traffic would have to be rerouted for up to 18 months, thereby causing significant disruptions to the surrounding community. Transportation planning would be conducted prior to the remedial activities. Tractor trailers would likely not be used based on the larger turning radius required for 6-axle vehicles. Based on the extent of excavation activates, soil-loading conditions from nearby buildings and roadways would have to be evaluated as part of the remedial design.

This alternative assumes O&R would purchase the former MGP property. O&R would have to consider purchasing a new property at an alternate location in Middletown to allow businesses leasing the buildings on this property to continue to operate. Additionally, the automotive shop and automotive sales business building (on the western portion of the former MGP property) would be demolished prior to the excavation activities.

Access agreements would have to be secured with the USPS post office and supermarket properties to conduct the excavation activities in these areas. The proposed excavation activities that would be conducted under this alternative could cause a significant disruption to the City of Middletown. Implementation of this remedial alternative would likely require extended discussions with the city to obtain city approval and demonstrate the benefits of the alternative given the relatively low potential for exposure to the impacted material. If Alternative 7 were implemented, following the completion of the remedial activities, ICs would be established for the USPS post office property, which would require coordination with state agencies (i.e., NYSDEC and NYSDOH).

5.3.7.6 Compliance with SCGs–Alternative 7

The alternative's ability to comply with applicable federal, state, and local criteria, advisories, and guidance in presented below.

5.3.7.6.1 Chemical-Specific SCGs

Chemical-specific SCGs are presented in Table 2-1. Potentially applicable chemical-specific SCGs for soil include 6 NYCRR Part 375-6 SCOs and 40 CFR Part 261 and 6 NYCRR Part 371 regulations for the identification of hazardous materials. Potentially applicable chemical-specific SCGs for groundwater include NYSDEC Class GA standards and guidance values:

- Alternative 7 would include the removal of soil on the former MGP property containing COCs at concentrations greater than 6 NYCRR Part 375-6 unrestricted use SCOs and soil at depths up to 15 feet below grade containing COCs at concentrations greater than 6 NYCRR Part 375-6 unrestricted use SCOs in the off-site area. Impacted soil would remain at depths greater than 15 feet below grade in the off-site area and would not be addressed by this alternative. However, these remaining impacted soils would be beneath 15 feet of clean imported fill material and non-impacted surface materials (i.e., pavement, concrete, buildings). Excavated materials and process residuals would be managed and characterized in accordance with 40 CFR Part 261 and 6 NYCRR Part 371 regulations to determine off-site treatment/disposal requirements. NYS LDRs would apply to materials that are characterized as a hazardous waste.

- As indicated in Section 1, site groundwater contains VOCs and SVOCs at concentrations greater than NYSDEC Class GA standards and guidance values. Alternative 7 would include the excavation of all visually impacted soil and NAPL on the former MGP property. Based on the extent of the removal activities in this area, groundwater SCGs would likely be achieved at the former MGP property. Although this alternative includes excavation of soil containing COCs at concentrations greater than 6 NYCRR Part 375-6 unrestricted used SCOs at depths up to 15 feet below grade in the off-site area, Alternative 7 does not include removal activities to address all soil containing MGP-related impacts in the off-site area. Therefore, this alternative would likely not achieve groundwater SCGs in the off-site area within a determinate period.

5.3.7.6.2 Action-Specific SCGs

Action-specific SCGs are presented in Table 2-2. Potentially applicable action-specific SCGs include health and safety requirements and regulations associated with handling impacted media. Work activities would be conducted in accordance with OSHA requirements that specify general industry standards, safety equipment and procedures, and record-keeping and reporting regulations. Compliance with these action-specific SCGs would be accomplished by following a site-specific HASP:

- Excavated soil and process residuals would be subject to USDOT requirements for packaging, labeling, manifesting, and transporting hazardous or regulated materials. Compliance with these requirements would be achieved by following a NYSDEC-approved Remedial Design/Remedial Action Work Plan and using licensed waste transporters and permitted disposal facilities. Per DER-4 (NYSDEC 2002), excavated material from a former MGP site that is characteristically toxic for benzene only (D018) is conditionally exempt from hazardous waste management requirements when destined for thermal treatment (e.g., LTTD). All excavated material would be disposed of in accordance with applicable NYS LDRs.

5.3.7.6.3 Location-Specific SCGs

Location-specific SCGs are presented in Table 2-3. Potentially applicable location-specific SCGs generally include regulations for conducting construction activities on floodplains. Compliance with these SCGs would be achieved by obtaining a joint USACE and NYSDEC permit prior to conducting site activities. Additionally, remedial activities would be conducted in accordance with Middletown building and construction codes and/ordinances, and necessary demolition and street work permits would be obtained prior to initiating the remedial activities. Implementation of Alternative 7 would require significant coordination with the City of Middletown based on the prolonged disruption to surrounding community due to the extensive excavation activities.

5.3.7.7 Overall Protection of Public Health and the Environment–Alternative 7

Alternative 7 would mitigate the potential for long-term exposures to impacted subsurface soil and groundwater by excavating soil containing MGP-related COCs at concentrations greater than 6 NYCRR Part 375-6 unrestricted use SCOs (including NAPL-impacted soil and former MGP structures) at the former MGP property and in the off-site area (up to 15 feet below grade), recovering mobile NAPL, monitoring groundwater, and implementing ICs. This alternative addresses the most likely potential future exposures that could occur at the site. The potential for future construction workers to be exposed to MGP-related impacts while conducting subsurface work during the redevelopment of the site would be significantly reduced through the removal of soil containing COCs at concentrations greater than 6 NYCRR Part 375-6 unrestricted use SCOs to depths up to 20 feet below grade (i.e., to the top of till) on the former MGP property and at depths up to 15 feet below grade in the off-site area. Impacted soils would remain at depths greater than 15 feet below grade in the off-site area and would not be addressed through active containment, treatment, or removal.

This alternative would prevent exposures (i.e., direct contact, ingestion, and inhalation) to MGP-related impacts in subsurface soil and groundwater (soil RAOs #1 and #2 and groundwater RAOs #1 and #2) by removal of soil containing COCs at concentrations greater than 6 NYCRR Part 375-6 unrestricted use SCOs (and former MGP structures). Based on the removal depths, potentially complete exposure pathways would likely be eliminated under this alternative.

Alternative 7 would work toward addressing MGP-related COCs and material that could cause impacts to groundwater (soil RAO #3) through the recovery of mobile NAPL and removal of impacted soil hydraulically upgradient of the Monhagen Brook culvert. Periodic monitoring would be completed to document the extent of dissolved-phase impacts and trends in COC concentrations. Although Alternative 7 includes the removal of all visually impacted soil and former MGP structures on the former MGP property, NAPL would remain within the till. Therefore, Alternative 7 may work toward, but not achieve, restoring groundwater to pre-disposal/pre-release conditions (groundwater RAO #3) and addressing all sources of groundwater impacts (groundwater RAO #4) on the former MGP property. Although soil excavation and NAPL recovery would be conducted in the off-site area, Alternative 7 is not expected to restore groundwater to pre-disposal/pre-release conditions (groundwater RAO #3) nor address all sources of groundwater impacts (groundwater RAO #4) because impacted soil would remain at depths greater than 15 feet below grade in the off-site area and NAPL would remain within the till.

Although this alternative does not include removal of impacted soil beneath the Monhagen Brook culvert, a vast majority of impacted soil would be removed upgradient from the culvert. As a result, groundwater containing MGP-related impacts would not be discharging to the Monhagen Brook culvert and groundwater RAO #5 would be achieved.

5.3.7.8 Cost–Alternative 7

The estimated costs associated with Alternative 7 are presented in Table 5-6. The total estimated 30-year present worth cost for this alternative is approximately $29,800,000. The estimated capital cost, including costs for conducting soil removal activities, installing NAPL collection wells and groundwater monitoring wells, and establishing ICs, is approximately $28,050,000. The estimated 30-year present worth cost of O&M activities associated with this alternative, including conducting semi-annual NAPL monitoring and annual groundwater monitoring, is approximately $1,750,000.

6 Comparative Analysis of Alternatives

6.1 General

This section presents a comparative analysis of each remedial alternative using the evaluation criteria identified in Section 5.2. The comparative analysis identifies the advantages and disadvantages of each alternative relative to each other and with respect to the evaluation criteria.

6.2 Comparative Analysis of Site-Wide Remedial Alternatives

The alternatives evaluated in Section 5 consist of the following:

- Alternative 1–No Action
- Alternative 2–NAPL Recovery, Groundwater Monitoring, and Institutional Controls
- Alternative 3–Utility Corridor Soil Removal, NAPL Recovery, Groundwater Monitoring, and Institutional Controls
- Alternative 4–Shallow Soil Removal at the Former MGP Property, NAPL Recovery, Groundwater Monitoring, and Institutional Controls
- Alternative 5–Targeted Soil Removal at the Former MGP Property, NAPL Recovery, Groundwater Monitoring, and Institutional Controls
- Alternative 6–Slurry-Supported Soil Removal at the Former MGP Property, Utility Corridor Stabilization, NAPL Recovery, Groundwater Monitoring, and Institutional Controls
- Alternative 7–Removal to 6 NYCRR Part 375-6 Unrestricted Use SCOs, NAPL Recovery, Groundwater Monitoring, and Institutional Controls

The comparative analysis of these site-wide alternatives is presented below.

6.2.1 Short-Term Impacts and Effectiveness

The short-term effectiveness criterion consists of an evaluation of potential impacts and nuisances to the public and environment, and potential impacts to site workers during implementation of the alternative, the effectiveness of measures used to mitigate the short-term impacts, the sustainability of the remedy, and the relative time frame for implementation.

Alternative 1 would not include any active remediation and subsequently would not present potential short-term impacts to remedial workers, the public, or the environment. Alternatives 2 through 7 each include installation of new groundwater monitoring wells and NAPL collection points. Soil cuttings generated during NAPL recovery well installation activities would be transported for off-site treatment/disposal. Overall, Alternative 2 would pose minimal potential short-term risks and potential disturbances to remedial workers and the surrounding community.

Alternatives 3 through 7 each include excavation of soil containing MGP-related impacts. Alternative 3 includes excavation of soil within the utility corridor beneath Fulton Street. Alternative 4 includes the same excavation as Alternative 3, as well as removal of visually impacted soil up to 10 feet below grade on the former MGP property. Alternative 5 includes the same removal foot print as Alternative 4, with excavation to the top of till (i.e., up to 20 feet below grade) on the former MGP property. Alternative 6 includes removal of an expanded foot print on the former MGP property, with excavation to the top of till (up to 20 feet below grade). Alternative 7 includes demolition of the autobody shop and automotive sales portion of the building located on the former MGP property and excavation of MGP-impacted soils to the top of till on the former MGP property and to depths up to 15 feet below grade in the off-site area. Each of these alternatives would pose potential short-term risks to remedial workers and the public from potential exposure to impacted soil and NAPL during soil excavation, off-site transportation of excavated material, and backfilling. Additionally, the excavation activities conducted under these alternatives would pose short-term risks from the operation of construction equipment, work area safety concerns for area residents, and generation of noise and dust.

Alternatives 3 through 6 would cause disruption to traffic on roads adjacent to the remedial activities for approximately 2 months to 7 months while excavation activities are conducted. Alternatives 4, 5, and 6 would also likely require closure of portions of Canal Street to complete the excavation activities associated with these alternatives. Alternatives 3 through 5 would require closure of the autobody shop and automotive sales shop during implementation of the alternatives based on the extent of remedial activities and associated health and safety concerns. Alternative 6 would require closure and/or temporary relocation of the automotive sales shop during remedy implementation. Alternative 7 would cause the greatest disruption due to the demolition activities and the extent of excavation and would cause significant disruption to traffic on roads adjacent to the remedial construction activities throughout an extended period.

Because each of the remedial alternatives includes excavation of a subsequently larger quantity of soil, each successive alternative would cause greater disruption to the surrounding community, except for Alternative 6. Alternative 6 anticipates use of an alternative excavation method that would lessen the duration of remedial activities and associated disruption to the community. Nuisances to the surrounding community would include noise from driving sheeting and operation construction equipment and an increase in local truck traffic in Middletown from the importation of fill materials and off-site transportation of excavated materials. The following is a list of estimated field times to implement each of the alternatives and the estimated number of tri-axle truck trips required for each alternative:

- Alternative 1–No time required and no truck trips
- Alternative 2–1 month and no truck trips

- Alternative 3–3 months and 250 truck trips
- Alternative 4–5 months and 500 truck trips
- Alternative 5–7 months and 950 truck trips
- Alternative 6-3 months and 350 truck trips
- Alternative 7–18 months and 3,650 truck trips

Potential exposures during remedial construction of these alternatives would be mitigated, to the extent practicable, by using appropriate PPE, air and work space monitoring, implementation of dust-control, odor control, and noise-mitigation measures (as appropriate and if necessary, based on monitoring results), proper planning and training of remedial workers, and use of temporary security fencing. Mitigation measures for each alternative would be identified in the remedial design. Excavation enclosures would be used to minimize the potential for exposures to the surrounding community during excavation and backfilling activities associated with Alternatives 3, 4, 5 and 7. With the exception of Alternative 6, as each successive alternative includes the excavation of a greater quantity of soil, the potential for short-term impacts to the public and remedial workers inherently increases. However, the potential for short-term impacts during implementation of Alternatives 4, 5, and 7 is greater than the other alternatives because these alternatives include larger excavation areas that abut buildings and implementation would cause greater disruption to the surrounding community and potentially near-by businesses relative to Alternatives 1, 2, 3 and 6.

Alternative 7 has the greatest carbon footprint compared to the other alternatives. The greatest contribution to greenhouse gases would occur as a result of equipment operation during excavation, backfilling, and transportation activities.

Compared to the other remedial alternatives, Alternative 7 would be the most disruptive to the surrounding community, has the greatest potential for exposures to remedial workers and the public, would require the longest time to implement, and has the greatest carbon footprint. Therefore, Alternative 7 has the lowest level of short-term effectiveness (i.e., the greatest potential for exposure during implementation).

6.2.2 Long-Term Effectiveness and Permanence

The long-term effectiveness and permanence comparison includes an evaluation of the risks remaining at the site following implementation of the remedy, as well as the effectiveness of the controls implemented to manage the remaining risks (if any).

Most of the surface cover on the former MGP property and in the off-site area consists of paved roadways/parking areas and buildings, which provide a physical barrier to impacted subsurface soil and groundwater. Additionally, soil containing visual MGP-related impacts is encountered at depths greater than 5 feet below grade on the former MGP property and generally at depths greater than

15 feet below grade in the off-site area. Groundwater is encountered at approximately 5 feet below grade on the former MGP property and approximately 9 feet below grade in the off-site area. Based on the current and foreseeable future use of the site and surrounding properties as a mixed commercial/residential area (i.e., USPS post office, autobody, sales, and automotive repair shops, supermarket) site workers, patrons, and nearby residents do not routinely conduct activities that would potentially result in exposure to impacted site media. Additionally, drinking water is currently and will continue to be provided via a public water supply.

Alternative 1 would not include the implementation of any remedial activities; therefore, it would not address potential long-term exposures to or impacts from site media that contain MGP-related impacts. Based on the limited potential for exposures to impacted site media, the periodic groundwater monitoring, institutional control, and SMP components of Alternative 2 could be considered an effective means to reduce the potential for future exposures. However, the effectiveness of Alternative 2 would depend on the degree to which the ICs and the SMP were adhered to.

Each of the alternatives (except for Alternative 1) would include NAPL recovery to reduce the volume of mobile NAPL present at the site and groundwater monitoring to evaluate and document the extent of dissolved-phase impacts and potential trends in COC concentrations. As indicated in Section 5, passive NAPL collection and manual NAPL recovery are the preferred NAPL recovery method. Other potential NAPL collection and recovery methods (i.e., active NAPL recovery and low-flow groundwater pumping) would create a greater potential for exposures to MGP-related materials on a long-term basis when compared to passive NAPL collection with manual recovery. Active NAPL recovery and low-flow groundwater pumping would require construction of structures and systems to store recovered NAPL and/or treat groundwater. The presence of the water treatment and NAPL storage systems would increase the potential for long-term exposures to the surrounding community (i.e., during routine system operation or repair activities, system malfunctions, or vandalism of the structures and systems). In contrast, passive collection activities could be conducted during non-peak hours, and NAPL collected during passive recovery activities would be immediately transported off-site for treatment/disposal, thereby significantly reducing the potential for long-term exposures to the surrounding public. Based on this rationale, active NAPL removal and low-flow groundwater pumping would decrease the long-term effectiveness and permanence of any alternative.

The greatest potential for exposure to soil and groundwater containing MGP-related impacts would occur during subsurface work that would be conducted within the Fulton Street utility corridor. Based on the depth to visually impacted soil and depth to groundwater in this area (i.e., 5 feet below grade), utility workers could be exposed to media containing MGP-related impacts. Alternatives 3 through 7 would each effectively address the potential for exposure to these materials through excavation.

Soil containing visual MGP-related impacts is encountered at depths greater than 5 feet below grade on the former MGP property and at depths generally greater than 15 feet below grade in the off-site area. Potential future subsurface activities that could be conducted on the former MGP or USPS post office properties (e.g., installation of new utilities) would likely be conducted from the 0-foot-depth to 5-foot-depth interval, and the potential for exposure to impacted media would be minimal based on the depth to visual impacts. Alternative 3 would address potential exposures to impacted soil at locations outside the utility corridor excavation limits through ICs and preparation of an SMP that would include protocols and procedures for managing impacted material that may be encountered during future site work. Alternative 4 would provide minimal additional benefit relative to Alternative 3 because most visually impacted materials on the former MGP property are present at depths greater than 10 feet below grade. Alternatives 5, 6 and 7 each include the excavation of subsequently greater quantities of soil to reduce the potential for encountering impacted materials during future site work and to reduce the need to implement the SMP. Based on the low potential for conducting subsurface activities in areas beyond the utility corridor to depths where soil contains visual MGP-related impacts, Alternative 3 is considered equally effective at protecting human health from potential long-term risks associated with MGP-impacted media when compared to Alternatives 4, 5, 6 and 7.

6.2.3 Land Use

This criterion evaluates the current and intended future land use of the site relative to the degree to which the remedial alternative addresses site impacts when unrestricted use cleanup levels would not be achieved.

As indicated in Section 5, the current and foreseeable future use of the site is a mixed commercial/residential urban setting. The current zoning for the site is DMU-1, which allows for retail, commercial, government, professional and residential (second floor or higher) uses. Based on the current and anticipated land use of the former MGP property and off-site area, the potential for property occupant exposure to MGP-related residual materials or soil containing MGP-related COCs is minimal. Most of the site is covered with asphalt, concrete, buildings, or vegetated soil, and there is little to no need to conduct subsurface activities. Additionally, drinking water is currently and will continue to be provided via a public water supply. Therefore, groundwater containing MGP-related COCs is not and will not be used for potable (or other) purposes.

Each of the alternatives would be consistent with current land use at the site and should not limit the future redevelopment of area under current zoning. Alternatives 3, 4, 5 and 6 would create a relatively short-term disruption to the surrounding community. However, based on the proposed excavation limits, Alternatives 4 and 5 would require temporary shutdown of both the autobody shop and the automotive sales business. Both Alternatives 4 and 5 would be disruptive to the surrounding community and nearby businesses for a minimum of five months. Alternative 6 would require temporary shutdown and/or relocation of the automotive sales business, but the autobody shop would be able to remain open during the remedial activities.

Alternative 7 would cause a significant prolonged disruption to the surrounding community and access to portions of the remedial area could be restricted for approximately 18 months. Following implementation of any of the alternatives, disturbed surfaces would be restored in a manner consistent with existing site conditions and land use should not change relative to the current zoning. Deed restrictions would be required for the former MGP property and/or USPS post office property as part of each alternative. Based on the proposed long-term groundwater monitoring and NAPL monitoring/recovery components of each alternative (except for Alternative 1), the future use of the properties that contain groundwater monitoring wells and NAPL collection points may require coordination with the current/future property owners to maintain the wells or to make provisions to access/repair/reinstall the wells as needed.

6.2.4 Reduction of Toxicity, Mobility, or Volume through Treatment

The comparative analysis for the reduction of toxicity, mobility, or volume consists of an evaluation of the ability of the remedial process to address the impacted material, the mass of material destroyed or treated, the irreversibility of the processes employed, and the nature of the residuals that would remain following implementation of the remedy.

Alternative 1 would not actively treat, remove, recycle, or destroy impacted site media; therefore, it is considered the least effective for this criterion. As indicated previously, Alternatives 3 through 7 each include removal of soil containing MGP-related impacts, including visually impacted soil and former MGP structures within the Fulton Street utility corridor, which represents the area most likely for future subsurface activities and potential exposures to media containing MGP-related impacts. Alternative 4 would also address soil containing visual MGP-related impacts on the former MGP property to a depth of 10 feet below grade. However, visually impacted material is generally encountered at depths greater than 5 feet below grade on the former MGP. Therefore, minimal additional impacted material would be removed under Alternative 4 relative to Alternative 3. Alternatives 5 and 6 would address accessible visually impacted soil on the former MGP property to the top of till, which would address a significant percentage of the NAPL-impacted material on the former MGP property. Alternative 7 would include excavation of soil containing COCs at concentrations greater than 6 NYCRR Part 375-6 unrestricted use SCOs on the former MGP property to the top of till and excavation of soil in the off-site area containing MGP-related COCs at concentrations greater than 6 NYCRR Part 375-6 unrestricted use SCOs to depths up to 15 feet below grade. The total volume of soil and the volume of visually impacted soil excavated under each alternative are summarized in Table 6-1.

Table 6-1
Soil Removal Volumes

Alternative	Estimated Volume of NAPL-Impacted Soil and MGP Structures Removed (CY)	Total Estimated Volume of Soil Removal (CY)
Alternative 1	0	0
Alternative 2	0	0
Alternative 3	450	1,700
Alternative 4	1,000	3,400
Alternative 5	3,600	6,700
Alternative 6	2,200	3,800
Alternative 7	6,150	26,200

Alternatives 2 through 7 each include the installation of NAPL collection points and conducting periodic NAPL recovery to reduce the volume of mobile NAPL present within the subsurface and periodic groundwater monitoring to document the extent of dissolved-phase impacts and potential trends in dissolved-phase COC concentrations.

Alternatives 5, 6 and 7 have the potential to significantly reduce dissolved-phase COC concentrations in groundwater on the former MGP property. These alternatives would address a majority of visually impacted soil on the former MGP property through excavation of impacted soil and NAPL collection/recovery. Alternatives 5, 6 and 7 would each remove a significant portion of the NAPL-impacted soil to the top of the till unit on the former MGP property, which is currently serving as an on-going source to dissolved-phase impacts at and downgradient from the former MGP property. Although it is not certain that the removal activities would achieve NYSDEC groundwater standards, improvement in shallow groundwater quality immediately downgradient from the former MGP property would be anticipated based on the volume of source material removal.

None of the alternatives would address NAPL-impacted soil or groundwater impacts at depths greater than 15 feet below grade in the off-site area or within the till unit.

6.2.5 Implementability

The implementability comparison includes an evaluation of the technical and administrative feasibility of implementing the remedial alternative.

Alternative 1 would not include the implementation of any remedial activities and therefore, is considered the most implementable. Each of the other alternatives would include installation of groundwater monitoring and NAPL collection wells, groundwater monitoring, NAPL monitoring/recovery, preparation of an SMP, and implementation of ICs. From a technical implementability standpoint, these activities do not require highly specialized equipment or personnel and could be easily implemented. Administratively, establishing ICs for the former MGP and USPS post office properties would require O&R to negotiate with the current property owners and would require coordination with state agencies (i.e., NYSDEC and NYSDOH). Access agreements would need to be secured by O&R to install new wells and conduct the periodic NAPL and groundwater monitoring activities on the former MGP property and off-site area.

Alternatives 3 through 7 include excavation of successively larger quantities of soil. Removal and off-site disposal of soil is technically feasible, although conducting soil removal activities in an urban public setting presents numerous logistical challenges. There is limited available space at the site for material handling and staging, and small construction equipment would be required to conduct the removal activities. Implementation of Alternatives 3 through 7 would require temporary traffic disruption along portions of the roads bordering the remedial construction activities, with the extent and duration of the disruptions increasing from Alternatives 3 through 7. Alternatives 4, 5 and 7 pose much greater implementability challenges due to the extent of the proposed excavations, space limitations, and existing overhead and underground utilities and infrastructure. Under these alternatives, the community could be directly disrupted by active operation for periods ranging from approximately 4 months to 18 months. The duration and extent of community disruption associated with Alternatives 3 and 6 would be substantially less than Alternatives 4, 5, and 7. Alternative 7 would have the potential for the most significant disruptions based on the duration and extent of the remedial construction activities.

Transportation planning would be conducted prior to the remedial activities. Tractor trailers would likely not be used based on the larger turning radius required from 6-axle vehicles. Additionally, soil removal activities would have to be conducted in a manner as to not jeopardize the health and safety of or cause a nuisance to the patrons that use the USPS post office/eastern-most automotive shop and adjacent roadways. Soil-loading conditions from nearby buildings and roadways would have to be evaluated as part of the remedial design. Overhead and underground utilities (i.e., electric, gas, water, and telecommunication) are located along the northern westbound lane of Fulton Street. Overhead utilities (e.g., electric and telecommunication lines) would likely have to be relocated prior to implementation of the remedial construction activities on the former MGP property under Alternatives 3 through 7. Underground utilities (e.g., water, stormwater, sanitary, and gas lines) located beneath Fulton Street would have to be re-routed, bypassed, and/or protected as appropriate during implementation of Alternatives 3, 4, 5 and 7. Alternative 6 would not require rerouting or bypassing during remedy implementation, however the utilities would need to be uncovered as part of the proposed jet grouting process.

Alternative 7 is the least implementable alternative. Multiple treatment/disposal facilities capable of handling more than 26,200 CY of impacted material may need to be identified. In addition, suitable borrow facilities would need to be identified to provide an equal volume of fill material. Conducting excavation activities to depths of 20 feet below grade within a sprung structure would be challenging given the urban setting of the site.

Administratively, access agreements would have to be secured with the USPS post office and autobody, sales, and automotive repair shops to perform the remedial activities described under Alternatives 2 – 7. Under Alternatives 4 – 7, O&R would have to consider providing rental property at an alternate location in Middletown to allow businesses leasing the buildings on the MGP property to continue to operate and potentially compensating the property owner for loss of a tenant(s) during the remedial construction. Additionally, Alternative 7 has been developed assuming the automotive shop and automotive sales business buildings would be demolished prior to the excavation activities. O&R would also have to consider potentially rebuilding or compensating the site owner to rebuild a structure on the property to replace the structures that would be demolished as part of this alternative. The proposed excavation activities that would be conducted under Alternative 7 could cause a significant disruption to the City of Middletown. Implementation of Alternative 7 would likely require extended discussions with the City to gain approval and demonstrate any benefit of the alternative given the current relatively low potential for exposure to impacted materials.

As indicated above, Alternatives 1 and 2 are considered the most implementable. Alternatives 3 through 7 each contain implementability challenges due to conducting excavation in an urban public setting. Alternative 6 would be the most implementable excavation alternative to implement based on the anticipated method of the proposed excavation. Alternative 5 provides additional implementability challenges relative to Alternative 6 while only addressing minimal additional impacted material. Although Alternatives 4 and 5 have the same excavation footprint, Alternative 5 poses additional implementability challenges due to the depth of the excavation and the proximity to the western-most automotive shop. Alternative 7 is considered the least implementable, when compared to the other alternatives, based on the size of the excavation, the associated extended disruption to the surrounding community, and the administrative approvals that would be required to implement the alternative.

6.2.6 Compliance with Standards, Criteria, and Guidelines

Presented below is a comparative analysis of each alternative's ability to comply with applicable federal, state, and local criteria, advisories, and guidance.

6.2.6.1 Chemical-Specific SCGs

Chemical-specific SCGs are presented in attached Table 2-1. None of the alternatives would address all soil containing COCs at concentrations greater than 6 NYCRR Part 375-6 unrestricted use SCOs because each alternative would leave behind soil containing COCs at concentrations above the unrestricted use SCOs within the shallow or deeper till unit. Alternatives 5 – 7 would remove most of the NAPL-impacted material on the former MGP property. Under each alternative, excavated material and process residuals generated during implementation of the alternatives would be characterized in accordance with 40 CFR Part 261 and 6NYCRR Part 371 to determine appropriate off-site treatment/disposal requirements.

Site groundwater contains VOCs and SVOCs at concentrations greater than NYSDEC Class GA standards and guidance values. Although Alternatives 2 – 7 each include NAPL recovery to reduce the volume of NAPL within the subsurface (i.e., the volume of material that serves as a source to dissolved-phase groundwater impacts), these alternatives are not expected to reduce COC concentrations in site groundwater to NYSDEC Class GA standards and guidance values. Alternatives 5 -7 have the potential to achieve groundwater SCGs on and potentially immediately downgradient of the former MGP property. Alternatives 5 and 6 would include the removal of accessible impacted soil and former MGP structures (on the former MGP property) and Alternative 7 would also include removal of soil containing COCs at concentrations greater than 6 NYCRR Part 375-6 unrestricted use SCOs on the former MGP property to depths up to 20 feet below grade (i.e., top of till) and up to 15 feet below grade in the off-site area. None of the alternatives would include the removal of all impacted soil in the off-site area; therefore, none of the alternatives are anticipated to achieve groundwater SCGs in the off-site area within a foreseeable timeframe.

6.2.6.2 Action-Specific SCGs

Action-specific SCGs are presented in attached Table 2-2. Potentially applicable action-specific SCGs include health and safety requirements and regulations associated with handling impacted media. Work activities would be conducted in accordance with OSHA requirements that specify general industry standards, safety equipment and procedures, and record-keeping and reporting regulations. Compliance with these action-specific SCGs would be accomplished by following a site-specific HASP:

Under each of the alternatives, excavated soil and process residuals generated for each alternative would be subject to USDOT requirements for packaging, labeling, manifesting, and transporting hazardous or regulated materials. Compliance with these requirements would be achieved by following a NYSDEC-approved Remedial Design/Remedial Action Work Plan and using licensed waste transporters and permitted disposal facilities. Per DER-4 (NYSDEC 2002), excavated material from a former MGP site that is characteristically hazardous for benzene only is conditionally exempt from hazardous waste management requirements when destined for thermal treatment (i.e., LTTD).

All excavated material and process residuals would be disposed of in accordance with applicable NYS LDRs. Alternatives 2 through 7 would be equally effective at meeting the action-specific SCGs, assuming proper project planning and implementation of appropriate controls.

6.2.6.3 Location-Specific SCGs

Location-specific SCGs are presented in Table 2-3. Potentially applicable location-specific SCGs generally include regulations on conducting excavation, backfilling, and construction activities on floodplains. Compliance with these SCGs would be achieved by obtaining a joint USACE and NYSDEC permit prior to conducting site activities. Additionally, remedial activities would be conducted in accordance with local building/construction codes and/ordinances.

Under each alternative, compliance with these SCGs would be achieved by complying with the requirements of a joint USACE and NYSDEC permit, and applicable local permits, before conducting site activities. Additionally, remedial activities would be conducted in accordance with local building/construction codes and/ordinances. Alternatives 2 through 7 would be equally effective at meeting the location-specific SCGs, assuming proper project planning and implementation of appropriate controls. However, Alternative 6 would require significantly more coordination with the City of Middletown based on the prolonged disruption to the surrounding community and the extensive excavation activities that would be completed under this alternative.

6.2.7 Overall Protection of Public Health and the Environment

This criterion evaluates the ability of each alternative to protect public health and the environment, and the ability of each alternative to achieve the RAOs.

The greatest potential for exposure to soil and groundwater containing MGP-related impacts would occur during subsurface work that would be conducted within the Fulton Street utility corridor. Because Alternative 1 does not include any active remedial measures or administrative controls, Alternative 1 is not considered protective of human health and the environment. Alternatives 2 through 7 would each prevent exposures (i.e., direct contact, ingestion, and inhalation) to MGP-related impacts in subsurface soil and groundwater (soil RAOs #1 and #2 and groundwater RAOs #1 and #2). Alternative 2 would solely rely on the implementation of ICs and procedures set forth in an SMP, and Alternatives 3 through 7 would use a combination of varying amounts of excavation, ICs, and an SMP to achieve these RAOs. Although each of these alternatives are considered protective of human health and the environment, Alternatives 5 through 7 would rely more on excavation to mitigate potential exposures to impacted media on the former MGP property.

Alternatives 2 through 7 would each work toward addressing MGP-related COCs and materials that could cause impacts to groundwater (soil RAO #3). Alternative 2 would solely rely on NAPL recovery; while Alternatives 3 through 7 would use a combination of varying amounts of excavation and NAPL recovery achieve this RAO. Each of these alternatives would include periodic groundwater monitoring to document the extent of dissolved-phase impacts and potential trends in COC concentrations.

Although varying amounts of NAPL would be permanently removed through excavation (Alternatives 3 through 7) and NAPL recovery (Alternatives 2 through 7), and backfill material for the USPS post office excavation would be supplemented with a groundwater amendment (Alternative 7), impacted soil (i.e., a source to dissolved-phase impacts) would remain at the former MGP property under Alternatives 3 and 4 and in the off-site area under each of these alternatives. Therefore, none of the alternatives are expected to restore groundwater to pre-disposal/pre-release conditions (groundwater RAO #3) or address all sources of groundwater impacts (groundwater RAO #4) in the off-site area. However, Alternatives 5, 6 and 7 include the removal of most of the visually impacted soil and former MGP structures on the former MGP property on the former MGP property. Therefore, Alternatives 5, 6 and 7 have the potential to restore groundwater to pre-disposal/pre-release conditions (groundwater RAO #3) and address all sources of groundwater impacts (groundwater RAO #4) on the former MGP property. However, because NAPL-impacted soil would remain at depths below 15 feet below grade in the off-site area and within till, it is not likely that Alternatives 5, 6 or 7 would achieve groundwater RAOs #3 or #4 in the off-site area south of Fulton Street.

Although Alternatives 5, 6 and 7 would remove the greatest amount of visually impacted soil from the former MGP property, Alternatives 3 and 4 are as effective as Alternatives 5 and 6 at achieving the RAOs that have been established for the site. Additionally, Alternative 6 would be the least disruptive to the surrounding community. As Alternative 6 achieves the site-specific RAOs, the minimal added benefit to long-term effectiveness and the reduction of toxicity, mobility, and volume from implementing Alternatives 5, or 7 do not outweigh the significantly greater short-term impacts and implementability concerns associated with these alternatives when compared to Alternative 6.

6.2.8 Cost Effectiveness

Table 6-2 summarizes the estimated costs associated with implementing each of the remedial alternatives.

Table 6-2
Estimated Costs

Alternative	Estimated Capital Cost	Estimated Present Worth of O&M Cost*	Total Estimated Cost
Alternative 1	$0	$0	$0
Alternative 2	$900,000	$2,500,000	$3,400,000
Alternative 3	$6,000,000	$2,500,000	$8,500,000
Alternative 4	$7,900,000	$2,500,000	$10,400,000
Alternative 5	$9,600,000	$2,500,000	$12,100,000

Alternative	Estimated Capital Cost	Estimated Present Worth of O&M Cost*	Total Estimated Cost
Alternative 6	$4,900,000	$2,200,000	$7,100,000
Alternative 7	$28,050,000	$1,750,000	$29,800,000

Note:
* = Estimated present worth of O&M cost is over an assumed 30-year period.

The capital cost to implement Alternative 7 is significantly greater relative to the other alternatives. As shown in Table 6-1, Alternative 7 includes the removal of more than four times the volume of soil removed under Alternative 5. Although the high cost for Alternative 7 corresponds to the greatest removal volume, approximately 80% of the soil removed under Alternative 7 does not contain visual MGP-related impacts. Additionally, Alternative 7 corresponds to the greatest disruption to the surrounding community and has greatest potential for exposures during implementation of the alternative. Therefore, Alternative 7 is considered the least cost-effective compared to the short-term effectiveness; reduction of toxicity, mobility, and volume; and long-term effectiveness.

The capital cost to implement Alternative 6 is approximately $1,100,000 less than the capital cost to implement Alternative 3. The capital cost to implement Alternative 4 is approximately $3,000,000 more than the cost to implement Alternative 6. Similarly, the capital cost to implement Alternative 5 is approximately $4,700,000 more than the cost to implement Alternative 6. The difference in costs between Alternative 6, and Alternatives 3, 4 and 5 is based on the proposed excavation method, which would not require the installation of sheet piling for excavation sidewall support or the use of a sprung structure to control vapor generation during the excavation activities.

When compared to Alternatives 3 and 6, Alternatives 4, 5 and 7 would cause a greater disruption (i.e., have lesser short-term effectiveness) to the surrounding community. Alternatives 4, 5, and 7 would also require the partial closure of the autobody shop and closure (or temporary relocation of) automotive sales business. Therefore, the additional capital costs to implement Alternatives 4, 5 and 7 would not be justified given that:

- The former MGP property currently contains a minimum of 5 feet of fill material above visually impacted soil
- Alternative 6 addresses a greater volume of impacted soil as compared with Alternative 4
- The area most likely subject to subsurface activities (i.e., the utility corridor) would be addressed under Alternative 3 and Alternative 6
- Inaccessible impacted soil would remain on the former MGP property under each of the alternatives (except for Alternative 7).

Compared to Alternatives 3, 4, 5, and 7, Alternative 6 is the most cost-effective alternative due to a higher short-term effectiveness and the fact Alternative 6 would permanently isolate the material that has the greatest potential for exposure in the future (i.e., NAPL-impacted material located within the utility corridor). Alternatives 5 and 7 provide minimal additional benefits related to long-term effectiveness and reduction of toxicity, mobility, and volume relative to Alternative 6.

6.3 Comparative Analysis Summary

Table 6-3 provides a summary of the remedial alternatives abilities to meet the RAOs as well as their relative short-term impacts and estimated cost.

Table 6-3
Comparative Analysis Summary

Criteria	Alternative #						
	1	**2**	**3**	**4**	**5**	**6**	**7**
RAOs							
Soil RAO 1	No	Yes	Yes	Yes	Yes	Yes	Yes
Soil RAO 2	No	Yes	Yes	Yes	Yes	Yes	Yes
Soil RAO 3	No	Limited	Moderate	Moderate	Moderate	Moderate	Moderate
Groundwater RAO 1	No	Yes	Yes	Yes	Yes	Yes	Yes
Groundwater RAO 2	No	Yes	Yes	Yes	Yes	Yes	Yes
Groundwater RAO 3	No	No	No	No	No	No	No
Groundwater RAO 4	No	Limited	Moderate	Moderate	Significantly	Significantly	Significantly
	Short Term Impacts						
Disruption to Community?	None	Low	Moderate	Moderate	Moderate	Low to Moderate	Significant
Length of Disruption?	None	1 Month	4 Months	6 Months	8 Months	3 Months	18 Months
	Cost						
Total Cost	$0	$3,400,000	$8,500,000	$10,400,000	$12,100,000	$7,100,000	$29,800,000

7 Preferred Remedial Alternative

7.1 General

The results of the comparative analysis were used as a basis for recommending a remedial alternative for the site. The components of the preferred remedial alternative for the site are presented below.

7.2 Summary of Preferred Remedial Alternative

Based on the comparative analysis of the remedial alternatives presented in Section 6, Alternative 6 is the preferred remedial alternative for the site. This alternative would cost effectively achieve the best balance of the NYSDEC evaluation criteria. The preferred remedial alternative reduces the potential for exposure to impacted media in the area most likely to be accessed to conduct future subsurface work (i.e., on the former MGP property and within the Fulton Street utility corridor).

As described in Section 5, the following are primary components of the preferred remedial alternative:

- Excavating approximately 3,200 CY of soil to remove former MGP structures and contaminated soil located in the southwestern corner of the former MGP.
- Transportation and off-site disposal (or recycling) of approximately 1,700 tons of surface material and other debris as C&D debris
- Transportation and off-site treatment/disposal of approximately 4,230 tons of soil containing MGP-related impacts via LTTD
- Performing in situ stabilization/removal via jet grouting of 620CY of soils underlying existing utilities adjacent to the autobody, sales, and automotive shops located on the former MGP.
- Restoration all disturbed surfaces to match existing site conditions
- Installation of a NAPL collection system (assumed to be passive collection wells for the purposes of this FS) to facilitate recovery of potentially mobile NAPL
- Installation of new groundwater monitoring wells to facilitate site-wide groundwater monitoring
- Establishing ICs on the properties that comprise the site (e.g., the former MGP property and the USPS post office property) as well as the off-site properties with proposed NAPL recovery and groundwater monitoring wells. The ICs would limit the future development and use of these areas (including groundwater), as well as control intrusive (i.e., subsurface) activities that could result in potential exposures to subsurface soil and groundwater containing MGP-related impacts at concentrations greater than applicable standards and guidance values. The ICs would also establish requirements for additional investigation activities (e.g., subsurface soil sampling) and/or remedial actions (e.g., excavation) if the building on the autobody, sales, and automotive repair shop property were to be demolished.
- Preparing an SMP to document the following:

- The ICs that have been established and will be maintained for the site
  - Requirements for notifications of the presence of MGP-related impacts in soil and groundwater that would be provided to those requesting utility clearance for intrusive activities on the former MGP property or in the off-site area
  - Known locations of remaining soil that contains COCs at concentrations greater than 6 NYCRR Part 375-6 commercial SCOs
  - Protocols (including health and safety requirements) for conducting invasive (i.e., subsurface) activities and managing potentially impacted material encountered during these activities
  - Protocols and requirements for conducting semi-annual NAPL monitoring (as appropriate) and annual groundwater monitoring
  - Protocols for addressing significant changes in COC concentrations in groundwater based on the results of the annual groundwater monitoring
  - Conducting semi-annual NAPL monitoring/passive NAPL recovery or operating and maintaining an automated NAPL recovery system (passive NAPL collection with periodic manual NAPL recovery [i.e., manual bailing or pumping] has been assumed for the purposes of this FS)
- Conducting annual groundwater monitoring to confirm groundwater flow direction and verify the extent and concentrations of dissolved-phase COCs
- Preparing an annual report to summarize semi-annual NAPL and annual groundwater monitoring activities and results

Excavation is the primary component of the preferred alternative. Excavation is a proven technology for addressing soil that contains MGP-related impacts. The preferred alternative also includes NAPL recovery and groundwater monitoring. Each of these technologies and processes has been successfully implemented at other MGP sites and is considered technically and administratively implementable.

Implementation challenges associated with Alternative 6 would primarily be related to conducting soil removal activities in an urban public setting, on property not owned by O&R. There is little available space for material handling and staging. Portions of Fulton Street between Canal and South streets and Canal Street would have to be closed during remedial construction. These challenges would be addressed during the remedial design of the alternative. O&R would have to secure access agreements with the USPS post office and autobody, sales, and automotive repair shops to conduct excavation activities in these areas and to install new groundwater monitoring and NAPL collection wells and conduct periodic groundwater monitoring and NAPL recovery. Transportation and coordination with the City of Middletown would be conducted prior to the implementation of the alternative to reroute local traffic around the work area.

Potential short-term impacts to the surrounding community and site workers would include potential exposures to soil and groundwater containing MGP-related COCs during excavation, material handling, and off-site transportation activities. The potential for exposures would be minimized through the use of appropriate field personnel and PPE, and by conducting work activities and air monitoring in accordance with a site-specific HASP and CAMP that would be prepared as part of the remedial design. The excavation activities would be conducted under a cement bentonite system which would suppress the generation of dust or vapors during excavation activities and would therefore minimize the potential for construction-related exposures to the surrounding community. Implementation of Alternative 6 would likely cause a short-term disruption to the surrounding community. Local truck traffic would increase from off-site transportation of excavated material and importation of materials to support the construction activities. Portions of Fulton and Canal streets would be closed during the remedial activities. Alternative 6 would require a short-term closure of the automotive sales business on the former MGP Property.

Alternative 6 would be protective of human health and the environment and effective over the long-term. Alternative 6 would prevent exposures (i.e., direct contact, ingestion, and inhalation) to MGP-related impacts in subsurface soil and groundwater (soil RAOs #1 and #2 and groundwater RAOs #1 and #2) through the implementation of ICs and removal of NAPL-impacted soil and portions of former MGP structures in the utility corridor near Fulton Street. Alternative 6 would partially address MGP-related COCs and materials that could cause impacts to groundwater (soil RAO #3) through the excavation of NAPL-impacted soils from the former MGP property and within the Fulton Street utility corridor and recovery of mobile NAPL.

Alternative 6 is preferred over the other alternatives because Alternative 6 would address the area most likely to require subsurface activities that would encounter visually impacted soil and former MGP structures. Alternative 6 is less disruptive to the surrounding community when compared to Alternatives 4, 5, and 7, which would include demolition of the autobody shop and/or automotive sales business building. Soil containing visual MGP-related impacts that may be located under the autobody shop or automotive sales business is likely to be encountered at depths greater than 5 feet below grade on the former MGP property. Soil containing visual MGP-related impacts in the off-site area is generally encountered at depths greater than 15 feet below grade. The former MGP property and off-site area are covered with asphalt pavement, concrete, buildings, and vegetated soil. Site workers, patrons, and nearby residents do not routinely conduct activities that would potentially result in exposure to impacted site media. There is a low potential for conducting subsurface activities at depths that would encounter impacted media following implementation of Alternative 6. Potential future exposures to impacted site media would be addressed through ICs and the SMP that would be prepared as part of Alternative 6.

7.3 Estimated Cost of Preferred Remedial Alternative

The total estimated cost associated with implementation of the preferred remedial alternative is summarized in Table 7-1.

Table 7-1
Cost Estimate for Alternative 6

Alternative 6	Estimated Capital Cost	Estimated Present Worth of O&M Cost*	Total Estimated Cost
Slurry-Supported Soil Removal at the Former MGP Property, Utility Corridor Stabilization, NAPL Recovery, Groundwater Monitoring, and Institutional Controls	$4,900,000	$2,200,000	$7,100,000

Note:
* = Estimated present worth of O&M cost is throughout an assumed 30-year period.

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Tables

Table 2-1
Potential Chemical-Specific SCGs

Regulation	Citation	Potential Standard or Guidance	Summary of Requirements	Applicability to the Remedial Design/Remedial Action
Federal				
National Primary Drinking Water Standards	40 CFR Part 141	S	Establishes maximum contaminant levels, which are health-based standards for public water supply systems.	These standards are potentially applicable if an action involves future use of groundwater as a public supply source.
RCRA–Hazardous Waste Characterization	40 CFR Part 261	S	Specifies the regulated levels for TCLP constituents for identification of hazardous wastes that exhibit the characteristic of toxicity.	Waste materials generated during remedial activities may be sampled and analyzed for TCLP constituents prior to disposal to determine if the materials are hazardous based on the characteristic of toxicity.
Universal Treatment Standards/Land Disposal Restrictions	40 CFR Part 268	S	Identifies hazardous wastes for which land disposal is restricted and provides a set of numerical constituent concentration criteria at which hazardous waste is restricted from land disposal (without treatment).	These standards are applicable if waste is determined to be hazardous and for remedial alternatives involving off-site land disposal.
New York State				
New York State Environmental Conservation Law and Associated Regulations	6 NYCRR Part 375-6	S	Provides soil cleanup objectives for remedial programs.	These standards are to be considered as appropriate in evaluating soil quality.
NYSDEC Guidance on the Management of Coal Tar Waste and Coal Tar Contaminated Soils and Sediment from Former MGPs	TAGM 4061	G	Outlines the criteria for conditionally excluding coal tar waste and impacted soil from former MGPs that exhibit the hazardous characteristic of toxicity for benzene (D018) from the hazardous waste requirements of 6 NYCRR Parts 370-374 and 376 when destined for thermal treatment.	This guidance will be used as appropriate in the management of MGP-impacted soil and coal tar waste generated during the remedial activities.

Table 2-1
Potential Chemical-Specific SCGs

Regulation	Citation	Potential Standard or Guidance	Summary of Requirements	Applicability to the Remedial Design/Remedial Action
NYSDEC Ambient Water Quality Standards and Guidance Values	Division of Water TOGS 1.1.1 (6/98)	S	Provides a compilation of ambient water quality standards and guidance values for toxic and non-conventional pollutants for use in NYSDEC programs.	These standards are to be considered in evaluating groundwater and surface water quality.
NYSDEC Soil Cleanup Guidance	CP-51	G	Provides the framework and policies for the selection of soil cleanup levels.	Guidance would be used to develop site-specific soil cleanup objectives.
Identification and Listing of Hazardous Wastes	6 NYCRR 371	S	Provides hazardous waste determinations.	Waste materials generated during remedial activities may be sampled and analyzed for TCLP constituents prior to disposal to determine if the materials are hazardous based on the characteristic of toxicity.
Land Disposal Restrictions	6 NYCRR 376	S	Identifies hazardous waste restricted from land disposal and defines land disposal.	These standards are applicable if waste is determined to be hazardous and for remedial alternatives involving off-site land disposal.

Notes:
CFR: Code of Federal Regulations
G: guidance
MGP: manufactured gas plant
NYCRR: New York Code of Rules and Regulations
NYSDEC: New York State Department of Environmental Conservation
RCRA: Resource and Conservation Recovery Act
S: standard
TAGM: Technical Administrative Guidance Memorandum
TCLP: toxic characteristics leaching procedure
TOGS: Technical and Operational Guidance Series

Table 2-2
Potential Action-Specific SCGs

Regulation	Citation	Potential Standard or Guidance	Summary of Requirements	Applicability to the Remedial Design/Remedial Action
Federal				
OSHA General Industry Standards	29 CFR Part 1910	S	Specifies the 8-hour time-weighted average concentration for worker exposure to various compounds. Training requirements for workers at hazardous waste operations are specified in 29 CFR 1910.120.	Proper respiratory equipment will be worn if it is not possible to maintain the work atmosphere below required concentrations. Appropriate training requirements will be met for remedial workers.
OSHA Safety and Health Standards	29 CFR Part 1926	S	Specifies the type of safety equipment and procedures to be followed during site remediation.	Appropriate safety equipment will be on site and appropriate procedures will be followed during remedial activities.
OSHA Recordkeeping, Reporting and Related Regulations	29 CFR Part 1904	S	Outlines recordkeeping and reporting requirements for an employer under OSHA.	These regulations apply to the company(s) contracted to install, operate, and maintain remedial actions at hazardous waste sites.
RCRA Preparedness and Prevention	40 CFR Part 264.30-264.31	S	Outlines requirements for safety equipment and spill control when treating, handling, and storing hazardous wastes.	Safety and communication equipment will be installed at the site as necessary. Local authorities will be familiarized with the site.
RCRA Contingency Plan and Emergency Procedures	40 CFR Part 264.50-264.56	S	Provides requirements for outlining emergency procedures to be used following explosions, fires, etc., when storing hazardous wastes.	Plans will be developed and implemented during remedial design. Copies of the plan will be kept on site.
CWA Discharge to Waters of the United States and Section 404	40 CFR Parts 403 and 230 Section 404(b)(1); 33 USC 1344	S	Establishes site-specific pollutant limitations and performance standards that are designed to protect surface water quality. Types of discharges regulated under CWA include: indirect discharge to a Publicly Operated Treatment Work and discharge of dredged or fill material into U.S. waters.	These standards are potentially applicable based on the site's proximity to Monhagen Brook.
CWA Section 401	33 USC 1341	S	Requires that a CWA 401 Water Quality Certification permit be provided to the federal permitting agency (U.S. Army Corps of Engineers) for any activity including, the construction or operation of facilities that may result in any discharge into jurisdictional waters of the United States and/or state.	These standards are potentially applicable based on the site's proximity to Monhagen Brook.

Table 2-2
Potential Action-Specific SCGs

Regulation	Citation	Potential Standard or Guidance	Summary of Requirements	Applicability to the Remedial Design/Remedial Action
90-Day Accumulation Rule for Hazardous Waste	40 CFR Part 262.34	S	Allows generators of hazardous waste to store and treat hazardous waste at the generation site for up to 90 days in tanks, containers, and containment buildings without having to obtain an RCRA hazardous waste permit.	These standards are potentially applicable to remedial alternatives that involve the storing or treating of hazardous materials on site.
Rivers and Harbors Act, Sections 9 & 10	33 USC 401 and 403; 33 CFR Parts 320-330	S	Prohibits unauthorized obstruction or alteration of navigable waters of the United States (dredging, fill, cofferdams, piers, etc.). Provides requirements for permits affecting navigable waters of the United States.	These standards are potentially applicable based on the site's proximity to Monhagen Brook.
Land Disposal Facility Notice in Deed	40 CFR Parts 264 and 265 Sections 116-119(b)(1)	S	Establishes provisions for a deed notation for closed hazardous waste disposal units, to prevent land disturbance by future owners.	The regulations are potentially applicable because site areas with MGP materials left in place may be similar to closed RCRA units.
RCRA General Standards	40 CFR Part 264.111	S	Provides general performance standards requiring minimization of need for further maintenance and control and minimization or elimination of post-closure escape of hazardous waste, hazardous constituents, leachate, contaminated runoff, or hazardous waste decomposition products. Requires decontamination or disposal of contaminated equipment, structures, and soils.	Decontamination actions and facilities will be constructed for remedial activities and will be disassembled after completion.
Standards Applicable to Transporters of Applicable Hazardous Waste, RCRA Section 3003	40 CFR Parts 170-179, 262, and 263	S	Establishes the responsibility of off-site transporters of hazardous waste in the handling, transportation, and management of the waste. Requires manifesting, recordkeeping, and immediate action in the event of a discharge.	These requirements will be applicable to any company(s) contracted to transport hazardous material from the site.
USDOT Rules for Transportation of Hazardous Materials	49 CFR Parts 107 and 171.1-172.558	S	Outlines procedures for the packaging, labeling, manifesting, and transporting of hazardous materials.	These requirements will be applicable to any company(s) contracted to transport hazardous material from the site.

Table 2-2
Potential Action-Specific SCGs

Regulation	Citation	Potential Standard or Guidance	Summary of Requirements	Applicability to the Remedial Design/Remedial Action
Clean Air Act National Ambient Air Quality Standards	40 CFR Part 60	S	Establishes ambient air quality standards for protection of public health.	Remedial operations will be performed in a manner that minimizes the production of benzene and particulate matter.
USEPA-Administered Permit Program: Hazardous Waste Permit Program	RCRA Section 3005; 40 CFR Part 270.124	S	Covers the basic permitting, application, monitoring, and reporting requirements for off-site hazardous waste management facilities.	Any off-site facility accepting hazardous waste from the site must be properly permitted. Implementation of the site remedy will include consideration of these requirements.
LDRs	40 CFR Part 368	S	Restricts land disposal of hazardous wastes that exceed specific criteria. Establishes UTSs to which hazardous waste must be treated prior to land disposal.	Excavated soils that display the characteristic of hazardous waste or that are decharacterized after generation must be treated to 90% constituent concentration reduction capped at 10 times the UTS.
RCRA Subtitle C	40 USC Section 6901 et seq.; 40 CFR Part 268	S	Restricts land disposal of hazardous wastes that exceed specific criteria. Establishes UTSs to which hazardous wastes must be treated prior to land disposal.	These standards are potentially applicable to remedial activities that include the disposal of soil from the site.
New York State				
Use and Protection of Waters Program	6 NYCRR Part 608	S	Provides protection of waters permit program and regulates any disturbance of the bed or banks of a protected stream or water course; construction and maintenance of dams; and excavation or fill in navigable waters of the state.	These standards are potentially applicable based on the site's proximity to Monhagen Brook
Discharges to Public Waters	NYSDEC Law, Section 71-3503	S	Provides that a person who deposits gas tar; the refuse of a gas house or gas factory; or offal, refuse, or any other noxious, offensive, or poisonous substances into any public waters or into any sewer or stream running or entering into such public waters is guilty of a misdemeanor.	During the remedial activities, MGP-impacted materials will not be deposited into public waters or sewers.

Table 2-2
Potential Action-Specific SCGs

Regulation	Citation	Potential Standard or Guidance	Summary of Requirements	Applicability to the Remedial Design/Remedial Action
New York Hazardous Waste Management System (General)	6 NYCRR Part 370	S	Provides definitions of terms and general instructions for the Part 370 series of hazardous waste management.	Hazardous waste is to be managed according to this regulation.
Identification and Listing of Hazardous Wastes	6 NYCRR Part 371	S	Outlines criteria for determining if a solid waste is a hazardous waste and is subject to regulation under 6 NYCRR Parts 371-376.	These standards are applicable for determining if soil generated during implementation of remedial activities is hazardous waste. These regulations do not set cleanup standards, but they are considered when developing remedial alternatives.
Hazardous Waste Manifest System and Related Standards for Generators, Transporters, and Facilities	6 NYCRR Part 372	S	Provides guidelines relating to the use of the manifest system and its recordkeeping requirements. Applies to generators, transporters, and facilities in New York State.	This regulation will be applicable to any company(s) contracted to do treatment work at the site or to transport or manage hazardous material generated at the site.
New York Regulations for Transportation of Hazardous Waste	6 NYCRR Part 372.3a-d	S	Outlines procedures for the packaging, labeling, manifesting, and transporting of hazardous waste.	These requirements will be applicable to any company(s) contracted to transport hazardous material from the site.
Waste Transporter Permits	6 NYCRR Part 364	S	Governs the collection, transport, and delivery of regulated waste within New York State.	Properly permitted haulers will be used if any waste materials are transported off site.
NYSDEC TAGMs	NYSDEC TAGMs	G	Provides guidance that is to be considered during the remedial process.	Appropriate TAGMs will be considered during the remedial process.
New York Regulations for Hazardous Waste Management Facilities	6 NYCRR Part 373.1.1-373.1.8	S	Provides requirements and procedures for obtaining a permit to operate a hazardous waste treatment, storage, and disposal facility. Lists contents and conditions of permits.	Any off-site facility accepting waste from the site must be properly permitted.
Management of Soil and Sediment Contaminated with Coal Tar from Former MGPs	NYSDEC Program Policy	G	Provides guidance to facilitate the permanent treatment of soil contaminated with coal tar from the sites of former MGPs.	Policy will be considered for benzene (D018) hazardous and non-hazardous soil removed during removal activities.

Table 2-2
Potential Action-Specific SCGs

Regulation	Citation	Potential Standard or Guidance	Summary of Requirements	Applicability to the Remedial Design/Remedial Action
Land Disposal of a Hazardous Waste	6 NYCRR Part 376	S	Restricts land disposal of hazardous wastes that exceed specific criteria.	New York State defers to USEPA for UTS/LDR regulations.
NYSDEC Guidance on the Management of Coal Tar Waste and Coal Tar Contaminated Soils and Sediment from Former MGPs	TAGM 4061(2002)	G	Outlines the criteria for conditionally excluding coal tar waste and impacted soils from former MGPs that exhibit the hazardous characteristic of toxicity for benzene (D018) from the hazardous waste requirements of 6 NYCRR Parts 370-374 and 376 when destined for thermal treatment.	This guidance will be used as appropriate in the management of MGP-impacted soil and coal tar waste generated during the remedial activities.
NPDES Program Requirements, Administered Under New York SPDES	40 CFR Parts 122 Subpart B, 125, 301, 303, and 307 (Administered under 6 NYCRR 750-758)	S	Establishes permitting requirements for point source discharges. Regulates discharge of water into navigable waters, including the quantity and quality of discharge.	These standards are potentially applicable based on the site's proximity to Monhagen Brook

Notes:
CFR: Code of Federal Regulations
CWA: Clean Water Act
G: guidance
LDR: Land Disposal Restriction
MGP: manufactured gas plant
NPDES: National Pollutant Discharge Elimination System
NYCRR: New York Code of Rules and Regulations
NYSDEC: New York State Department of Environmental Conservation
OSHA: Occupational Safety and Health Act
RCRA: Resource and Conservation Recovery Act
S: standard
SPDES: State Pollutant Discharge Elimination System
TAGM: Technical Administrative Guidance Memorandum
USC: U.S. Code
USDOT: U.S. Department of Transportation
USEPA: U.S. Environmental Protection Agency
UTS: Universal Treatment Standard

Table 2-3
Potential Location-Specific SCGs

Regulation	Citation	Potential Standard or Guidance	Summary of Requirements	Applicability to the Remedial Design/Remedial Action
Federal				
National Environmental Policy Act Executive Orders 11988 and 11990	40 CFR 6.302; 40 CFR Part 6, Appendix A	S	Requires federal agencies, where possible, to avoid or minimize adverse impacts of federal actions upon wetlands/floodplains and enhance natural values of such. Establishes the "no-net-loss" of waters/wetland area or function policy.	Applicable if remedial activities are conducted within the floodplain or wetlands.
Clean Water Act Section 404	33 USC 1344, Section 404; 33 CFR Parts 320-330; 40 CFR Part 230	S	Ensures discharges of dredge or fill materials into waters of the United States, including wetlands, are regulated by the U.S. Army Corps of Engineers.	These standards are potentially applicable for alternatives that propose filling within the Monhagen Brook floodplain.
Fish and Wildlife Coordination Act	16 USC 661; 40 CFR 6.302	S	Ensures actions must be taken to protect fish or wildlife when diverting, channeling, or otherwise modifying a stream or river.	These standards are potentially applicable for alternatives that impact Monhagen Brook
Endangered Species Act	16 USC 1531 et seq.; 50 CFR Part 200; 50 CFR Part 402	S	Requires federal agencies to confirm that the continued existence of any endangered or threatened species and their habitat will not be jeopardized by a site action.	These standards are not applicable. Threatened or endangered species were not reported in the immediate vicinity of the site.
Historical and Archaeological Data Preservation Act	16 USC 469a-1	S	Provides for the preservation of historical and archaeological data that might otherwise be lost as the result of alteration of the terrain.	These standards are not applicable. The nearest property listed on the National Register of Historic Places is the Paramount Theatre, located approximately 500 feet north of the former MGP site, on South Street.
National Historic and Historical Preservation Act	16 USC 470; 36 CFR Part 65; 36 CFR Part 800	S	Provides requirements for the preservation of historic properties.	These standards are not applicable. The nearest property listed on the National Register of Historic Places is the Paramount Theatre, located approximately 500 feet north of the former MGP site, on South Street.

Table 2-3
Potential Location-Specific SCGs

Regulation	Citation	Potential Standard or Guidance	Summary of Requirements	Applicability to the Remedial Design/Remedial Action
Rivers and Harbors Act	33 USC 401/403	S	Prohibits unauthorized obstruction or alteration of navigable waters of the United States (dredging, fill, cofferdams, piers, etc.). Provides requirement for permits affecting navigable waters of the United States.	These standards are potentially applicable based on proximity to Monhagen Brook.
Hazardous Waste Facility Located on a Floodplain	40 CFR Part 264.18(b)	S	Provides requirements for a TSD facility built within a 100-year floodplain.	Hazardous waste TSD activities (if any) will be designed to comply with applicable requirements cited in this regulation.
New York State				
New York State Floodplain Management Development Permits	6 NYCRR Part 500	S	Provides conditions necessitating NYSDEC permits and provides definitions and procedures for activities conducted within floodplains.	These standards are potentially applicable based on the site's proximity to the 100-year floodplain.
New York State Freshwater Wetlands Act	Environmental Conservation Law Articles 24 and 71; 6 NYCRR Parts 662-665	S	Ensures activities in wetlands areas are conducted to preserve and protect wetlands.	These standards do not appear to be applicable because the site is not located in a wetlands area.
New York State Parks, Recreation, and Historic Preservation Law	New York Executive Law Article 14	S	Provides requirements for the preservation of historic properties.	These standards are not applicable. The nearest property listed on the National Register of Historic Places is the Paramount Theatre, located approximately 500 feet north of the former MGP site, on South Street.
Use and Protection of Waters Program	6 NYCRR Part 608	S	Provides protection of waters permit program and regulates any disturbance of the bed or banks of a protected stream or water course; construction and maintenance of dams; and excavation or fill in navigable waters of the state.	These standards are potentially applicable based on the site's proximity to Monhagen Brook.

Table 2-3
Potential Location-Specific SCGs

Regulation	Citation	Potential Standard or Guidance	Summary of Requirements	Applicability to the Remedial Design/Remedial Action
Endangered & Threatened Species of Fish and Wildlife	6 NYCRR Part 182	S	Identifies endangered and threatened species of fish and wildlife in New York State.	These standards are not applicable. Threatened or endangered species are not located in the immediate vicinity of the former MGP site.
New York Preservation of Historic Structures or Artifacts	New York State Historic Preservation Act, Section 14.09	S	Provides requirements for preservation of historical/archeological artifacts.	These standards are not applicable. The nearest property listed on the National Register of Historic Places is the Paramount Theatre, located approximately 500 feet north of the former MGP site, on South Street.
Floodplain Management Criteria for State Projects	6 NYCRR Part 502	S	Establishes floodplain management practices for projects involving state-owned and state-financed facilities.	Portions of the area to be remediated are located within the floodplain. Activities located in these areas would be performed in accordance with this regulation
Local				
Local Building Permits	N/A	S	States that local authorities may require a building permit for any permanent or semi-permanent structure, such as an on-site water treatment system building or a retaining wall.	Substantive provisions are potentially applicable to remedial activities that require construction of permanent or semi-permanent structures.
Local Water Usage Permits	N/A	S	States that local authorities may require a permit for the connection to a public potable water supply.	Permits or other local approvals may be required to access the public water supply for use in select remedial activities (such as in situ solidification and stabilization).

Notes:
CFR: Code of Federal Regulations
G: guidance
MGP: manufactured gas plant
NYCRR: New York Code of Rules and Regulations
NYSDEC: New York State Department of Environmental Conservation
S: standard
TSD: treatment, storage, and disposal
USC: U.S. Code

Table 4-1
Summary of Soil Remedial Alternatives Retained for Detailed Analysis

General Response Action	Technology Type	Technology Process Option	Description of Option	Evaluation Criteria: Implementability	Evaluation Criteria: Effectiveness	Evaluation Criteria: Relative Cost	Retained for Further Analysis?
No Action	No Action	No Action	No remedial activities would be completed to address site-related impacts. The "No Action" alternative serves as the baseline for comparison of the overall effectiveness of the other remedial alternatives.	Implementable. Because this alternative does not require implementation of any remedial activities, the alternative is technically and administratively implementable.	Not effective. This alternative does not address toxicity, mobility, or volume of MGP-related soil impacts and would not meet the RAOs established for the site.	Low	Yes
Institutional Controls	Institutional Controls	Governmental Controls, Proprietary Controls, Enforcement and Permit Controls	This alternative would include deed restrictions, environmental land use restrictions, enforcement and permit controls, and annual monitoring of site conditions. Institutional controls would be summarized in a Site Management Plan and would be used to limit permissible future site uses, and to establish health and safety requirements to be followed during subsurface activities that could result in construction worker exposure to impacted soil.	Implementable. This alternative requires negotiation and agreement with the property owner, site occupants, and municipality.	Effective. This alternative can achieve RAOs when implemented in combination with other technology types.	Low	Yes
Engineering Controls	Surface Controls	Maintain Existing Surface Cover Materials	The existing surface cover would be maintained to achieve the RAO of providing continued protection against potential exposure to subsurface soils containing COCs.	Easily implementable. Resources to maintain the existing surface covers are readily available.	Effective. Current and future use of the site is anticipated to be for automotive maintenance and repair; therefore, this alternative is considered effective when combined with other technology types such as institutional controls.	Low	Yes
In Situ Containment/ Controls	Capping	Clay/Soil Cap/ Multi-Media Cap	This alternative involves placing and compacting clay material or soil material over impacted soil. Multi-media cap variation includes application of a combination of clay/soils and synthetic membrane(s) over impacted soil.	Not Readily Implementable. Equipment and materials necessary to construct the cap are readily available. However, existing site usage includes high-traffic areas and movement of vehicles, which would impede installation and maintenance and could substantially disrupt current operations.	Not effective. This alternative may reduce the mobility of COCs by reducing infiltration; however, enhanced effectiveness (as compared with existing surface covers) is unlikely. This alternative would not reduce toxicity or volume of impacts or prevent off-site migration of NAPLs. Current and future use of the site is for a parking lot or high-traffic storage area; therefore, long-term effectiveness is diminished.	Moderate capital and O&M costs	No
		Asphalt/Concrete Cap	This alternative involves application of a layer of asphalt or concrete over impacted soils.	Implementable. Equipment and materials necessary to construct the cap are readily available. However, existing site usage includes high-traffic areas and movement of vehicles, which would impede installation and could substantially disrupt current operations.		Moderate capital and O&M costs	No
	Containment	Sheet Pile	Steel sheet piles are driven into the subsurface to contain impacted soils and NAPLs. The sheetpile wall is typically keyed into a confining unit and could be permeable or impermeable to groundwater flow.	Implementable. Equipment and materials necessary to install sheetpile walls are readily available. Presence of subsurface utilities and historic fill materials would hinder technology use and may require pre-drilling or pre-trenching to install. Sheet piles would not be installed through or into the fractured till layer. Installation would substantially disrupt current site businesses (including potentially temporary closure of the on-site businesses, closure of Fulton Street, and rerouting of subsurface utilities).	Not effective. Because the potential for NAPL migration would not be addressed within the fractured till layer, this technology option would not achieve the Soil RAO for Environmental Protection. Presence of upward hydraulic gradients at the site could result in impacted groundwater or NAPL upwelling into subsurface structures, which would not achieve the Soil RAO for Protection of Human Health.	High capital and O&M costs	No
		Slurry Walls	This alternative involves excavating a trench and adding a slurry (e.g., soil/cement-bentonite mixture) to control migration of subsurface soils, groundwater, and NAPL from an area. Slurry walls are typically keyed into a low-permeability unit (e.g., an underlying silt/clay layer).	Potentially implementable. Underground utilities and historic fill material would hinder installation. Although this technology could be installed through the fractured till layer, the equipment capable of penetrating into this layer is not readily available. Based on the size of the equipment and the support equipment (grout mix plant, water supply, filtration equipment), implementation of this remedy would likely require temporary shutdown of the site businesses,	Not effective. Because the potential for NAPL migration would not be addressed within the fractured till layer, this technology option would not achieve the Soil RAO for Environmental Protection. Presence of upward hydraulic gradients at the site could result in impacted groundwater or NAPL upwelling into subsurface structures, which would not achieve the Soil RAO for Protection of Human Health.	High capital and O&M costs	No

Note: Shading indicates that technology process has not been retained for development of a remedial alternative.

Table 4-1
Summary of Soil Remedial Alternatives Retained for Detailed Analysis

General Response Action	Technology Type	Technology Process Option	Description of Option	Evaluation Criteria			Retained for Further Analysis?
				Implementability	Effectiveness	Relative Cost	
				temporary closure of Fulton Street, and relocation of the subsurface utilities.			
In Situ Treatment	Immobilization	Solidification/ Stabilization	This alternative involves addition of material to the impacted soil that limits the solubility or mobility of COCs and NAPL present within the treated area. It also involves treating soil to produce a stable, non-leachable material that physically or chemically locks the constituents within the solidified matrix.	Potentially implementable. Solidification/stabilization materials are readily available. Underground structures would hinder technology use. Technology may alter groundwater patterns and affect current conditions of the dissolved plume and NAPL migration. This alternative would not be implementable across the entire site but could be implemented in targeted locations.	Effective. The overall effectiveness of this process would need to be evaluated during a bench-scale treatability study. Underground structures and obstructions would need to be removed. This alternative would not be effective in addressing COCs or NAPL within the fractured till layer. It may be effective when combined with other technology types.	High capital and low O&M costs	Yes
	Chemical Treatment	Chemical Oxidation	Oxidizing agents are added to oxidize and reduce the mass of organic constituents. In situ chemical oxidation involves the introduction of chemicals such as ozone, hydrogen peroxide, magnesium peroxide, sodium persulfate, or potassium permanganate. A pilot study would be required to evaluate/determine oxidant application requirements. Large amounts of oxidizing agents would be needed to oxidize NAPL.	Implementable. Equipment and materials necessary to inject/apply oxidizing agents are readily available. This alternative may require special provisions for storage of process chemicals and long-term access to inject the oxidant, which could impede business operations at the site.	Not Effective. This alternative is not effective for addressing NAPL within the overburden soils or for addressing COCs or NAPL within fractured till layers. It would require multiple treatments of chemicals to reduce constituents and may not be a cost-effective means to achieve the RAOs. Time requirements may not be acceptable for the site owner.	High capital and O&M costs	No
	Biological Treatment	Biodegradation	This alternative involves natural biological and physical processes that, under favorable conditions, act without human intervention to reduce the mass, volume, concentration, toxicity, and mobility of COCs. This process relies on long-term monitoring to demonstrate the reduction of impacts.	Implementable. This alternative would require long-time access to monitoring wells.	Not Effective. This alternative would be less effective for heavier, more condensed PAHs and not effective for NAPLs. It would not achieve RAOs in an acceptable timeframe.	Low capital and moderate O&M costs	No
		Enhanced Biodegradation	This alternative involves addition of amendments (e.g., oxygen, nutrients) and controls to the subsurface to enhance indigenous microbial populations to improve the rate of natural degradation.	Implementable. Equipment and materials necessary to inject amendments are readily available. This alternative requires long-term access to injection points.	Not Effective. This alternative would be less effective for heavier, more condensed PAHs and would not be effective for addressing NAPL within the overburden soils or for addressing COCs or NAPL within fractured till layers.	Low capital and moderate O&M costs	No
		Biosparging	Air/oxygen injection wells are installed within the impacted regions to enhance biodegradation of constituents by increasing oxygen availability. Low-flow injection technology may be incorporated. This technology requires long-term monitoring.	Implementable. Equipment capable of installing wells is readily available. This alternative would require use of compressed air/oxygen or installation of a compressor to provide continuous air/oxygen supply. Access to areas that would require injection wells for this process option to be effective is limited and so is space for locating air/oxygen canisters or a compressor.	Not Effective. This alternative would not be effective for addressing NAPL within the overburden soils or for addressing COCs or NAPL within fractured till layer. It could help to reduce toxicity, mobility, and volume of dissolved constituents when combined with other process options and would likely require many years or decades of treatment.	Low capital and moderate O&M costs	No
Removal	Excavation	Excavation	This alternative involves physical removal of impacted soil. Typical excavation equipment would include backhoes, loaders, and dozers. Temporary structures and extraction wells may be used to lower the groundwater to create "dry" areas to allow use of typical excavation equipment to physically remove soil.	Implementable. Equipment capable of excavating the soil is readily available.	Effective. This is a proven process for effectively removing impacted soil.	High capital cost and low O&M costs	Yes

Note: Shading indicates that technology process has not been retained for development of a remedial alternative.

Table 4-1
Summary of Soil Remedial Alternatives Retained for Detailed Analysis

General Response Action	Technology Type	Technology Process Option	Description of Option	Evaluation Criteria: Implementability	Evaluation Criteria: Effectiveness	Evaluation Criteria: Relative Cost	Retained for Further Analysis?
On-Site Ex Situ Treatment	Immobilization	Solidification/ Stabilization	This alternative involves addition of material to the removed soil that limits the solubility or mobility of the COCs present. It involves treating soil to produce a stable, non-leachable material that physically or chemically locks the constituents within the solidified matrix. It may also include addition of amendments (e.g., Portland cement) to remove free liquids from excavated soils.	Implementable. Solidification/stabilization materials are readily available. On-site space to perform treatment technology is limited and would impede existing business operations at the site.	Effective. This is a proven process for effectively reducing mobility and toxicity of organic and select inorganic constituents. The overall effectiveness of this process would need to be evaluated during a bench-scale treatability study. Timeline requirements associated with on-site treatment may not be feasible. Although not retained as a standalone treatment method, this method may be used in combination with soil removal alternatives to address free liquids prior to off-site transport for off-site treatment and or disposal.	Moderate capital and O&M costs	Yes
	Extraction	LTTD	LTTD is the process by which soils containing organics with boiling point temperatures less than 800°F are excavated, conditioned, and heated. The organic compounds are desorbed from the soils into an induced airflow. The resulting gas is treated either by condensation and filtration or by thermal destruction. Treated soils are returned to the subsurface as fill.	Implementable. Treatment facilities are available. Space to perform treatment technology is limited and could impede existing business operations at the site. Permitting for a temporary treatment system would pose an additional implementability challenge. It is unlikely that the surrounding community would accept the operation of a LTTD facility at the site.	Effective. This is a proven process for effectively addressing organic constituents. The efficiency of the system and rate of removal of organic constituents would require evaluation during bench-scale or pilot-scale testing. Timeline requirements associated with on-site treatment may limit feasibility of process. This treatment method would not address the presence of inorganics within the excavated materials and is assumed to not meet on-site reuse criteria.	High capital and O&M costs	No
Off-Site Treatment and/or Disposal	Extraction	LTTD	LTTD is the process by which soils containing organics with boiling point temperatures less than 800°F are excavated, conditioned, and heated. The organic compounds are desorbed from the soils into an induced airflow. The resulting gas is treated either by condensation and filtration or by thermal destruction.	Implementable. Treatment facilities are available.	Effective. This is a proven process for effectively addressing organic constituents.	Moderate capital costs	Yes
	Thermal Destruction	Incineration	Soils are transported off-site for high temperature thermal destruction of the organic compounds present in the media. Soils are excavated and conditioned prior to incineration.	Not implementable. Limited number of treatment facilities available.	Proven process for effectively addressing organic constituents. The efficiency and effectiveness of the system and rate of removal of organic constituents would need to be verified during bench-scale and/or pilot-scale testing.	High Capital Costs	No
	Disposal	Solid Waste Landfill	This alternative involves disposal of impacted soil in an existing permitted non-hazardous waste landfill.	Implementable. Non-hazardous waste landfill facilities are available.	Effective. This is a proven process that can effectively achieve the RAOs for non-hazardous solid waste.	Moderate capital costs	Yes
		RCRA Landfill	This alternative involves disposal of impacted soil in an existing RCRA-permitted landfill facility.	Implementable.	Not Effective. Soils that exhibit hazardous characteristic of waste (and are not exempt) would require pre-treatment prior to disposal.	Moderate to high capital costs	Yes

Notes:
COC: constituent of concern
LTTD: low-temperature thermal desorption
MGP: manufactured gas plant
NAPL: nonaqueous phase liquid
O&M: operation and maintenance
RAO: Remedial Action Objective
RCRA: Resource Conservation and Recovery Act

Note: Shading indicates that technology process has not been retained for development of a remedial alternative.

Table 4-2
Summary of Groundwater Remedial Alternatives Retained for Detailed Analysis

General Response Action	Technology Type	Technology Process Option	Description of Option	Evaluation Criteria: Implementability	Evaluation Criteria: Effectiveness	Relative Cost	Retained for Further Analysis?
No Action	No Action	No Action	This alternative would not include any active remedial action. A No Action alternative serves as a baseline for comparison of the overall effectiveness of other remedial alternatives. Consideration of a No Action alternative is required by the National Contingency Plan and U.S. Environmental Protection Agency.	Implementable. Because this alternative does not require implementation of any remedial activities, the alternative is technically and administratively implementable.	Not effective. This alternative does not address toxicity, mobility, or volume of MGP-related groundwater impacts and would not meet the RAOs established for the site.	Low	Yes
Institutional Controls	Institutional Controls	Governmental Controls, Proprietary Controls, Enforcement and Permit Controls	Institutional controls would include legal and/or administrative controls that mitigate the potential for exposure to impacted materials and/or jeopardize the integrity of an installed remedy. Examples of potential institutional controls include establishing land-use restrictions, health and safety requirements for subsurface activities, and restrictions on groundwater use and/or extraction.	Implementable. Requires negotiation and agreement with the current property owners.	Effective. This alternative can achieve RAOs when implemented in combination with other technology options.	Low	Yes
In Situ Treatment	Biological Treatment	Groundwater Monitoring	Groundwater monitoring would include natural biological, chemical, and physical processes that, under favorable conditions, act without human intervention to reduce the mass, volume, concentration, toxicity, and mobility of chemical constituents. This process relies on long-term monitoring to demonstrate the reduction of impacts caused by chemical constituents.	Easily implemented. Would require long-term access to monitoring wells to demonstrate reduction of impacts.	Limited effectiveness. The presence of DNAPL would continue to generate dissolved phase COCs for an extended period.	Low capital and O&M costs	Yes
		Enhanced Biodegradation	This option involves addition of amendments (e.g., nutrients, oxygen) to the subsurface to enhance indigenous microbial populations to improve the rate of natural biodegradation.	Implementable. Would require monitoring to demonstrate reduction of COC concentrations and extent of dissolved phase plume. Amendments can be mixed with backfill materials during restoration of excavation areas or applied via injection/application wells.	Limited effectiveness. May not achieve RAOs for groundwater. Would likely require a significant amount of oxygen to enhance aerobic degradation. Anaerobic degradation is not as effective as aerobic degradation. Would only be potentially effective at treating groundwater if NAPL and impacted soil (i.e., source of dissolved phase impacts) is removed.	Low capital and moderate O&M costs	Yes
		Biosparging	Air/oxygen injection wells are installed within the dissolved phase plume to enhance biodegradation of COCs by increasing oxygen availability to enhance indigenous microbial populations and improve the rate of natural biodegradation. Low-flow injection technology may be incorporated. This technology requires long-term monitoring.	Implementable. Equipment capable of installing wells is readily available. Would require use of compressed air/oxygen or installation of a compressor to provide continuous air/oxygen supply. Access to areas that would require injection wells for this process option to be effective is limited, as is space for locating air/oxygen canisters or a compressor.	Not effective for addressing source of dissolved phase COCs in groundwater (DNAPL). Could help to reduce toxicity, mobility, and volume of dissolved phase COCs when combined with other process options. Presence of DNAPL within the fractured till layer would not be treated and would serve as a long-term source of dissolved phase COCs in groundwater.	Low capital and moderate O&M costs	No

Note: Shading indicates that technology process has not been retained for development of a remedial alternative.

Table 4-2
Summary of Groundwater Remedial Alternatives Retained for Detailed Analysis

General Response Action	Technology Type	Technology Process Option	Description of Option	Evaluation Criteria: Implementability	Evaluation Criteria: Effectiveness	Relative Cost	Retained for Further Analysis?
In Situ Treatment (continued)	Chemical Treatment	Chemical Oxidation	Oxidizing agents are added to oxidize and reduce the mass of organic COCs. In situ chemical oxidation involves the introduction of chemicals such as ozone, hydrogen peroxide, magnesium peroxide, sodium persulfate, or potassium permanganate. A bench-scale treatability study would be required to evaluate and estimate the amount of oxidizing agent. Large amounts of oxidizing agents are needed to oxidize DNAPL.	Implementable. Equipment and materials necessary to inject/apply oxidizing agents are readily available. May require special provisions for storage of process chemicals and long-term access to inject oxidant, which could impede business operations at the Site.	Not effective for addressing source of dissolved phase COCs in groundwater (DNAPL) unless targeted, repeated contact is made with between the oxidant and the DNAPL. Would require several treatments of chemicals over several years to reduce COCs. Presence of DNAPL within the fractured till layer would not be treated and would serve as a long-term source of dissolved phase COCs in groundwater.	High capital and O&M costs	No
		PRB	PRBs are installed in or downgradient from the flow path of a contaminant plume. The contaminants in the plume react with the media inside the barrier to either break the compound down into harmless products or immobilize contaminants by precipitation or sorption.	Potentially implementable. Presence of underground obstructions may hinder technology use. May require relocation of utilities that cross the path of the barrier. Pilot study would be required to evaluate appropriate design given site-specific hydraulic conditions.	Limited effectiveness. NAPL in subsurface would inhibit effectiveness of PRB. Groundwater conditions may potentially encourage biological growth and fouling of PRB. Could be effective when combined with source removal.	Moderate capital and low O&M costs	No
In Situ Containment	Hydraulic Containment	Groundwater Extraction Using Recovery Wells	This option provides hydraulic control across a dissolved phase plume by pumping and treating groundwater and DNAPL from wells and drains. Monitoring wells are also used to determine whether required hydraulic controls have been obtained. This option typically requires extensive design and testing to determine required hydraulic gradients and feasibility of achieving those gradients.	Not implementable as a standalone remedy. Materials and equipment required to install extraction wells are readily available. Access for well installation and space to perform water treatment is limited. May be implemented in connection with a removal remedy to provide groundwater control during soil excavation.	Effective. Proven process for effectively containing dissolved phase groundwater plume; however, plume appears to be stabilized. Access to locations for installation of recovery wells is limited. Would require pumping and treating large quantities of water over long periods of time. Stability of DNAPL plume is unknown; however, hydraulic control unlikely to affect DNAPL migration in weathered or fractured till layer; therefore, it may not be effective.	High capital and O&M costs	Yes
	Physical Containment	Sheetpile	Steel sheetpiles are driven into the subsurface to contain and control migration of impacted groundwater and DNAPL from an area. The sheetpile wall is typically keyed into a confining unit and would be designed as impermeable to groundwater flow.	Implementable. Equipment and materials necessary to install sheetpile walls are readily available. Presence of subsurface utilities and historic fill materials would hinder technology use and may require pre-drilling or pre-trenching to install. Sheetpiles would be not be installed through the fractured till layer or into the layer. Installation would substantially disrupt current site businesses (including potentially temporary closure of the on-site businesses, closure of Fulton Street, as well as rerouting of subsurface utilities.)	Limited effectiveness. Because the potential for DNAPL migration or dissolved phase COC groundwater migration would not be addressed within the fractured till layer, this technology option would not achieve the Groundwater RAOs for Environmental Protection. Presence of upward hydraulic gradients at the site could result in impacted groundwater and or DNAPL upwelling into subsurface structures, which would not achieve the Groundwater RAOs for Public Health Protection.	High capital and O&M costs	No

Note: Shading indicates that technology process has not been retained for development of a remedial alternative.

Table 4-2
Summary of Groundwater Remedial Alternatives Retained for Detailed Analysis

General Response Action	Technology Type	Technology Process Option	Description of Option	Evaluation Criteria: Implementability	Evaluation Criteria: Effectiveness	Relative Cost	Retained for Further Analysis?
In Situ Containment (Continued)	Physical Containment (Continued)	Slurry Walls	This process involves excavating a trench and adding a slurry (e.g., soil/cement-bentonite mixture) to contain and control migration of groundwater and DNAPL from an area. Slurry walls are typically keyed into a low-permeability unit (e.g., an underlying silt/clay layer).	Potentially implementable. Underground utilities and historic fill material would hinder installation. Although this technology could be installed through the fractured till layer, the equipment capable of penetrating through this layer are not readily available. Based on the size of the equipment, as well as the support equipment (grout mix plant, water supply, filtration equipment), implementation of this remedy would likely require temporary shutdown of the site businesses, temporary closure of Fulton Street, and relocation of the subsurface utilities.	Limited effectiveness. Because the potential for DNAPL or dissolved phase COC groundwater migration would not be addressed within the fractured till layer, this technology option would not achieve the Groundwater RAO for Environmental Protection. The presence of upward hydraulic gradients at the site could result in impacted groundwater and or DNAPL upwelling into subsurface structures, which would not achieve the Groundwater RAOs for Public Health Protection.	High capital and O&M costs	No
Removal	Groundwater and/or DNAPL Extraction	Pump and Treatment Using Vertical or Horizontal Wells	Wells are installed to recover groundwater and DNAPL for treatment/disposal.	Not implementable. Would require installation of supporting infrastructure (such as pumps and temporary holding tanks for extracted water and DNAPL). Footprint of extraction system and associated treatment system (discussed below) ongoing operation of an extraction system would substantially impede on-site businesses.	Effective, but inefficient for recovery/treatment of dissolved phase plume and DNAPL within the fractured till layer. Presence of upward hydraulic gradients combined with DNAPL in fractured till layers would continue to serve a source of dissolved phase COCs to the overburden soils. Access to locations for installation of recovery wells and supporting infrastructure is limited. Would require pumping and treating large quantities of water over long periods of time.	Moderate capital and high O&M costs	No
		Collection Trenches	A zone of higher permeability material is installed within the desired capture area with a perforated collection pipe laterally placed along the base to direct groundwater to a collection area for on-site treatment and/or disposal.				
		Passive DNAPL Removal	DNAPL is passively collected in vertical wells and removed.	Implementable. Space to place the vertical wells is limited to areas outside existing structures on-site and outside of public right of ways.	Potentially effective for recovering DNAPL for treatment/disposal. Locations of DNAPL recovery wells would need to be selected to optimize recovery.	Low capital and O&M costs	Yes
Ex Situ On-Site Treatment	Chemical Treatment	Ultraviolet Light/Oxidation	This option involves extraction of groundwater and treatment using oxidation by subjecting groundwater to ultraviolet light and ozone.	Not implementable due to site configuration and use as an active business. Space to store extracted water, perform water treatment, and store treated water is limited. Would require a full-time on-site operator to perform the treatment activities. In addition to addressing dissolved phase COCs, the water treatment system would require separation of extracted DNAPL or other oils that may be present in extracted groundwater (and unrelated to the MGP operations). May require special provisions for storage of process chemicals. Solids generated from treatment facility would require off-site disposal.	Effective. Proven process for effectively treating organic compounds. Use of this process combined with groundwater removal could achieve RAOs. A bench-scale treatability study may be required to evaluate the efficiency of this process and to make project-specific adjustments to the process. May require special provisions for the storage of process chemicals.	High capital and O&M costs.	No
		Chemical Oxidation	This option involves extraction of groundwater and treatment using oxidizing agents. Oxidizing agents are injected into the groundwater treatment train to oxidize and reduce the mass of dissolved phase organic COCs. Chemical oxidation involves the introduction of chemicals such as ozone, hydrogen peroxide, magnesium peroxide, sodium persulfate, or potassium permanganate. Large amounts of oxidizing agents are needed to oxidize DNAPL.				

Note: Shading indicates that technology process has not been retained for development of a remedial alternative.

Table 4-2
Summary of Groundwater Remedial Alternatives Retained for Detailed Analysis

General Response Action	Technology Type	Technology Process Option	Description of Option	Evaluation Criteria: Implementability	Evaluation Criteria: Effectiveness	Relative Cost	Retained for Further Analysis?
Ex Situ On-Site Treatment (Continued)	Physical Treatment	Adsorption	Extracted groundwater is treated for discharge (to a POTW) by carbon adsorption, which is a process that adsorbs organic COCs to the adsorption media as groundwater is passed through the media. Typical media effective for treatment of MGP-related COCs are activated carbon and organoclay.	Not implementable due to site configuration and use as an active business. Space to store extracted water, perform water treatment and store treated water is limited. Would require a full-time on-site operator to perform the treatment activities. In addition to addressing dissolved phase COCs, the water treatment system would require separation of extracted DNAPL or other oils that may be present in extracted groundwater (and unrelated to the MGP operations). May require special provisions for storage of process chemicals. Solids generated from treatment facility would require off-site disposal.	Effective at removing organic COCs. Use of this treatment process may effectively achieve the RAOs when combined with groundwater extraction. While not effective as a standalone remedy, may be used to support a soil removal remedy through treatment of extracted groundwater prior to discharge to a POTW.	Moderate capital and O&M costs	Yes
		Settling and Filtration	Extracted groundwater is treated for discharge using settling and filtration. Settling includes removal of free product through oil-water separation systems and removal of particulates via flocculation. Filtration is a process by which the groundwater is passed through granular media or filtration fabrics to remove suspended solids and associated contaminants by interception and straining within the filter.				
Off-Site Treatment/ Disposal	Groundwater Disposal	Discharge to a local POTW	Treated water is discharged to a sanitary sewer and treated at a local POTW facility.	Implementable. Equipment and materials necessary to extract, pretreat (if necessary), and discharge the water to the sewer system are readily available. Discharges to the sewer will require a POTW-issued discharge permit. Space to perform water treatment is limited.	Proven process for effectively disposing of groundwater following on-site treatment. Typically requires the least amount of pretreatment because the discharged water will be subjected to additional treatment at the POTW.	Moderate capital costs	Yes

Notes:
COC: constituents of concern
DNAPL: dense nonaqueous phase liquid
MGP: manufactured gas plant
O&M: operation and maintenance
POTW: Publicly Owned Treatment Works
PRB: permeable reactive barrier
RAO: remedial action objective

Note: Shading indicates that technology process has not been retained for development of a remedial alternative.

Table 4-3
Summary of NAPL Remedial Alternatives Retained for Detailed Analysis

General Response Action	Technology Type	Technology Process Option	Description of Option	Evaluation Criteria: Implementability	Evaluation Criteria: Effectiveness	Relative Cost	Retained for Further Analysis?
No Action	No Action	No Action	This alternative would not include any active remedial action. A "No Action" alternative serves as a baseline for comparison of the overall effectiveness of other remedial alternatives. Consideration of a No Action alternative is required by the National Contingency Plan and U.S. Environmental Protection Agency.	Implementable. Because this alternative does not require implementation of any remedial activities, the alternative is technically and administratively implementable.	Not effective. This alternative does not address toxicity, mobility, or volume of MGP-related groundwater impacts and would not meet the RAOs established for the site.	Low	Yes
Institutional Controls	Institutional Controls	Governmental Controls, Proprietary Controls, Enforcement and Permit Controls	Institutional controls would include legal and administrative controls that mitigate the potential for exposure to impacted materials and jeopardization of the integrity of an installed remedy. Examples of potential institutional controls include establishing land use restrictions, health and safety requirements for subsurface activities, and restrictions on groundwater use and extraction.	Implementable. This alternative requires negotiation and agreement with the current property owners.	Effective. This alternative may achieve RAOs when implemented in combination with other technology options.	Low	Yes
In Situ Containment/ Controls	Capping	Soil Cap	This alternative involves placing and compacting soil/gravel material over impacted soil to provide a physical barrier to human and biota exposure to NAPL.	Implementable. Equipment and materials necessary to construct the cap are readily available. A soil cap is only consistent with current and future uses of grassed/vegetated areas of the site.	Not effective. This alternative would not reduce toxicity or volume of impacts or address the potential for migration of NAPLs. Long-term effectiveness requires ongoing maintenance. Surface soils are not impacted with MGP-related waste materials; therefore, capping does not provide additional reductions in the potential for exposure to MPG-related impacts relative to current site conditions.	Moderate capital and O&M costs	No
		Asphalt/Concrete Cap	This alternative involves application of a layer of asphalt or concrete over soil containing NAPL.	Implementable. Equipment and materials necessary to construct the cap are readily available. An asphalt/concrete cap is consistent with current and future uses of roadways and sidewalks at the site.	This alternative may reduce the mobility of NAPL by reducing infiltration, but it would not reduce toxicity or volume of impacts or further migration of NAPLs. Long-term effectiveness requires ongoing maintenance. Surface soils are not impacted with MGP-related waste materials; therefore, capping does not provide additional reductions in the potential for exposure to MPG-related impacts relative to current site conditions.	Moderate capital and O&M costs	No
	Containment	Sheetpile	Steel sheetpiles are driven into the subsurface to prevent the migration of NAPLs. The sheetpile wall is typically keyed into a confining unit.	Potentially implementable. Presence of subsurface fill and shallow depth to till in some areas may make sheetpile installation difficult.	Limited effectiveness. The presence of NAPL in fractured till would limit the effectiveness to prevent migration of NAPL. This technology alone would not address potential exposure to impacted soil and NAPL. Although site-wide containment options are not practical, containment options may be effective when used in targeted areas to prevent NAPL migration upgradient of the barriers (i.e., recontamination of excavated areas) and enhance NAPL collection/recovery.	High capital and low O&M costs	Yes
		Slurry Walls	This alternative involves excavating a trench and adding a slurry (e.g., soil/cement-bentonite mixture) to create a low-permeability barrier wall and prevent the migration of NAPL. Slurry walls are typically keyed into a low-permeability unit (e.g., an underlying silt/clay layer or bedrock).	Potentially implementable. Equipment and materials required to install slurry walls are available. Presence of underground obstructions may hinder technology use. This alternative would require trenching through fill material and obstructions to facilitate installation and may require relocation of utilities that cross the path of the barrier.		Moderate capital and low O&M costs	Yes
		HDPE Liners	HDPE liners are installed or "hung" on the vertical walls of excavation areas to prevent recontamination of clean fill used to backfill excavation areas.	Potentially implementable. Equipment and materials required to install HDPE liners are available. This alternative may require trenching through fill material and obstructions to facilitate installation.		Low capital and O&M costs	Yes

Note: Shading indicates that technology process has not been retained for development of a remedial alternative.

Table 4-3
Summary of NAPL Remedial Alternatives Retained for Detailed Analysis

General Response Action	Technology Type	Technology Process Option	Description of Option	Evaluation Criteria: Implementability	Evaluation Criteria: Effectiveness	Relative Cost	Retained for Further Analysis?
In Situ Treatment	Immobilization	Solidification/Stabilization	This alternative involves addition of material to the impacted soil that limits the solubility and mobility of the NAPL and COCs in soil and groundwater. It also involves treating soil to produce a stable material with low leachability of NAPL and associated COCs.	Not implementable on a large scale. Both the former MGP property and the downgradient area have limited space available for grout/slurry mixing and material handling. Additionally, the presence of subsurface obstructions (i.e., former MGP structures and utilities) further hinders the ability for implementation of this technology process at the former MGP property. NAPL-impacted soil immediately on top of (i.e., within 5 feet) and within the till may not be addressed due to the uneven till surface, density of the till, and density of material immediately above the till (standard penetration test blow counts greater than 30). This alternative is potentially implementable in localized, target areas via jet-grouting.	Limited effectiveness. The overall effectiveness of this process would need to be evaluated during a bench-scale treatability study. In situ solidification and stabilization (ISS) would leave an area/layer of untreated soil on top of and within the till (i.e., where NAPL is believed to be collecting in low areas of the till surface) due to the undulating nature of the top of the till and the density of material immediately above the till and in the till itself. Additionally, unknown changes in the hydrogeology within this area of untreated soil could result in NAPL movement. Jet-grouting could potentially be used to target localized areas of NAPL-impacted soil.	High capital and O&M costs	Yes
	Chemical Treatment	Chemical Oxidation	Oxidizing agents are added to oxidize and reduce the mass of organic constituents. In situ chemical oxidation involves the introduction of chemicals such as ozone, hydrogen peroxide, magnesium peroxide, sodium persulfate, or potassium permanganate.	Technically Implementable. Limited space is available for large quantities of oxidizing agents and equipment. Soil vapor issues are a concern given the proximity to commercial and residential buildings.	Not. effective. This alternative would require multiple treatments of chemicals to reduce COCs. Based on results of pilot testing conducted at other sites, this alternative would not be effective at treating NAPL.	High capital and O&M costs	No
		Surfactant Enhanced Chemical Oxidation	Similar to chemical oxidation, oxidizing agents are added to the subsurface to oxidize and reduce the mass of organic constituents. Unlike chemical oxidation, surfactants are also added to the subsurface to desorb organic constituents from the soil to allow for chemical oxidation in the aqueous phase.	Potentially implementable. The technology is considered innovative and has not been widely used to date. It would require areas to store surfactant and oxidizing chemicals. Soil vapor issues are a concern given the proximity to commercial and residential buildings.	Not effective. This alternative could potentially enhance NAPL mobilization. The technology may not be effective for NAPLs. Soil heterogeneity can cause inadequate contact between the oxidants and contaminants, thereby reducing the effectiveness of the oxidation process.	High capital and O&M costs	No
	Biological Treatment	Biodegradation	This alternative involves natural biological and physical processes that, under favorable conditions, act without human intervention to reduce the mass, volume, concentration, toxicity, and mobility of COCs. This process relies on long-term monitoring to demonstrate the reduction of impacts.	Implementable.	Not effective for NAPLs. This alternative would not achieve RAOs in an acceptable time frame.	Low capital and O&M costs	No
		Enhanced Biodegradation	This alternative involves addition of amendments (e.g., oxygen, nutrients) and controls to the subsurface to enhance indigenous microbial populations to improve the rate of natural degradation.	Implementable.	Not effective for NAPLs. This alternative would not achieve RAOs in an acceptable time frame.	Low capital and O&M costs	No
		Biosparging	Air/oxygen injection wells are installed within the impacted regions to enhance biodegradation of constituents by increasing oxygen availability. Low-flow injection technology may be incorporated. This technology requires long-term monitoring	Technically Implementable. This alternative would require construction and long-term operation of an oxygen applicable system.	Not effective for NAPLs. This alternative would not achieve RAOs in an acceptable time frame.	Low capital and O&M costs	No

Note: Shading indicates that technology process has not been retained for development of a remedial alternative.

Table 4-3
Summary of NAPL Remedial Alternatives Retained for Detailed Analysis

General Response Action	Technology Type	Technology Process Option	Description of Option	Evaluation Criteria		Relative Cost	Retained for Further Analysis?
				Implementability	Effectiveness		
Removal	NAPL Removal	Active Removal	Active removal is the process by which automated pumps are used to remove NAPL from recovery wells.	Technically implementable. Based on the viscosity of NAPL observed during investigation activities, this alternative may have limited effectiveness. A pilot study would be needed to verify the implementability.	May be effective in removing NAPL.	Moderate capital and O&M costs	Yes
		Passive Removal	NAPL is passively collected in vertical wells and periodically removed (i.e., via bottom-loading bailers, manually operated pumps).	Technically implementable. Based on the viscosity of NAPL observed during investigation activities, this alternative may have limited effectiveness. A pilot study would be needed to verify the implementability.	May be effective in removing NAPL.	Moderate capital and O&M costs	Yes
		Collection Trenches/ Passive Barrier Wall	A zone of higher permeability material is installed within a trench hydraulically downgradient from the NAPL-impacted capture area. A perforated collection trench/pipe is placed laterally along the base of the trench or permeable wall to direct NAPL to a collection sump for recovery and disposal.	Equipment and materials to construct a NAPL collection trench are readily available. Limited space is available for large collection trenches/passive barrier walls. This alternative may be implementable for localized areas on the former MGP property or in the downgradient area. Collection trenches cannot be constructed/installed within till at depths where NAPL has been observed.	May be effective in collecting NAPL in alluvium. This alternative would not address NAPL in till.	Moderate capital and high O&M costs	Yes
		Hot Water/Steam Injection	This process involves the injection of hot water or steam to heat groundwater and decrease the viscosity of NAPL to facilitate mobilization and removal. It is used in conjunction with one (or more) of the above recovery technologies.	Technically feasible. Soil vapor issues are a concern given the proximity to commercial and residential buildings.	This process may facilitate uncontrolled migration of NAPL. It would not meet the RAOs as a stand-alone technology. Due to the difficulty of predicting NAPL movement, potentially enhancing NAPL movement poses significant risk.	High capital and high O&M costs	No
Off-Site Treatment/ Disposal	NAPL Disposal	Discharge to a Privately Owned/Commercially Operated Treatment Facility.	NAPL is collected and transported to a privately owned treatment facility. This process option can be used to support long-term technologies (e.g., pump and treat) or short-term activities (e.g., dewatering of the excavation area).	Implementable. Recovered NAPL would not be pre-treated on site.	This is a proven process for effectively disposing of recovered NAPL.	High capital and O&M costs	Yes

Notes:
COC: constituent of concern
HDPE: high-density polyethylene
MGP: manufactured gas plant
NAPL: nonaqueous phase liquid
O&M: operation and maintenance
RAO: Remedial Action Objective

Note: Shading indicates that technology process has not been retained for development of a remedial alternative.

Table 5-1
Cost Estimate for Alternative 2
NAPL Recovery, Groundwater Monitoring, and Institutional Controls

Item No.	Description	Estimated Quantity	Unit	Unit Price	Estimated Cost
Capital					
1	Permitting/Access Agreements	1	LS	$25,000	$25,000
2	Mobilization/Demobilization	1	LS	$12,000	$12,000
3	Construct and Remove Decontamination Pad	1	LS	$5,000	$5,000
4	Utility Mark out and Clearance	3	DAY	$4,000	$12,000
5	Install Groundwater Monitoring Wells	210	VLF	$225	$47,250
6	Install NAPL Collection Wells	390	VLF	$700	$273,000
7	Waste Disposal – Well Installation	1	LS	$45,000	$45,000
8	Site Management Plan	1	LS	$50,000	$50,000
9	Establish Institutional Controls	1	LS	$100,000	$100,000
				Subtotal Capital Cost	$569,250
10	Administration & Engineering (15%)				$78,638
	Construction Management (15%)				$78,638
				Contingency (20%)	$113,850
				Total Capital	$840,375
Operation and Maintenance Costs					
11	Annual Permitting/Access Agreements	1	LS	$15,000	$15,000
12	Annual Verification of Institutional Controls	1	LS	$10,000	$10,000
13	Semi-Annual NAPL Monitoring and Passive Recovery	2	EVENT	$15,000	$30,000
14	Annual Groundwater Sampling	1	EVENT	$25,000	$25,000
15	Laboratory Analysis of Groundwater Samples	28	EACH	$750	$21,000
16	Waste Disposal	8	DRUM	$750	$6,000
17	Annual Summary Report	1	LS	$30,000	$30,000
				Subtotal O&M Cost	$137,000
				Contingency (20%)	$27,400
				Total Annual O&M Cost	$164,400
18	30-Year Total Present Worth Cost of O&M				$2,527,231
				Total Estimated Cost:	**$3,367,606**
				Rounded	**$3,400,000**

General Notes:

1. Cost estimate is based on Anchor QEA Engineering, LLC's (Anchor QEA's) past experience and vendor estimates using 2019 dollars.

2. This estimate has been prepared for the purposes of comparing potential remedial alternatives. The information in this cost estimate is based on the available information regarding the site investigation and the anticipated scope of the remedial alternative. Changes in cost elements are likely to occur as a result of new information and data collected during the engineering design of the remedial alternative. This cost estimate is expected to be within -30% to +50% of the actual projected cost. Utilization of this cost estimate information beyond the stated purpose is not recommended.

3. All costs assume construction field work to be conducted by non-unionized labor.

Assumptions:

1. Permitting/access agreements cost estimate includes all costs necessary to obtain appropriate permits and access agreements to install new groundwater monitoring wells and new NAPL collection wells.

2. Mobilization/demobilization cost estimate includes mobilization and demobilization of all labor, equipment, and materials necessary to install new groundwater and NAPL collection wells.

3. Construct and remove decontamination pad cost estimate includes all labor, equipment, and materials necessary to construct, maintain, and remove a decontamination pad and appurtenances.

4. Utility markout and clearance cost estimate includes all labor, equipment, and materials necessary to identify, markout, and clear (via hand-digging) any underground utilities at the locations of the new groundwater monitoring and NAPL collection wells. Cost assumes that utility location and markout would be conducted by a private utility locating company.

5. Install groundwater monitoring wells cost estimate includes all labor, equipment, and materials necessary to install up to 7 groundwater monitoring wells to an average depth of 30 feet below grade. Cost estimate includes oversight by a geologist, and drill rig and crew. Cost estimate assumes no work stoppages during field work due to weather or other potential delays. Cost estimate assumes 2-inch diameter PVC well construction and wells equipped with sumps.

6. Install NAPL collection wells cost estimate includes all labor, equipment, and materials necessary to install up to 13 NAPL collection wells to an average depth of 30 feet below grade. Cost estimate includes oversight by a geologist, and drill rig and crew. Cost estimate assumes no work stoppages during field work due to weather or other potential delays. Cost estimate assumes 8-inch diameter stainless steel well construction and wells equipped with minimum 5-foot long sumps. Cost estimate assumes wells will not be installed within roadways and local vehicle traffic patterns will not be affected by well installation activities.

7. Waste disposal - well installation cost estimate includes all labor, equipment, and materials necessary to transport and dispose of soil cuttings generated during well installation. Cost assumes all the soil cuttings will be loaded into lined roll- offs and transported for treatment/disposal via LTTD. Cost estimate assumes that approximately 16 tons of material will generated during installation of new NAPL collection and groundwater monitoring wells. Cost estimate includes collection and laboratory analysis of one waste characterization sample. Cost estimate includes disposal fee; transportation fuel surcharge; and environmental, transportation, and spotting fees.

8. Site management plan cost estimate includes all labor necessary to prepare a site management plan to document: the institutional controls that have been established and will be maintained for the site; known locations of soil that contains COCs at concentrations greater than 6 NYCRR Part 375-6 commercial soil cleanup objectives; requirements for notifications of the presence of MGP-related impacts in soil and groundwater that would be provided to those requesting utility clearance for intrusive activities on the former MGP property or in the off-Site area; protocols and requirements for semi-annual NAPL monitoring and annual groundwater monitoring; protocols (including health and safety requirements) for conducting invasive (i.e., subsurface) activities and managing potentially impacted material encountered during these activities; protocols for addressing significant changes in COC concentrations in groundwater based on the results obtained from the annual monitoring activities.

9. Establish institutional controls cost estimate includes all legal expenses to institute environmental easements and deed restrictions for the former MGP property and post office property to control intrusive activities that could result in exposure to impacted soil and groundwater and restrict groundwater use. Institutional controls would also establish requirements for additional investigation activities and/or remedial actions if the automotive repair shops or post office were demolished or the property/building use changes. Such institutional controls may include governmental controls, proprietary controls, enforcement tools, and/or informational devices.

10. Administration and engineering and construction management costs are based on an assumed 15% of the total capital costs, not including costs for offsite transportation and treatment/disposal of excavated material.

11. Annual permitting/access agreements cost estimate includes all costs necessary to obtain appropriate permits and access agreements to conduct annual groundwater monitoring and semi-annual NAPL monitoring activities.

12. Annual verification of institutional controls cost estimate includes administrative costs for confirming institutional controls to minimize the potential for human exposure to site soil and groundwater are present. Annual costs associated with institutional controls include verifying the status of institutional controls and preparing/submitting notification to the NYSDEC to demonstrate that the institutional controls are being maintained and remain effective.

13. Semi-annual NAPL monitoring and passive recovery cost estimate includes all labor, equipment, and materials necessary to conduct semi-annual NAPL monitoring at up to 13 wells. Cost estimate includes passive NAPL recovery via manual bailing or a portable peristaltic pump. Cost estimate assumes two workers will require one day to complete monitoring and recovery per event. Estimate includes field vehicle and equipment.

14. Annual groundwater sampling cost estimate includes all labor, equipment, and materials necessary to conduct annual groundwater sampling activities. Cost estimate assumes groundwater samples will be collected from up to 22 existing and newly installed groundwater monitoring wells using low-flow sampling procedures. Cost estimate assumes two workers will require 8 days to complete the sampling activities. Estimate includes labor, field vehicle, lodging, subsistence, and equipment rental.

15. Laboratory analysis of groundwater samples cost estimate includes the analysis of groundwater samples for BTEX, PAHs, and cyanide. Estimate assumes laboratory analysis of groundwater samples from up to 22 existing and newly installed groundwater monitoring wells and up to 6 QA/QC samples per sampling event.

16. Waste disposal cost estimate includes off-site disposal of drummed PPE, disposable sampling equipment, purge water, and NAPL generated/collected during semi-annual NAPL and annual groundwater monitoring activities.

17. Annual summary report cost estimate includes all labor necessary to prepare an annual report summarizing semi-annual NAPL and annual groundwater monitoring activities and results. Annual report to be submitted to NYSDEC.

18. Present worth is estimated based on a 5% beginning-of-year discount rate (adjusted for inflation). It is assumed that "year zero" is 2019.

Abbreviations:
BTEX: benzene, toluene, ethylbenzene, and xylenes
COC: constituent of concern
LS: lump sum
LTTD: low-temperature thermal desorption
MGP: manufactured gas plant
NAPL: nonaqueous phase liquid
NYCRR: New York Codes, Rules and Regulations
NYSDEC: New York State Department of Environmental Conservation
O&M: operation and maintenance
PAH: polycyclic aromatic hydrocarbon
PPE: personal protective equipment
QA/QC: quality assurance/quality control
VLF: vertical linear foot

Table 5-2

Cost Estimate for Alternative 3

Utility Corridor Soil Removal, NAPL Recovery, Groundwater Monitoring, and Institutional Controls

Item #	Description	Estimated Quantity	Unit	Unit Price	Estimated Cost
Capital Costs					
1	Permitting/Access Agreements	1	LS	$60,000	$60,000
2	Temporary Property Rental	1	LS	$210,000	$210,000
3	Mobilization/Demobilization	1	LS	$300,000	$300,000
4	Temporary Site Fencing	700	LF	$50	$35,000
5	Erosion and Sedimentation Control	1,000	LF	$8	$8,000
6	Construct and Remove Decontamination Pad	1	LS	$10,000	$10,000
7	Utility Mark out and Clearance	5	DAY	$4,000	$20,000
8	Traffic Control and Diversion	12	WEEK	$8,000	$96,000
9	Open Span Structure	1	LS	$310,000	$310,000
	Air Treatment	1	LS	$230,000	$230,000
10	Install and Remove Temporary Sheetpile	6,500	VSF	$70	$455,000
	Internal Bracing and Support	1	LS	$60,000	$60,000
11	Temporary Groundwater Treatment System	2	MONTH	$75,000	$150,000
12	Utility Bypass/Relocation	1	LS	$1,000,000	$1,000,000
13	Soil Excavation and Handling	1,700	CY	$60	$102,000
14	Stabilization Admixture	120	TON	$120	$14,400
15	Community Air Monitoring and Vapor/Odor Control	12	WEEK	$4,000	$48,000
16	Demarcation Layer	1,200	SY	$6	$7,200
17	HDPE Liner	150	SY	$20	$3,000
18	General Fill	1,600	CY	$45	$72,000
19	Surface Restoration	4,500	SF	$6	$27,000
20	Solid Waste Characterization	6	EACH	$1,200	$7,200
21	Solid Waste Transportation and Disposal - C&D Debris	600	TON	$90	$54,000
22	Solid Waste Transportation and Disposal - LTTD	2,200	TON	$140	$308,000
23	Install Groundwater Monitoring Wells	210	VLF	$225	$47,250
24	Install NAPL Collection Wells	390	VLF	$700	$273,000
25	Site Management Plan	1	LS	$50,000	$50,000
26	Establish Institutional Controls	1	LS	$100,000	$100,000
	Subtotal Capital Cost				$4,057,050
27	Administration & Engineering (15%)				$554,258
	Construction Management (15%)				$554,258
	Contingency (20%)				$811,410
	Total Capital Cost				$5,976,975
Operation and Maintenance Costs					
28	Annual Permitting/Access Agreements	1	LS	$15,000	$15,000
29	Annual Verification of Institutional Controls	1	LS	$10,000	$10,000
30	Semi-Annual NAPL Monitoring and Passive Recovery	2	EVENT	$15,000	$30,000
31	Annual Groundwater Sampling	1	EVENT	$25,000	$25,000
32	Laboratory Analysis of Groundwater Samples	28	EACH	$750	$21,000
33	Waste Disposal	8	DRUM	$750	$6,000
34	Annual Summary Report	1	LS	$30,000	$30,000
	Subtotal O&M Cost				$137,000
	Contingency (20%)				$27,400
	Total Annual O&M Cost				$164,400
35	30-Year Total Present Worth Cost of O&M				$2,527,231
	Total Estimated Cost				**$8,504,206**
	Rounded To				**$8,500,000**

General Notes:

1. Cost estimate is based on Anchor QEA Engineering, LLC's (Anchor QEA's) past experience and vendor estimates using 2019 dollars.
2. This estimate has been prepared for the purposes of comparing potential remedial alternatives. The information in this cost estimate is based on the available information regarding the site investigation and the anticipated scope of the remedial alternative. Changes in cost elements are likely to occur as a result of new information and data collected during the engineering design of the remedial alternative. With the exception of Items 2 and 12, this cost estimate is expected to be within -30% to +50% of the actual projected cost. Utilization of this cost estimate information beyond the stated purpose is not recommended.
3. All costs assume construction field work to be conducted by non-unionized labor.

Assumptions:

1. Permitting/access agreements cost estimate includes all costs necessary to obtain appropriate permits and access agreements to complete the remedial construction activities associated with this alternative.
2. Temporary property rental cost estimate includes costs associated with a 12 month lease of the existing automotive repair shop on the western side of the former MGP property, 12 month lease of a similar building for the displaced automotive business, and moving expenses. Anchor QEA does not certify that cost estimate for property rental will be within -30% to +50% during time of remedial construction.
3. Mobilization/demobilization cost estimate includes mobilization and demobilization of labor, equipment, and materials necessary to conduct the remedial construction activities associated with this alternative.
4. Temporary site fencing cost estimate includes all labor, equipment, and materials necessary to purchase, install, and remove concrete jersey barriers equipped with six-foot tall woven steel chain link fence and barbed wire to secure the project site.
5. Erosion and sedimentation control cost estimate includes all labor, equipment and materials necessary for placement/maintenance of staked hay bales or silt fence around project work limits and material staging areas.
6. Construct and remove decontamination pad cost estimate includes all labor, equipment, and materials necessary to construct, maintain, and remove a decontamination pad and appurtenances.
7. Utility markout and clearance cost estimate includes all labor, equipment, and materials necessary to identify, markout, and clear (via hand-digging) any underground utilities at excavation areas and the locations of the new groundwater monitoring and NAPL collection wells. Cost assumes that utility location and markout would be conducted by a private utility locating company.
8. Traffic control and diversion cost estimate includes all labor, equipment, and materials necessary to establish and maintain road closures to facilitate completion of remedial activities. Cost estimate includes rental of light arrows, signs, barricades, and drums/cones to close Fulton Street between Canal Street and South Street and Canal Street during excavation and backfilling activities within Fulton Street.
9. Open span structure and air treatment cost estimate includes rental of an approximately 100-foot by 75-foot Sprung structure to enclose excavation areas on the former MGP property. Estimate assumes lease costs of approximately $28 per square-foot and construction cost of approximately $12 per square-foot. Cost estimate assumes structure is equipped with overheard doors for truck and excavator access. Final structure construction details to be determined as part of the Remedial Design. Air treatment cost estimate includes rental of vapor treatment system to collect and treat air within the excavation enclosure. Cost estimate includes lease of all vapor collection and treatment equipment, delivery and set-up fees, and filter media change out. Cost estimate assumes structure will be moved once during excavation activities at assumed cost of $10,000 per move. Cost estimate assumes maximum 6-month rental of open span structure and air treatment system.
10. Install and remove temporary sheet pile cost estimate includes all labor, equipment, and materials necessary to install, remove, and decontaminate temporary steel sheet pile. Cost estimate assumes sheet pile will be installed at an average depth of 18 feet below grade within the utility corridor. Cost estimate includes internal bracing and lateral supports. Estimate includes increased cost for pre-trenching for removal of subsurface obstructions when encountered. Sheet pile to be removed following site restoration activities. Final excavation support system to be determined as part of the Remedial Design.
11. Temporary groundwater treatment system cost estimate includes installation of sumps within excavation areas and rental of a portable water treatment system capable of operating at 75 gallons-per-minute. Cost estimate assumes water treatment system includes pumps, influent piping and hoses, frac tanks, carbon filters, bag filters, discharge piping and hoses, and flow meter. Estimate assumes treated water would be discharge to a local POTW sanitary sewer under a local discharge permit at no additional cost.
12. Utility bypass/relocation cost estimate includes all labor, equipment, and materials necessary to temporarily bypass or relocate underground and overhead utilities to facilitate remedial construction activities. Cost estimate assumes that overhead utilities consisting of electric and telephone services would be relocated to the south side of Fulton Street between Canal and South Streets. Cost estimate assumes that underground utilities consisting of water, storm water, and gas lines would be temporarily bypassed and replaced at their current location as part of site restoration activities. As the scope of the bypass/relocation activities cannot be assessed at this time, estimated cost is not certified to be with -30% to +50% of the actual cost
13. Soil excavation and handling includes all labor, equipment, and materials necessary to address NAPL-impacted soil and portions of former MGP structures in the utility corridor extending beneath the westbound lanes of Fulton Street at a depth up to 10 feet below grade. Cost estimate is based on in-place soil volume.
14. Stabilization admixture cost estimate includes the purchase and importation of stabilizing agents to amend material excavated from below the water table. Cost estimate assumes stabilization admixture (e.g., Portland cement) will be added at ratio of 10% of the volume of material to be stabilized. Cost estimate assumes that any water generated in association with soil management will be treated by the temporary water treatment system.
15. Community air monitoring and vapor/odor control cost estimate includes all labor, equipment, and materials necessary to monitor vapor/odor emission during intrusive site activities using AirLogics-type monitoring system and applying vapor/odor suppressing foam to open excavations.
16. Demarcation layer cost estimate includes all labor, equipment, and materials necessary to place a woven, light-weight, non-biodegradable, high-visibility demarcation layer within soil excavation area footprints and along the side walls.

17. HDPE liner cost estimate includes all labor, equipment, and materials necessary to install HDPE liner along the upgradient edge of the utility corridor excavation area to minimize the potential for recontamination of backfill material from residual MGP-related impacts that would remain upgradient of the excavation area.

18. General fill cost estimate includes all labor, equipment, and materials necessary to import, place, grade and compact general fill in excavation areas to within 6 inches of the surrounding grade. Cost estimate is based on in-place soil volume. Cost estimate assumes 95% compaction based on standard proctor testing and includes survey verification and compaction testing.

19. Surface restoration cost estimate includes all labor, equipment, and material necessary to restore surfaces disturbed during remedial activities in kind. Final surface restorations include 6-inch layer of asphalt pavement, vegetated topsoil, and/or concrete sidewalk.

20. Solid waste characterization cost estimate includes the analysis of soil samples (including, but not limited to, PCBs, VOCs, SVOCs, and RCRA Metals). Costs assumes that waste characterization samples would be collected at a frequency of one sample per every 500 tons of material destined for off-site treatment/disposal.

21. Solid waste transportation and disposal - C&D debris cost estimate includes all labor, equipment, and materials necessary to transport and dispose of excavated surface material (e.g., pavement, concrete, gravel sub-base) as construction and demolition debris. Costs assume excavated material from 0 to 2 feet below grade at the utility corridor would be transported off-site for disposal as C&D debris at an assumed density of 1.75 tons per cubic-yard. Cost estimate includes disposal fee; transportation fuel surcharge; and environmental, transportation, and spotting fees. Cost estimate assumes that no material will be recycled or reused.

22. Solid waste transportation and disposal - LTTD cost estimate includes all labor, equipment, and materials necessary to transport and thermally treat excavated soil exhibiting toxicity characteristic for benzene at a thermal treatment facility. Cost assumes excavated soil from 2 to 10 feet below grade at the utility corridor plus stabilization mixture will be treated/disposed of via LTTD at an estimated density of 1.5 tons per cubic-yard. Cost estimate also assumes soil cuttings generated during well installation activities will be treated/disposed of via LTTD. Cost estimate includes treatment fee, transportation fuel surcharge, and spotting fees. Cost estimate assumes thermally treated soil does not require subsequent treatment or disposal.

23. Install groundwater monitoring wells cost estimate includes all labor, equipment, and materials necessary to install up to 7 groundwater monitoring wells to an average depth of 30 feet below grade. Cost estimate includes oversight by a geologist, and drill rig and crew. Cost estimate assumes no work stoppages during field work due to weather or other potential delays. Cost estimate assumes 2-inch diameter PVC well construction and wells equipped with sumps.

24. Install NAPL collection wells cost estimate includes all labor, equipment, and materials necessary to install up to 13 NAPL collection wells to an average depth of 30 feet below grade. Cost estimate includes oversight by a geologist, and drill rig and crew. Cost estimate assumes no work stoppages during field work due to weather or other potential delays. Cost estimate assumes 8-inch diameter stainless steel well construction and wells equipped with minimum 5-foot long sumps. Cost estimate assumes wells will not be installed within roadways and local vehicle traffic patterns will not be affected by well installation activities.

25. Site management plan cost estimate includes all labor necessary to prepare a site management plan to document: the institutional controls that have been established and will be maintained for the site; known locations of remaining soil that contains COCs at concentrations greater than 6 NYCRR Part 375-6 commercial soil cleanup objectives; requirements for notifications of the presence of MGP-related impacts in soil and groundwater that would be provided to those requesting utility clearance for intrusive activities on the former MGP property or in the off-Site area; protocols and requirements for semi-annual NAPL monitoring and annual groundwater monitoring; protocols (including health and safety requirements) for conducting invasive (i.e., subsurface) activities and managing potentially impacted material encountered during these activities; and protocols for addressing significant changes in COC concentrations in groundwater based on the results obtained from the annual monitoring activities.

26. Establish institutional controls cost estimate includes all legal expenses to institute environmental easements and deed restrictions for the former MGP property and post office property to control intrusive activities that could result in exposure to impacted soil and groundwater and restrict groundwater use. Institutional controls would also establish requirements for additional investigation activities and/or remedial actions if the automotive repair shops or post office were demolished or the property/building use changes. Such institutional controls may include governmental controls, proprietary controls, enforcement tools, and/or informational devices. Estimate does not include potential costs associated with compensation of property owners for easements/deed restrictions.

27. Administration and engineering and construction management costs are based on an assumed 15% of the total capital costs, not including costs for offsite transportation and treatment/disposal of excavated material.

28. Annual permitting/access agreements cost estimate includes all costs necessary to obtain appropriate permits and access agreements to conduct annual groundwater monitoring and semi-annual NAPL monitoring activities.

29. Annual verification of institutional controls cost estimate includes administrative costs for confirming institutional controls to minimize the potential for human exposure to site soil and groundwater are present. Annual costs associated with institutional controls include verifying the status of institutional controls and preparing/submitting notification to the NYSDEC to demonstrate that the institutional controls are being maintained and remain effective.

30. Semi-annual NAPL monitoring and passive recovery cost estimate includes all labor, equipment, and materials necessary to conduct semi-annual NAPL monitoring at up to 13 wells. Cost estimate includes passive NAPL recovery via manual bailing or a portable peristaltic pump. Cost estimate assumes two workers will require one day to complete monitoring and recovery per event. Estimate includes field vehicle and equipment.

31. Annual groundwater sampling cost estimate includes all labor, equipment, and materials necessary to conduct annual groundwater sampling activities. Cost estimate assumes groundwater samples will be collected from up to 22 existing and newly installed groundwater monitoring wells using low-flow sampling procedures. Cost estimate assumes two workers will require 8 days to complete the sampling activities. Estimate includes labor, field vehicle, lodging, subsistence, and equipment rental.

32. Laboratory analysis of groundwater samples cost estimate includes the analysis of groundwater samples for BTEX, PAHs, and cyanide. Estimate assumes laboratory analysis of groundwater samples from up to 22 existing and newly installed groundwater monitoring wells and up to 6 QA/QC samples per sampling event.

33. Waste disposal cost estimate includes off-site disposal of drummed PPE, disposable sampling equipment, purge water, and NAPL generated/collected during semi-annual NAPL and annual groundwater monitoring activities.

34. Annual summary report cost estimate includes all labor necessary to prepare an annual report summarizing semi-annual NAPL and annual groundwater monitoring activities and results. Annual report to be submitted to NYSDEC.

35. Present worth is estimated based on a 5% beginning-of-year discount rate (adjusted for inflation). It is assumed that "year zero" is 2019.

Abbreviations:

BTEX: benzene, toluene, ethylbenzene, and xylenes
C&D: construction and demolition
COC: constituent of concern
CY: cubic yard
HDPE: high-density polyethylene
LF: linear foot
LS: lump sum
LTTD: low-temperature thermal desorption
MGP: manufactured gas plant
NAPL: nonaqueous phase liquid
NYCRR: New York Codes, Rules and Regulations
NYSDEC: New York State Department of Environmental Conservation
O&M: operation and maintenance
PAH: polycyclic aromatic hydrocarbon
PCB: polychlorinated biphenyl
POTW: Publicly Owned Treatment Works
QA/QC: quality assurance/quality control
RCRA: Resource Conservation and Recovery Act
SF: square foot
SVOC: semivolatile organic compound
SY: square yard
VLF: vertical linear foot
VOC: volatile organic compound
VSF: vertical square foot

Table 5-3

Cost Estimate for Alternative 4

Shallow Soil Removal at the Former MGP Property, NAPL Recovery, Groundwater Monitoring, and Institutional Controls

Item #	Description	Estimated Quantity	Unit	Unit Price	Estimated Cost
Capital Costs					
1	Permitting/Access Agreements	1	LS	$60,000	$60,000
2	Temporary Property Rental	1	LS	$210,000	$210,000
3	Mobilization/Demobilization	1	LS	$400,000	$400,000
4	Temporary Site Fencing	900	LF	$50	$45,000
5	Erosion and Sedimentation Control	1,200	LF	$8	$9,600
6	Construct and Remove Decontamination Pad	1	LS	$10,000	$10,000
7	Utility Mark out and Clearance	5	DAY	$4,000	$20,000
8	Traffic Control and Diversion	22	WEEK	$8,000	$176,000
9	Open Span Structure	1	LS	$330,000	$330,000
	Air Treatment	1	LS	$230,000	$230,000
10	Install and Remove Temporary Sheetpile	11,800	VSF	$70	$826,000
	Internal Bracing and Support	1	LS	$115,000	$115,000
11	Temporary Groundwater Treatment System	3	MONTH	$75,000	$225,000
12	Utility Bypass/Relocation	1	LS	$1,000,000	$1,000,000
13	Soil Excavation and Handling	3,400	CY	$60	$204,000
14	Stabilization Admixture	260	TON	$120	$31,200
15	Community Air Monitoring and Vapor/Odor Control	22	WEEK	$4,000	$88,000
16	Demarcation Layer	1,700	SY	$6	$10,200
17	HDPE Liner	220	SY	$20	$4,400
18	General Fill	3,200	CY	$45	$144,000
19	Surface Restoration	9,000	SF	$6	$54,000
20	Solid Waste Characterization	11	EACH	$1,200	$13,200
21	Solid Waste Transportation and Disposal - C&D Debris	1,200	TON	$90	$108,000
22	Solid Waste Transportation and Disposal - LTTD	4,300	TON	$140	$602,000
23	Install Groundwater Monitoring Wells	210	VLF	$225	$47,250
24	Install NAPL Collection Wells	390	VLF	$700	$273,000
25	Site Management Plan	1	LS	$50,000	$50,000
26	Establish Institutional Controls	1	LS	$100,000	$100,000
				Subtotal Capital Cost	$5,385,850
27				Administration & Engineering (15%)	$701,378
				Construction Management (15%)	$701,378
				Contingency (20%)	$1,077,170
				Total Capital Cost	$7,865,775
Operation and Maintenance Costs					
28	Annual Permitting/Access Agreements	1	LS	$15,000	$15,000
29	Annual Verification of Institutional Controls	1	LS	$10,000	$10,000
30	Semi-Annual NAPL Monitoring and Passive Recovery	2	EVENT	$15,000	$30,000
31	Annual Groundwater Sampling	1	EVENT	$25,000	$25,000
32	Laboratory Analysis of Groundwater Samples	28	EACH	$750	$21,000
33	Waste Disposal	8	DRUM	$750	$6,000
34	Annual Summary Report	1	LS	$30,000	$30,000
				Subtotal O&M Cost	$137,000
				Contingency (20%)	$27,400
				Total Annual O&M Cost	$164,400
35				30-Year Total Present Worth Cost of O&M	$2,527,231
				Total Estimated Cost	**$10,393,006**
				Rounded To	**$10,400,000**

Table 5-3
Cost Estimate for Alternative 4
Shallow Soil Removal at the Former MGP Property, NAPL Recovery, Groundwater Monitoring, and Institutional Controls

General Notes:

1. Cost estimate is based on Anchor QEA Engineering, PLLC's (Anchor QEA's) past experience and vendor estimates using 2019 dollars.

2. This estimate has been prepared for the purposes of comparing potential remedial alternatives. The information in this cost estimate is based on the available information regarding the site investigation and the anticipated scope of the remedial alternative. Changes in cost elements are likely to occur as a result of new information and data collected during the engineering design of the remedial alternative. With the exception of Items 2 and 12, this cost estimate is expected to be within -30% to +50% of the actual projected cost. Utilization of this cost estimate information beyond the stated purpose is not recommended.

3. All costs assume construction field work to be conducted by non-unionized labor.

Assumptions:

1. Permitting/access agreements cost estimate includes all costs necessary to obtain appropriate permits and access agreements to complete the remedial construction activities associated with this alternative.

2. Temporary property rental cost estimate includes costs associated with a 12 month lease of the existing automotive repair shop on the western side of the former MGP property, 12 month lease of a similar building for the displaced automotive business, and moving expenses. Anchor QEA does not certify that cost estimate will be within -30% to +50% during time of remedial construction.

3. Mobilization/demobilization cost estimate includes mobilization and demobilization of labor, equipment, and materials necessary to conduct the remedial construction activities associated with this alternative.

4. Temporary site fencing cost estimate includes all labor, equipment, and materials necessary to purchase, install, and remove concrete jersey barriers equipped with six-foot tall woven steel chain link fence and barbed wire to secure the project site.

5. Erosion and sedimentation control cost estimate includes all labor, equipment, and material necessary for placement/maintenance of staked hay bales or silt fence around project work limits and material staging areas.

6. Construct and remove decontamination pad cost estimate includes all labor, equipment, and materials necessary to construct, maintain, and remove a decontamination pad and appurtenances.

7. Utility markout and clearance cost estimate includes all labor, equipment, and materials necessary to identify, markout, and clear (via hand-digging) any underground utilities at excavation areas and the locations of the new groundwater monitoring and NAPL collection wells. Cost assumes that utility location and markout would be conducted by a private utility locating company.

8. Traffic control and diversion cost estimate includes all labor, equipment, and materials necessary to establish and maintain road closures to facilitate completion of remedial activities. Cost estimate includes rental of light arrows, signs, barricades, and drums/cones to close Fulton Street between Canal Street and South Street and Canal Street near Fulton Street during excavation and backfilling activities within Fulton Street and at the former MGP property.

9. Open span structure and air treatment cost estimate includes rental of an approximately 100-foot by 75-foot Sprung structure to enclose excavation areas on the former MGP property. Estimate assumes lease costs of approximately $28 per square-foot and construction cost of approximately $12 per square-foot. Cost estimate assumes structure is equipped with overheard doors for truck and excavator access. Final structure construction details to be determined as part of the Remedial Design. Air treatment cost estimate includes rental of vapor treatment system to collect and treat air within the excavation enclosure. Cost estimate includes lease of all vapor collection and treatment equipment, delivery and set-up fees, and filter media change out. Cost estimate assumes structure will be moved three times during excavation activities at assumed cost of $10,000 per move. Cost estimate assumes maximum 6-month rental of open span structure and air treatment system.

10. Install and remove temporary sheet pile cost estimate includes all labor, equipment, and materials necessary to install, remove, and decontaminate temporary steel sheet pile. Cost estimate assumes sheet pile will be installed at an average depth of 18 feet below grade within the utility corridor and at an average depth of 20 feet below grade on the former MGP property. Cost estimate includes internal bracing and lateral supports. Estimate includes increased cost for pre-trenching for removal of subsurface obstructions when encountered. Sheet pile to be removed following site restoration activities. Final excavation support system to be determined as part of the Remedial Design.

Table 5-3
Cost Estimate for Alternative 4
Shallow Soil Removal at the Former MGP Property, NAPL Recovery, Groundwater Monitoring, and Institutional Controls

11. Temporary groundwater treatment system cost estimate includes installation of sumps within excavation areas and rental of a portable water treatment system capable of operating at 75 gallons-per-minute. Cost estimate assumes water treatment system includes pumps, influent piping and hoses, frac tanks, carbon filters, bag filters, discharge piping and hoses, and flow meter. Estimate assumes treated water would be discharge to a local POTW sanitary sewer under a local discharge permit at no additional cost.

12. Utility bypass/relocation cost estimate includes all labor, equipment, and materials necessary to temporarily bypass or relocate underground and overhead utilities to facilitate remedial construction activities. Cost estimate assumes that overhead utilities consisting of electric and telephone services would be relocated to the south side of Fulton Street between Canal and South Streets. Cost estimate assumes that underground utilities consisting of water, storm, gas lines would be temporary bypassed and replaced are their current location. As the scope of the bypass/relocation activities cannot be assessed at this time, estimated cost is not certified to be with -30% to +50% of the actual cost.

13. Soil excavation and handling includes all labor, equipment, and materials necessary to address NAPL-impacted soil and portions of former MGP structures in the utility corridor and accessible NAPL-impacted soil at the former MGP property at a depth up to 20 feet below grade. Cost estimate is based on in-place soil volume.

14. Stabilization admixture cost estimate includes the purchase and importation of stabilizing agents to amend material excavated from the below the water table. Cost estimate assumes stabilization admixture (e.g., Portland cement) will be added at ratio of 10% of the volume of material to be stabilized. Cost estimate assumes that any water generated in association with soil management will be treated by the temporary water treatment system.

15. Community air monitoring and vapor/odor control cost estimate includes all labor, equipment, and materials necessary to monitor vapor/odor emission during intrusive site activities using AirLogics-type monitoring system and applying vapor/odor suppressing foam to open excavations.

16. Demarcation layer cost estimate includes all labor, equipment, and materials necessary to place a woven, light-weight, non-biodegradable, high-visibility demarcation layer within soil excavation area footprints and along the side walls.

17. HDPE liner cost estimate includes all labor, equipment, and material necessary to install HDPE liner along the upgradient edge of the utility corridor excavation area to minimize the potential for recontamination of backfill material from residual MGP-related impacts that would remain upgradient of the excavation area.

18. General fill cost estimate includes all labor, equipment, and materials necessary to import, place, grade and compact general fill in excavation areas to within 6 inches of the surrounding grade. Cost estimate is based on in-place soil volume. Cost estimate assumes 95% compaction based on standard proctor testing and includes survey verification and compaction testing.

19. Surface restoration cost estimate includes all labor, equipment, and material necessary to restore surfaces disturbed during remedial activities in kind. Final surface restorations include 6-inch layer of asphalt pavement, vegetated topsoil, and/or concrete sidewalk.

20. Solid waste characterization cost estimate includes the analysis of soil samples (including, but not limited to, PCBs, VOCs, SVOCs, and RCRA Metals). Costs assumes that waste characterization samples would be collected at a frequency of one sample per every 500 tons of material destined for off-site treatment/disposal.

21. Solid waste transportation and disposal - C&D debris cost estimate includes all labor, equipment, and materials necessary to transport and dispose of excavated surface material (e.g., pavement, concrete, gravel sub-base) as construction and demolition debris. Costs assume excavated material from 0 to 2 feet below grade at the utility corridor and former MGP property would be transported off-site for disposal as C&D debris at an assumed density of 1.75 tons per cubic-yard. Cost estimate includes disposal fee; transportation fuel surcharge; and environmental, transportation, and spotting fees. Cost estimate assumes that no material will be recycled or reused.

22. Solid waste transportation and disposal - LTTD cost estimate includes all labor, equipment, and materials necessary to transport and thermally treat excavated soil exhibiting toxicity characteristic for benzene at a thermal treatment facility. Cost assumes excavated soil from 5 to 10 feet below grade at the utility corridor and former MGP property plus stabilization mixture will be treated/disposed of via LTTD at an estimated density of 1.5 tons per cubic-yard. Cost estimate also assumes soil cuttings generated during well installation activities will be treated/disposed of via LTTD. Cost estimate includes treatment fee, transportation fuel surcharge, and spotting fees. Cost estimate assumes thermally treated soil does not require subsequent treatment or disposal.

Table 5-3
Cost Estimate for Alternative 4
Shallow Soil Removal at the Former MGP Property, NAPL Recovery, Groundwater Monitoring, and Institutional Controls

23. Install groundwater monitoring wells cost estimate includes all labor, equipment, and materials necessary to install up to 7 groundwater monitoring wells to an average depth of 30 feet below grade. Cost estimate includes oversight by a geologist, and drill rig and crew. Cost estimate assumes no work stoppages during field work due to weather or other potential delays. Cost estimate assumes 2-inch diameter PVC well construction and wells equipped with sumps.

24. Install NAPL collection wells cost estimate includes all labor, equipment, and materials necessary to install up to 13 NAPL collection wells to an average depth of 30 feet below grade. Cost estimate includes oversight by a geologist, and drill rig and crew. Cost estimate assumes no work stoppages during field work due to weather or other potential delays. Cost estimate assumes 8-inch diameter stainless steel well construction and wells equipped with minimum 5-foot long sumps. Cost estimate assumes wells will not be installed within roadways and local vehicle traffic patterns will not be affected by well installation activities.

25. Site management plan cost estimate includes all labor necessary to prepare a site management plan to document: the institutional controls that have been established and will be maintained for the site; known locations of remaining soil that contains COCs at concentrations greater than 6 NYCRR Part 375-6 commercial soil cleanup objectives; requirements for notifications of the presence of MGP-related impacts in soil and groundwater that would be provided to those requesting utility clearance for intrusive activities on the former MGP property or in the off-Site area; protocols and requirements for semi-annual NAPL monitoring and annual groundwater monitoring; protocols (including health and safety requirements) for conducting invasive (i.e., subsurface) activities and managing potentially impacted material encountered during these activities; and protocols for addressing significant changes in COC concentrations in groundwater based on the results obtained from the annual monitoring activities.

26. Establish institutional controls cost estimate includes all legal expenses to institute environmental easements and deed restrictions for the former MGP property and post office property to control intrusive activities that could result in exposure to impacted soil and groundwater and restrict groundwater use. Institutional controls would also establish requirements for additional investigation activities and/or remedial actions if the automotive repair shops or post office were demolished or the property/building use changes. Such institutional controls may include governmental controls, proprietary controls, enforcement tools, and/or informational devices. Estimate does not include potential costs associated with compensation of property owners for easements/deed restrictions.

27. Administration and engineering and construction management costs are based on an assumed 15% of the total capital costs, not including costs for offsite transportation and treatment/disposal of excavated material.

28. Annual permitting/access agreements cost estimate includes all costs necessary to obtain appropriate permits and access agreements to conduct annual groundwater monitoring and semi-annual NAPL monitoring activities.

29. Annual verification of institutional controls cost estimate includes administrative costs for confirming institutional controls to minimize the potential for human exposure to site soil and groundwater are present. Annual costs associated with institutional controls include verifying the status of institutional controls and preparing/submitting notification to the NYSDEC to demonstrate that the institutional controls are being maintained and remain effective.

30. Semi-annual NAPL monitoring and passive recovery cost estimate includes all labor, equipment, and materials necessary to conduct semi-annual NAPL monitoring at up to 13 wells. Cost estimate includes passive NAPL recovery via manual bailing or a portable peristaltic pump. Cost estimate assumes two workers will require one day to complete monitoring and recovery per event. Estimate includes field vehicle and equipment.

31. Annual groundwater sampling cost estimate includes all labor, equipment, and materials necessary to conduct annual groundwater sampling activities. Cost estimate assumes groundwater samples will be collected from up to 22 existing and newly installed groundwater monitoring wells using low-flow sampling procedures. Cost estimate assumes two workers will require 8 days to complete the sampling activities. Estimate includes labor, field vehicle, lodging, subsistence, and equipment rental.

32. Laboratory analysis of groundwater samples cost estimate includes the analysis of groundwater samples for BTEX, PAHs, and cyanide. Estimate assumes laboratory analysis of groundwater samples from up to 22 existing and newly installed groundwater monitoring wells and up to 6 QA/QC samples per sampling event.

33. Waste disposal cost estimate includes off-site disposal of drummed PPE, disposable sampling equipment, purge water, and NAPL generated/collected during semi-annual NAPL and annual groundwater monitoring activities.

34. Annual summary report cost estimate includes all labor necessary to prepare an annual report summarizing semi-annual NAPL and annual groundwater monitoring activities and results. Annual report to be submitted to NYSDEC.

35. Present worth is estimated based on a 5% beginning-of-year discount rate (adjusted for inflation). It is assumed that "year zero" is 2019.

Table 5-3
Cost Estimate for Alternative 4
Shallow Soil Removal at the Former MGP Property, NAPL Recovery, Groundwater Monitoring, and Institutional Controls

Abbreviations
BTEX: benzene, toluene, ethylbenzene, and xylenes
C&D: construction and demolition
COC: constituent of concern
CY: cubic yard
HDPE: high-density polyethylene
LF: linear foot
LS: lump sum
LTTD: low-temperature thermal desorption
MGP: manufactured gas plant
NAPL: nonaqueous phase liquid
NYCRR: New York Codes, Rules and Regulations
NYSDEC: New York State Department of Environmental Conservation
O&M: operation and maintenance
PAH: polycyclic aromatic hydrocarbon
PCB: polychlorinated biphenyl
POTW: Publicly Owned Treatment Works
QA/QC: quality assurance/quality control
RCRA: Resource Conservation and Recovery Act
SF: square foot
SVOC: semivolatile organic compound
SY: square yard
VLF: vertical linear foot
VOC: volatile organic compound
VSF: vertical square foot

Table 5-4

Cost Estimate Alternative 5

Targeted Soil Removal at the Former MGP Property, NAPL Recovery, Groundwater Monitoring, and Institutional Controls

Item #	Description	Estimated Quantity	Unit	Unit Price	Estimated Cost
Capital Costs					
1	Permitting/Access Agreements	1	LS	$60,000	$60,000
2	Temporary Property Rental	1	LS	$50,000	$50,000
3	Mobilization/Demobilization	1	LS	$50,000	$50,000
4	Temporary Site Fencing	900	LF	$50	$45,000
5	Erosion and Sedimentation Control	1,200	LF	$8	$9,600
6	Construct and Remove Decontamination Pad	1	LS	$10,000	$10,000
7	Utility Mark out and Clearance	5	DAY	$4,000	$20,000
8	Traffic Control and Diversion	30	WEEK	$8,000	$240,000
9	Open Span Structure	1	LS	$330,000	$330,000
	Air Treatment	1	LS	$460,000	$460,000
10	Install and Remove Temporary Sheetpile	11,800	VSF	$70	$826,000
	Internal Bracing and Support	1	LS	$290,000	$290,000
11	Temporary Groundwater Treatment System	5	MONTH	$75,000	$375,000
12	Utility Bypass/Relocation	1	LS	$1,000,000	$1,000,000
13	Soil Excavation and Handling	6,700	CY	$60	$402,000
14	Stabilization Admixture	800	TON	$120	$96,000
15	Community Air Monitoring and Vapor/Odor Control	30	WEEK	$4,000	$120,000
16	Demarcation Layer	2,300	SY	$6	$13,800
17	HDPE Liner	440	SY	$20	$8,800
18	General Fill	6,500	CY	$45	$292,500
19	Surface Restoration	9,000	SF	$6	$54,000
20	Solid Waste Characterization	24	EACH	$1,200	$28,800
21	Solid Waste Transportation and Disposal - C&D Debris	1,200	TON	$90	$108,000
22	Solid Waste Transportation and Disposal - LTTD	9,700	TON	$140	$1,358,000
23	Install Groundwater Monitoring Wells	210	VLF	$225	$47,250
24	Install NAPL Collection Wells	390	VLF	$700	$273,000
25	Site Management Plan	1	LS	$50,000	$50,000
26	Establish Institutional Controls	1	LS	$100,000	$100,000
				Subtotal Capital Cost	$6,717,750
27				Administration & Engineering (15%)	$787,763
				Construction Management (15%)	$787,763
				Contingency (20%)	$1,343,550
				Total Capital Cost	$9,636,825
Operation and Maintenance Costs					
28	Annual Permitting/Access Agreements	1	LS	$15,000	$15,000
29	Annual Verification of Institutional Controls	1	LS	$10,000	$10,000
30	Semi-Annual NAPL Monitoring and Passive Recovery	2	EVENT	$15,000	$30,000
31	Annual Groundwater Sampling	1	EVENT	$25,000	$25,000
32	Laboratory Analysis of Groundwater Samples	28	EACH	$750	$21,000
33	Waste Disposal	8	DRUM	$750	$6,000
34	Annual Summary Report	1	LS	$30,000	$30,000
				Subtotal O&M Cost	$137,000
				Contingency (20%)	$27,400
				Total Annual O&M Cost	$164,400
35				30-Year Total Present Worth Cost of O&M	$2,527,231
				Total Estimated Cost	**$12,164,056**
				Rounded To	**$12,200,000**

Table 5-4
Cost Estimate Alternative 5
Targeted Soil Removal at the Former MGP Property, NAPL Recovery, Groundwater Monitoring, and Institutional Controls

General Notes:

1. Cost estimate is based on Anchor QEA Engineering, PLLC's (Anchor QEA's) past experience and vendor estimates using 2019 dollars.

2. This estimate has been prepared for the purposes of comparing potential remedial alternatives. The information in this cost estimate is based on the available information regarding the site investigation and the anticipated scope of the remedial alternative. Changes in cost elements are likely to occur as a result of new information and data collected during the engineering design of the remedial alternative. With the exception of Items 2 and 12, this cost estimate is expected to be within -30% to +50% of the actual projected cost. Utilization of this cost estimate information beyond the stated purpose is not recommended.

3. All costs assume construction field work to be conducted by non-unionized labor.

Assumptions:

1. Permitting/access agreements cost estimate includes all costs necessary to obtain appropriate permits and access agreements to complete the remedial construction activities associated with this alternative.
2. Temporary property rental cost estimate includes costs associated with a 12 month lease of a secure parking area in the vincinty of the former MGP site to provide additional parking/automotive storage for teh current businesses on-site. Cost does not include relocation of vehicles or maintenance of the parking area during the 12 month lease of similar a similar building for the displaced automotive business, and moving expenses. Anchor QEA does not certify that cost estimate will be within -30% to +50% during time of remedial construction.
3. Mobilization/demobilization cost estimate includes mobilization and demobilization of labor, equipment, and materials necessary to conduct the remedial construction activities associated with this alternative.
4. Temporary site fencing cost estimate includes all labor, equipment, and materials necessary to purchase, install, and remove concrete jersey barriers equipped with six-foot tall woven steel chain link fence and barbed wire to secure the project site.

5. Erosion and sedimentation control cost estimate includes all labor, equipment, and materials necessary for placement/maintenance of staked hay bales or silt fence around project work limits and material staging areas.

6. Construct and remove decontamination pad cost estimate includes all labor, equipment, and materials necessary to construct, maintain, and remove a decontamination pad and appurtenances.
7. Utility markout and clearance cost estimate includes all labor, equipment, and materials necessary to identify, markout, and clear (via hand-digging) any underground utilities at excavation areas and the locations of the new groundwater monitoring and NAPL collection wells. Cost assumes that utility location and markout would be conducted by a private utility locating company.

8. Traffic control and diversion cost estimate includes all labor, equipment, and materials necessary to establish and maintain road closures to facilitate completion of remedial activities. Cost estimate includes rental of light arrows, signs, barricades, and drums/cones to close Fulton Street between Canal Street and South Street and Canal Street near Fulton Street during excavation and backfilling activities within Fulton Street and at the former MGP property.

9. Open span structure and air treatment cost estimate includes rental of an approximately 100-foot by 75-foot Sprung structure to enclose excavation areas on the former MGP property. Estimate assumes lease costs of approximately $28 per square-foot and construction cost of approximately $12 per square-foot. Cost estimate assumes structure is equipped with overheard doors for truck and excavator access. Final structure construction details to be determined as part of the Remedial Design. Air treatment cost estimate includes rental of vapor treatment system to collect and treat air within the excavation enclosure. Cost estimate includes lease of all vapor collection and treatment equipment, delivery and set-up fees, and filter media change out. Cost estimate assumes structure will be moved three times during excavation activities at assumed cost of $10,000 per move. Cost estimate assumes maximum 12-month rental of open span structure and air treatment system.

10. Install and remove temporary sheet pile cost estimate includes all labor, equipment, and materials necessary to install, remove, and decontaminate temporary steel sheet pile. Cost estimate assumes sheet pile will be installed at an average depth of 18 feet below grade within the utility corridor and at an average depth of 20 feet below grade on the former MGP property. Cost estimate includes internal bracing and lateral supports. Estimate includes increased cost for pre-trenching for removal of subsurface obstructions when encountered. Sheet pile to be removed following site restoration activities. Final excavation support system to be determined as part of the Remedial Design.

Table 5-4
Cost Estimate Alternative 5
Targeted Soil Removal at the Former MGP Property, NAPL Recovery, Groundwater Monitoring, and Institutional Controls

11. Temporary groundwater treatment system cost estimate includes installation of sumps within excavation areas and rental of a portable water treatment system capable of operating at 75 gallons-per-minute. Cost estimate assumes water treatment system includes pumps, influent piping and hoses, frac tanks, carbon filters, bag filters, discharge piping and hoses, and flow meter. Estimate assumes treated water would be discharge to a local POTW sanitary sewer under a local discharge permit at no additional cost.

12. Utility bypass/relocation cost estimate includes all labor, equipment, and materials necessary to temporarily bypass or relocate underground and overhead utilities to facilitate remedial construction activities. Cost estimate assumes that overhead utilities consisting of electric and telephone services would be relocated to the south side of Fulton Street between Canal and South Streets. Cost estimate assumes that underground utilities consisting of water, storm, gas lines would be temporary bypassed and replaced are their current location. As the scope of the bypass/relocation activities cannot be assessed at this time, estimated cost is not certified to be with -30% to +50% of the actual cost.

13. Soil excavation and handling includes all labor, equipment, and materials necessary to address NAPL-impacted soil and portions of former MGP structures in the utility corridor and accessible NAPL-impacted soil at the former MGP property at a depth up to 20 feet below grade. Cost estimate is based on in-place soil volume.

14. Stabilization admixture cost estimate includes the purchase and importation of stabilizing agents to amend material excavated from the below the water table. Cost estimate assumes stabilization admixture (e.g., Portland cement) will be added at ratio of 10% of the volume of material to be stabilized. Cost estimate assumes that any water generated in association with soil management will be treated by the temporary water treatment system.

15. Community air monitoring and vapor/odor control cost estimate includes all labor, equipment, and materials necessary to monitor vapor/odor emission during intrusive site activities using AirLogics-type monitoring system and applying vapor/odor suppressing foam to open excavations.

16. Demarcation layer cost estimate includes al labor, equipment, and materials necessary to place a woven, light-weight, non-biodegradable, high-visibility demarcation layer within soil excavation area footprints and along the side walls.

17. HDPE liner cost estimate includes all labor, equipment, and material necessary to install HDPE liner along the upgradient edge of the utility corridor excavation area to minimize the potential for recontamination of backfill material from residual MGP-related impacts that would remain upgradient of the excavation area.

18. General fill cost estimate includes all labor, equipment, and materials necessary to import, place, grade and compact general fill in excavation areas to within 6 inches of the surrounding grade. Cost estimate is based on in-place soil volume. Cost estimate assumes 95% compaction based on standard proctor testing and includes survey verification and compaction testing.

19. Surface restoration cost estimate includes all labor, equipment, and material necessary to restore surfaces disturbed during remedial activities in kind. Final surface restorations include 6-inch layer of asphalt pavement, vegetated topsoil, and/or concrete sidewalk.

20. Solid waste characterization cost estimate includes the analysis of soil samples (including, but not limited to, PCBs, VOCs, SVOCs, and RCRA Metals). Costs assumes that waste characterization samples would be collected at a frequency of one sample per every 500 tons of material destined for off-site treatment/disposal.

21. Solid waste transportation and disposal - C&D debris cost estimate includes all labor, equipment, and materials necessary to transport and dispose of excavated surface material (e.g., pavement, concrete, gravel sub-base) as construction and demolition debris. Costs assume excavated material from 0 to 2 feet below grade at the utility corridor and former MGP property would be transported off-site for disposal as C&D debris at an assumed density of 1.75 tons per cubic-yard. Cost estimate includes disposal fee; transportation fuel surcharge; and environmental, transportation, and spotting fees. Cost estimate assumes that no material will be recycled or reused.

22. Solid waste transportation and disposal - LTTD cost estimate includes all labor, equipment, and materials necessary to transport and thermally treat excavated soil exhibiting toxicity characteristic for benzene at a thermal treatment facility. Cost assumes excavated soil from 5 to 20 feet below grade at the utility corridor and former MGP property plus stabilization mixture will be treated/disposed of via LTTD at an estimated density of 1.5 tons per cubic-yard. Cost estimate also assumes soil cuttings generated during well installation activities will be treated/disposed of via LTTD. Cost estimate includes treatment fee, transportation fuel surcharge, and spotting fees. Cost estimate assumes thermally treated soil does not require subsequent treatment or disposal.

23. Install groundwater monitoring wells cost estimate includes all labor, equipment, and materials necessary to install up to 7 groundwater monitoring wells to an average depth of 30 feet below grade. Cost estimate includes oversight by a geologist, and drill rig and crew. Cost estimate assumes no work stoppages during field work due to weather or other potential delays. Cost estimate assumes 2-inch diameter PVC well construction and wells equipped with sumps.

24. Install NAPL collection wells cost estimate includes all labor, equipment, and materials necessary to install up to 13 NAPL collection wells to an average depth of 30 feet below grade. Cost estimate includes oversight by a geologist, and drill rig and crew. Cost estimate assumes no work stoppages during field work due to weather or other potential delays. Cost estimate assumes 8-inch diameter stainless steel well construction and wells equipped with minimum 5-foot long sumps. Cost estimate assumes wells will not be installed within roadways and local vehicle traffic patterns will not be affected by well installation activities.

25. Site management plan cost estimate includes all labor necessary to prepare a site management plan to document: the institutional controls that have been established and will be maintained for the site; known locations of remaining soil that contains COCs at concentrations greater than 6 NYCRR Part 375-6 commercial soil cleanup objectives; requirements for notifications of the presence of MGP-related impacts in soil and groundwater that would be provided to those requesting utility clearance for intrusive activities on the former MGP property or in the off-Site area; protocols and requirements for semi-annual NAPL monitoring and annual groundwater monitoring; protocols (including health and safety requirements) for conducting invasive (i.e., subsurface) activities and managing potentially impacted material encountered during these activities; and protocols for addressing significant changes in COC concentrations in groundwater based on the results obtained from the annual monitoring activities.

26. Establish institutional controls cost estimate includes all legal expenses to institute environmental easements and deed restrictions for the former MGP property and post office property to control intrusive activities that could result in exposure to impacted soil and groundwater and restrict groundwater use. Institutional controls would also establish requirements for additional investigation activities and/or remedial actions if the automotive repair shops or post office were demolished or the property/building use changes. Such institutional controls may include governmental controls, proprietary controls, enforcement tools, and/or informational devices. Estimate does not include potential costs associated with compensation of property owners for easements/deed restrictions.

27. Administration and engineering and construction management costs are based on an assumed 15% of the total capital costs, not including costs for offsite transportation and treatment/disposal of excavated material.

28. Annual permitting/access agreements cost estimate includes all costs necessary to obtain appropriate permits and access agreements to conduct annual groundwater monitoring and semi-annual NAPL monitoring activities.

29. Annual verification of institutional controls cost estimate includes administrative costs for confirming institutional controls to minimize the potential for human exposure to site soil and groundwater are present. Annual costs associated with institutional controls include verifying the status of institutional controls and preparing/submitting notification to the NYSDEC to demonstrate that the institutional controls are being maintained and remain effective.

30. Semi-annual NAPL monitoring and passive recovery cost estimate includes all labor, equipment, and materials necessary to conduct semi-annual NAPL monitoring at up to 11 wells. Cost estimate includes passive NAPL recovery via manual bailing or a portable peristaltic pump. Cost estimate assumes two workers will require one day to complete monitoring and recovery per event. Estimate includes field vehicle and equipment.

31. Annual groundwater sampling cost estimate includes all labor, equipment, and materials necessary to conduct annual groundwater sampling activities. Cost estimate assumes groundwater samples will be collected from up to 22 existing and newly installed groundwater sampling wells using low-flow sampling procedures. Cost estimate assumes two workers will require 8 days to complete the monitoring activities. Estimate includes labor, field vehicle, lodging, subsistence, and equipment rental.

32. Laboratory analysis of groundwater samples cost estimate includes the analysis of groundwater samples for BTEX, PAHs, and cyanide. Estimate assumes laboratory analysis of groundwater samples from up to 22 existing and newly installed groundwater monitoring wells and up to 6 QA/QC samples per sampling event.

33. Waste disposal cost estimate includes off-site disposal of drummed PPE, disposable sampling equipment, purge water, and NAPL generated/collected during semi-annual NAPL and annual groundwater monitoring activities.

34. Annual summary report cost estimate includes all labor necessary to prepare an annual report summarizing semi-annual NAPL and annual groundwater monitoring activities and results. Annual report to be submitted to NYSDEC.

Table 5-4
Cost Estimate Alternative 5
Targeted Soil Removal at the Former MGP Property, NAPL Recovery, Groundwater Monitoring, and Institutional Controls

35. Present worth is estimated based on a 5% beginning-of-year discount rate (adjusted for inflation). It is assumed that "year zero" is 2019.

Abbreviations
BTEX: benzene, toluene, ethylbenzene, and xylenes
C&D: construction and demolition
COC: constituent of concern
CY: cubic yard
HDPE: high-density polyethylene
LF: linear foot
LS: lump sum
LTTD: low-temperature thermal desorption
MGP: manufactured gas plant
NAPL: nonaqueous phase liquid
NYCRR: New York Codes, Rules and Regulations
NYSDEC: New York State Department of Environmental Conservation
O&M: operation and maintenance
PAH: polycyclic aromatic hydrocarbon
PCB: polychlorinated biphenyl
POTW: Publicly Owned Treatment Works
QA/QC: quality assurance/quality control
RCRA: Resource Conservation and Recovery Act
SF: square foot
SVOC: semivolatile organic compound
SY: square yard
VLF: vertical linear foot
VOC: volatile organic compound
VSF: vertical square foot

Table 5-5

Cost Estimate for Alternative 6

Slurry-Supported Soil Removal at the Former MGP Property, Utility Corridor Stabilization, NAPL Recovery, Groundwater Monitoring, and Institutional Controls

Item #	Description	Estimated Quantity	Unit	Unit Price	Estimated Cost
Capital Costs					
1	Pre-Design Investigation	1	LS	$100,000	$100,000
2	Permitting/Access Agreements	1	LS	$85,000	$85,000
3	Temporary Property Rental	1	LS	$35,000	$35,000
4	Mobilization/Demobilization	1	LS	$200,000	$200,000
5	Temporary Site Fencing	1,000	LF	$20	$20,000
6	Erosion and Sedimentation Control	1	LS	$15,000	$15,000
7	Construct and Remove Decontamination Pad	4	LS	$15,000	$60,000
8	Utility Mark out and Clearance	5	DAY	$4,000	$20,000
9	Traffic Control and Diversion	16	WEEK	$8,000	$128,000
10	Utility Shielding	1	LS	$50,000	$50,000
11	Saw Cut Asphalt	560	LF	$7	$3,920
12	Pre-Excavation to Remove Near Surface Obstructions	1,000	CY	$25	$25,000
13	Jet Grouting Subsurface Utilities	620	CY	$600	$372,000
14	Slurry Supported Excavation	2,200	CY	$400	$880,000
15	Community Air Monitoring	16	WEEK	$3,000	$48,000
16	General Fill	880	CY	$45	$39,600
17	Asphalt	7,050	SF	$7	$49,350
18	Surface Restoration	2,400	SF	$6	$14,400
19	Construction Water Management and Disposal	1	LS	$50,000	$50,000
20	Solid Waste Characterization	12	EACH	$1,200	$14,400
21	Solid Waste Transportation and Disposal - C&D Debris	1,700	TON	$90	$153,000
22	Solid Waste Transportation and Disposal - LTTD	4,230	TON	$140	$592,200
23	Install Groundwater Monitoring Wells	210	VLF	$225	$47,250
24	Install NAPL Collection Wells	330	VLF	$700	$231,000
25	Site Management Plan	1	LS	$50,000	$50,000
26	Establish Institutional Controls	1	LS	$100,000	$100,000
	Subtotal Capital Cost				$3,383,120
27	Administration & Engineering (15%)				$395,688
	Construction Management (15%)				$395,688
	Contingency (20%)				$676,624
	Total Capital Cost				**$4,851,120**
Operation and Maintenance Costs					
28	Annual Permitting/Access Agreements	1	LS	$15,000	$15,000
29	Annual Verification of Institutional Controls	1	LS	$10,000	$10,000
30	Semi-Annual NAPL Monitoring and Passive Recovery	2	EVENT	$10,000	$20,000
31	Annual Groundwater Sampling	1	EVENT	$20,000	$20,000
32	Laboratory Analysis of Groundwater Samples	28	EACH	$750	$21,000
33	Waste Disposal	6	DRUM	$750	$4,500
34	Annual Summary Report	1	LS	$30,000	$30,000
	Subtotal O&M Cost				$120,500
	Contingency (20%)				$24,100
	Total Annual O&M Cost				$144,600
35	30-Year Total Present Worth Cost of O&M				$2,222,856
	Total Estimated Cost:				**$7,073,976**
	Rounded To:				**$7,100,000**

Table 5-5
Cost Estimate for Alternative 6
Slurry-Supported Soil Removal at the Former MGP Property, Utility Corridor Stabilization, NAPL Recovery, Groundwater Monitoring, and Institutional Controls

General Notes:

1. Cost estimate is based on Anchor QEA Engineering, LLC's (Anchor QEA's) past experience and vendor estimates using 2019 dollars.

2. This estimate has been prepared for the purposes of comparing potential remedial alternatives. The information in this cost estimate is based on the available information regarding the site investigation and the anticipated scope of the remedial alternative. Changes in cost elements are likely to occur as a result of new information and data collected during the engineering design of the remedial alternative. With the exception of Items 3 and 10, this cost estimate is expected to be within -30% to +50% of the actual projected cost. Utilization of this cost estimate information beyond the stated purpose is not recommended.

3. All costs assume construction field work to be conducted by non-unionized labor.

Assumptions:

1. Pre-design investigation cost estimate includes all costs necessary to install soil borings to obtain geotechical information for slurry design and confirm subsurface conditions (e.g., obstructions, holder configuration).

2. Permitting/access agreements cost estimate includes all costs necessary to obtain appropriate permits and access agreements to complete the remedial construction activities associated with this alternative.

3. Temporary property rental includes costs associated with a 12 month lease of a secure off-street parking lot to provide parking space for the automotive sales and body shops. Anchor QEA does not certify that cost estimate will be within -30% to +50% during time of remedial construction.

4 Mobilization/demobilization cost estimate includes mobilization and demobilization of labor, equipment, and materials necessary to conduct the remedial construction activities associated with this alternative.

5. Temporary site fencing cost estimate includes all labor, equipment, and materials necessary to purchase, install, and remove concrete jersey barriers equipped with six-foot tall woven steel chain link fence and barbed wire to secure the project site.

6. Erosion and sedimentation control cost estimate includes all labor, equipment, and materials necessary for placement/maintenance of staked hay bales or silt fence around project work limits and material staging areas.

7. Construct and remove decontamination pad cost estimate includes all labor, equipment, and materials necessary to construct, maintain, and remove a decontamination pad and appurtenances.

8. Utility markout and clearance cost estimate includes all labor, equipment, and materials necessary to identify, markout, and clear (via hand-digging) any underground utilities at excavation areas and the locations of the new groundwater monitoring and NAPL collection wells. Cost assumes that utility location and markout would be conducted by a private utility locating company.

9. Traffic control and diversion cost estimate includes all labor, equipment, and materials necessary to establish and maintain road closures to facilitate completion of remedial activities. Cost estimate includes rental of light arrows, signs, barricades, and drums/cones to close Fulton Street between Canal Street and South Street and Canal Street during excavation and backfilling activities within Fulton Street.

10. Utility shielding cost estimate includes all labor, equipment, and materials necessary to temporarily shield overhead utilities adjacent to the excavation area to protect the existing overhead lined. Cost estimate assumes that overhead utilities consisting of electric and telephone services would be shielded during the excavation activities. Anchor QEA does not certify that cost estimate will be within -30% to +50% during time of remedial construction.

11. Sawcut asphalt cost estimate includes all labor, equipment, and materials necessary to perform a neat cut around the proposed excavation in the street (to promote ease of restoration activities), followed by removal of the asphalt layer for off site disposal as a non-hazardous waste.

12. Pre-excavation to remove near surface obstructions cost estimate includes all labor, equipment, and materials to pre-excavate soils to approximately 4 feet below ground surface. Estimate assumes the excavated soils will be managed for disposal and will not be reused on site.

13. Jet grouting subsurface utilities cost estimate includes all labor, equipment, and materials necessary to jet grout the soils underlying the utility corridor using angle drilling -methods. Up to 6 feet of soils beneath the subsurface utilities will be jet grouted to create a semi-permanent barrier between the utilities and deeper, MGP-impacted soils along Fulton Street.

14. Slurry supported excavation cost estimate includes all labor, equipment, and materials necessary to excavate the impacted soils in the parking lot area using a cement-bentonite slurry for sidewall support. The excavation would be performed by installing a single slurry trench to a maximum depth of 20 feet bgs each day. At the end of the workday, the slurry trench would be terminated and allowed to solidify. The next workday, a new trench would be started. The trenches would be staggered so that no area would be excavated adjacent to the prior day's excavation area to allow additional time for solidification and strength gain. Estimate assumes that excavated soils will not require dewatering other than overnight placement in dewatering container prior to removal from the site for disposal.

15. Community air monitoring cost estimate includes all labor, equipment, and materials necessary to monitor vapor/odor emission during intrusive site activities using AirLogics-type monitoring system. Estimate assumes that no other odor suppression is required.

16. General fill cost estimate includes all labor, equipment, and materials necessary to import, place, grade and compact general fill in excavation areas, above the solidified cement bentonite slurry, to within 6 inches of the surrounding grade. Cost estimate is based on in-place soil volume. Cost estimate assumes 95% compaction based on standard proctor testing and includes survey verification and compaction testing.

17. Asphalt cost estimate includes all labor, equipment, and materials necessary to install a 6-inch asphalt surface over excavation footprint in parking area.

18. Surface restoration cost estimate includes all labor, equipment, and material necessary to restore surfaces disturbed during remedial activities in kind (excluding the asphalt restoration covered under line 17). Including landscaped areas and/or concrete sidewalk flag replacement.

19. Construction water management and disposal cost estimate includes labor, equipment and materials necessary to transfer fluids generated during excavated materials dewatering to a tanker truck and transport off-site for treatment as a non-hazardous liquid waste. Estimate assumes up to 5,000 gallons of non hazardous liquid will be generated per week during the soil removal activities.

20. Solid waste characterization cost estimate includes the analysis of soil samples (including, but not limited to, PCBs, VOCs, SVOCs, and RCRA Metals). Costs assumes that waste characterization samples would be collected at a frequency of one sample per every 500 tons of material destined for off-site treatment/disposal.

21. Solid waste transportation and disposal - C&D debris cost estimate includes all labor, equipment, and materials necessary to transport and dispose of excavated surface material (e.g., pavement, concrete, gravel sub-base) as construction and demolition debris. Costs assume excavated material from 0 to 2 feet below grade at the utility corridor would be transported off-site for disposal as C&D debris at an assumed density of 1.75 tons per cubic-yard. Cost estimate includes disposal fee; transportation fuel surcharge; and environmental, transportation, and spotting fees. Cost estimate assumes that no material will be recycled or reused.

22. Solid waste transportation and disposal - LTTD cost estimate includes all labor, equipment, and materials necessary to transport and thermally treat excavated soil exhibiting toxicity characteristic for benzene at a thermal treatment facility. Cost assumes excavated soil from 2 to 10 feet below grade at the utility corridor plus stabilization mixture will be treated/disposed of via LTTD at an estimated density of 1.5 tons per cubic-yard. Cost estimate also assumes soil cuttings generated during well installation activities will be treated/disposed of via LTTD. Cost estimate includes treatment fee, transportation fuel surcharge, and spotting fees. Cost estimate assumes thermally treated soil does not require subsequent treatment or disposal.

23. Install groundwater monitoring wells cost estimate includes all labor, equipment, and materials necessary to install up to 7 groundwater monitoring wells to an average depth of 30 feet below grade. Cost estimate includes oversight by a geologist, and drill rig and crew. Cost estimate assumes no work stoppages during field work due to weather or other potential delays. Cost estimate assumes 2-inch diameter PVC well construction and wells equipped with sumps.

Table 5-5

Cost Estimate for Alternative 6

Slurry-Supported Soil Removal at the Former MGP Property, Utility Corridor Stabilization, NAPL Recovery, Groundwater Monitoring, and Institutional Controls

24. Install NAPL collection wells cost estimate includes all labor, equipment, and materials necessary to install up to 11 NAPL collection wells to an average depth of 30 feet below grade. Cost estimate includes oversight by a geologist, and drill rig and crew. Cost estimate assumes no work stoppages during field work due to weather or other potential delays. Cost estimate assumes 8-inch diameter stainless steel well construction and wells equipped with minimum 5-foot long sumps. Cost estimate assumes wells will not be installed within roadways and local vehicle traffic patterns will not be affected by well installation activities.

25. Site management plan cost estimate includes all labor necessary to prepare a site management plan to document: the institutional controls that have been established and will be maintained for the site; known locations of remaining soil that contains COCs at concentrations greater than 6 NYCRR Part 375-6 commercial soil cleanup objectives; requirements for notifications of the presence of MGP-related impacts in soil and groundwater that would be provided to those requesting utility clearance for intrusive activities on the former MGP property or in the off-Site area; protocols and requirements for semi-annual NAPL monitoring and annual groundwater monitoring; protocols (including health and safety requirements) for conducting invasive (i.e., subsurface) activities and managing potentially impacted material encountered during these activities; and protocols for addressing significant changes in COC concentrations in groundwater based on the results obtained from the annual monitoring activities.

26. Establish institutional controls cost estimate includes all legal expenses to institute environmental easements and deed restrictions for the former MGP property and post office property to control intrusive activities that could result in exposure to impacted soil and groundwater and restrict groundwater use. Institutional controls would also establish requirements for additional investigation activities and/or remedial actions if the automotive repair shops or post office were demolished or the property/building use changes. Such institutional controls may include governmental controls, proprietary controls, enforcement tools, and/or informational devices. Estimate does not include potential costs associated with compensation of property owners for easements/deed restrictions.

27. Administration and engineering and construction management costs are based on an assumed 15% of the total capital costs, not including costs for offsite transportation and treatment/disposal of excavated material.

28. Annual permitting/access agreements cost estimate includes all costs necessary to obtain appropriate permits and access agreements to conduct annual groundwater monitoring and semi-annual NAPL monitoring activities.

29. Annual verification of institutional controls cost estimate includes administrative costs for confirming institutional controls to minimize the potential for human exposure to site soil and groundwater are present. Annual costs associated with institutional controls include verifying the status of institutional controls and preparing/submitting notification to the NYSDEC to demonstrate that the institutional controls are being maintained and remain effective.

30. Semi-annual NAPL monitoring and passive recovery cost estimate includes all labor, equipment, and materials necessary to conduct semi-annual NAPL monitoring at up to 11 wells. Cost estimate includes passive NAPL recovery via manual bailing or a portable peristaltic pump. Cost estimate assumes two workers will require one day to complete monitoring and recovery per event. Estimate includes field vehicle and equipment.

31. Annual groundwater sampling cost estimate includes all labor, equipment, and materials necessary to conduct annual groundwater sampling activities. Cost estimate assumes groundwater samples will be collected from up to 22 groundwater existing and newly installed monitoring wells using low-flow sampling procedures. Cost estimate assumes two workers will require 8 days to complete the sampling activities. Estimate includes labor, field vehicle, lodging, subsistence, and equipment rental.

32. Laboratory analysis of groundwater samples cost estimate includes the analysis of groundwater samples for BTEX, PAHs, and cyanide. Estimate assumes laboratory analysis of groundwater samples from up to 22 existing and newly installed groundwater monitoring wells and up to 6 QA/QC samples per sampling event.

33. Waste disposal cost estimate includes off-site disposal of drummed PPE, disposable sampling equipment, purge water, and NAPL generated/collected during semi-annual NAPL and annual groundwater monitoring activities.

34. Annual summary report cost estimate includes all labor necessary to prepare an annual report summarizing semi-annual NAPL and annual groundwater monitoring activities and results. Annual report to be submitted to NYSDEC.

35. Present worth is estimated based on a 5% beginning-of-year discount rate (adjusted for inflation). It is assumed that "year zero" is 2019.

Abbreviations:

bgs: below ground surface
BTEX: benzene, toluene, ethylbenzene, and xylenes
C&D: construction and demolition
COC: constituent of concern
CY: cubic yard
LF: linear foot
LS: lump sum
LTTD: low-temperature thermal desorption
MGP: manufactured gas plant
NAPL: nonaqueous phase liquid
NYCRR: New York Codes, Rules and Regulations
NYSDEC: New York State Department of Environmental Conservation
O&M: operation and maintenance
PAH: polycyclic aromatic hydrocarbon
PCB: polychlorinated biphenyl
POTW: Publicly Owned Treatment Works
QA/QC: quality assurance/quality control
RCRA: Resource Conservation and Recovery Act
SVOC: semivolatile organic compound
SF: square foot
VLF: vertical linear foot
VOC: volatile organic compound

Table 5-6

Cost Estimate for Alternative 7

Removal to 6 NYCRR Part 375-6 Unrestricted Use SCOs, NAPL Recovery, Groundwater Monitoring, and Institutional Controls

Item #	Description	Estimated Quantity	Unit	Unit Price	Estimated Cost
Capital Costs					
1	Property Acquisition	1	LS	$2,200,000	$2,200,000
2	Structure Demolition and Disposal	1	LS	$250,000	$250,000
3	Permitting/Access Agreements	1	LS	$50,000	$50,000
4	Mobilization/Demobilization	1	LS	$700,000	$700,000
5	Temporary Site Fencing	3,000	LF	$50	$150,000
6	Erosion and Sedimentation Control	3,600	LF	$8	$28,800
7	Construct and Remove Decontamination Pad	1	LS	$10,000	$10,000
8	Utility Mark out and Clearance	6	DAY	$4,000	$24,000
9	Traffic Control and Diversion	78	WEEK	$8,000	$624,000
10	Open Span Structure	1	LS	$360,000	$360,000
	Air Treatment	1	LS	$800,000	$800,000
11	Install and Remove Temporary Sheetpile	41,100	VSF	$70	$2,877,000
	Internal Bracing and Support	1	LS	$600,000	$600,000
12	Temporary Groundwater Treatment System	13	MONTH	$75,000	$975,000
13	Utility Bypass/Relocation	1	LS	$1,000,000	$1,000,000
14	Soil Excavation and Handling	26,200	CY	$60	$1,572,000
15	Stabilization Admixture	2,600	TON	$120	$312,000
16	Community Air Monitoring and Vapor/Odor Control	78	WEEK	$4,000	$312,000
17	Demarcation Layer	2,000	SY	$6	$12,000
18	Backfill Amendment	250	LB	$7	$1,750
19	General Fill	26,200	CY	$45	$1,179,000
20	Surface Restoration	40,000	SF	$6	$240,000
21	Solid Waste Characterization	81	EACH	$1,200	$97,200
22	Solid Waste Transportation and Disposal - C&D Debris	4,600	TON	$90	$414,000
23	Solid Waste Transportation and Disposal - LTTD	36,000	TON	$140	$5,040,000
24	Install Groundwater Monitoring Wells	210	VLF	$225	$47,250
25	Install NAPL Collection Wells	270	VLF	$700	$189,000
26	Site Management Plan	1	LS	$50,000	$50,000
27	Establish Institutional Controls	1	LS	$100,000	$100,000
				Subtotal Capital Cost	$20,215,000
28				Administration & Engineering (15%)	$1,884,150
				Construction Management (15%)	$1,884,150
				Contingency (20%)	$4,043,000
				Total Capital Cost	$28,026,300
Operation and Maintenance Costs					
29	Annual Permitting/Access Agreements	1	LS	$15,000	$15,000
30	Annual Verification of Institutional Controls	1	LS	$10,000	$10,000
31	Semi-Annual NAPL Monitoring and Passive Recovery	2	EVENT	$10,000	$20,000
32	Annual Groundwater Sampling	1	EVENT	$12,000	$12,000
33	Laboratory Analysis of Groundwater Samples	12	EACH	$750	$9,000
34	Waste Disposal	4	DRUM	$750	$3,000
35	Annual Summary Report	1	LS	$25,000	$25,000
				Subtotal O&M Cost	$94,000
				Contingency (20%)	$18,800
				Total Annual O&M Cost	$112,800
36				30-Year Total Present Worth Cost of O&M	$1,734,012
				Total Estimated Cost	**$29,760,312**
				Rounded To	**$29,800,000**

Table 5-6
Cost Estimate for Alternative 7
Removal to 6 NYCRR Part 375-6 Unrestricted Use SCOs, NAPL Recovery, Groundwater Monitoring, and Institutional Controls

General Notes:

1. Cost estimate is based on Anchor QEA Engineering, LLC's (Anchor QEA's) past experience and vendor estimates using 2019 dollars.

2. This estimate has been prepared for the purposes of comparing potential remedial alternatives. The information in this cost estimate is based on the available information regarding the site investigation and the anticipated scope of the remedial alternative. Changes in cost elements are likely to occur as a result of new information and data collected during the engineering design of the remedial alternative. With the exception of Items 1 and 13, this cost estimate is expected to be within -30% to +50% of the actual projected cost. Utilization of this cost estimate information beyond the stated purpose is not recommended.

3. All costs assume construction field work to be conducted by non-unionized labor.

Assumptions:

1. Property acquisition cost estimate includes costs associated with O&R purchasing the former MGP property from the current owner and purchasing a similar property in Middletown, New York for the displaced property Owner. Estimate is based on 2019 assessed value of the former MGP Property. Anchor QEA does not certify that cost estimate will be within -30% to +50% during time of remedial construction.

2. Structure demolition and disposal cost estimate includes all labor and equipment necessary to demolish the existing automotive repair shop on the west side of the former MGP property. Cost estimate includes demolition of structure and foundation at an assumed cost of $25 per square-foot of structure and disposal of structure walls, roofs, and foundations as C&D debris at a solid waste landfill at an assumed cost of $90 per ton.

3. Permitting/access agreements cost estimate includes all costs necessary to obtain appropriate permits and access agreements to complete the remedial construction activities associated with this alternative. Cost estimate includes separate permitting costs for the remediation of each property.

4. Mobilization/demobilization cost estimate includes mobilization and demobilization of labor, equipment, and materials necessary to conduct the remedial construction activities associated with this alternative. Cost estimate includes separate mobilization/demolition costs for the remediation of each property.

5. Temporary site fencing cost estimate includes all labor, equipment, and materials necessary to purchase, install, and remove concrete jersey barriers equipped with six-foot tall woven steel chain link fence and barbed wire to secure the project site.

6. Erosion and sedimentation control cost estimate includes all labor, equipment, and materials necessary for placement/maintenance of staked hay bales or silt fence around project work limits and material staging areas.

7. Construct and remove decontamination pad cost estimate includes all labor, equipment, and materials necessary to construct, maintain, and remove a decontamination pad and appurtenances. Cost estimate includes separate pads for the remediation of each property.

8. Utility markout and clearance cost estimate includes all labor, equipment, and materials necessary to identify, markout, and clear (via hand-digging) any underground utilities at excavation areas and the locations of the new groundwater monitoring and NAPL collection wells. Cost assumes that utility location and markout would be conducted by a private utility locating company.

9. Traffic control and diversion cost estimate includes all labor, equipment, and materials necessary to establish and maintain road closures to facilitate completion of remedial activities. Cost estimate includes rental of light arrows, signs, barricades, and drums/cones to close Fulton Street between Canal Street and South Street and Wawayanda Avenue and Canal Street near Fulton Street during excavation and backfilling activities.

10. Open span structure and air treatment cost estimate includes rental of an approximately 100-foot by 75-foot Sprung structure to enclose excavation areas on the former MGP property. Estimate assumes lease costs of approximately $28 per square-foot and construction cost of approximately $12 per square-foot. Cost estimate assumes structure is equipped with overheard doors for truck and excavator access. Final structure construction details to be determined as part of the Remedial Design. Air treatment cost estimate includes rental of vapor treatment system to collect and treat air within the excavation enclosure. Cost estimate includes lease of all vapor collection and treatment equipment, delivery and set-up fees, and filter media change out. Cost estimate assumes structure will be moved six times during excavation activities at assumed cost of $10,000 per move. Cost estimate assumes maximum 24-month rental of open span structure and air treatment system.

11. Install and remove temporary sheet pile cost estimate includes all labor, equipment, and materials necessary to install, remove, and decontaminate temporary steel sheet pile. Cost estimate assumes sheet pile will be installed at an average depth of 30 feet below grade at the post office property and at an average depth of 20 feet below grade on the former MGP property (including the utility corridor). Estimate includes increased cost for pre-trenching for removal of subsurface obstructions when encountered. Cost estimate includes internal bracing and lateral supports and assumes sheet pile will not be cantilevered. Sheet pile to be removed following site restoration activities. Final excavation support system to be determined as part of the Remedial Design.

12. Temporary groundwater treatment system cost estimate includes installation of sumps within excavation areas and rental of a portable water treatment system capable of operating at 75 gallons-per-minute. Cost estimate assumes water treatment system includes pumps, influent piping and hoses, frac tanks, carbon filters, bag filters, discharge piping and hoses, and flow meter. Estimate assumes treated water would be discharge to a local POTW sanitary sewer under a local discharge permit at no additional cost.

13. Utility bypass/relocation cost estimate includes all labor, equipment, and materials necessary to temporarily bypass or relocate underground and overhead utilities to facilitate remedial construction activities. Cost estimate assumes that overhead utilities consisting of electric and telephone services would be relocated to the south side of Fulton Street between Canal and South Streets. Cost estimate assumes that underground utilities consisting of water, storm, gas lines would be temporary bypassed and replaced are their current location. As the scope of the bypass/relocation activities cannot be assessed at this time, estimated cost is not certified to be with -30% to +50% of the actual cost.

14. Soil excavation and handling includes all labor, equipment, and materials necessary to address NAPL-impacted soil and portions of former MGP structures in the utility corridor at a depth up to 20 feet below grade, soil containing COCs at concentrations greater than 6 NYCRR Part 375-6 unrestricted use soil cleanup objectives on the eastern portion of the former MGP property at depth up to 7, and soil containing COCs at concentrations greater than 6 NYCRR Part 375-6 unrestricted use soil cleanup objectives on the post office property and supermarket property at depths up to 15 feet below grade. Cost estimate is based on in-place soil volume.

15. Stabilization admixture cost estimate includes the purchase and importation of stabilizing agents to amend material excavated from the below the water table. Cost estimate assumes stabilization admixture (e.g., Portland cement) will be added at ratio of 10% of the volume of material to be stabilized. Cost estimate assumes that any water generated in association with soil management will be treated by the temporary water treatment system.

16. Community air monitoring and vapor/odor control cost estimate includes all labor, equipment, and materials necessary to monitor vapor/odor emission during intrusive site activities using AirLogics-type monitoring system and applying vapor/odor suppressing foam to open excavations.

17. Demarcation layer cost estimate includes all labor, equipment, and materials necessary to place a woven, light-weight, non-biodegradable, high-visibility demarcation layer within soil excavation area footprints and along the side walls on the post office property.

18. Backfill amendment cost estimate includes all labor, equipment, and materials necessary to purchase and incorporate a groundwater amendment such as a slow-oxygen-releasing compound into the general fill below the water table. Cost estimate assumes that backfill amendment powder would be manually placed within the open excavation near the post office during backfilling activities. Estimate includes costs for purchase and delivery of a 250 pound, 55 gallon drum of amendment.

19. General fill cost estimate includes all labor, equipment, and materials necessary to import, place, grade and compact general fill in excavation areas to within 6 inches of the surrounding grade. Cost estimate is based on in-place soil volume. Cost estimate assumes 95% compaction based on standard proctor testing and includes survey verification and compaction

20. Surface restoration cost estimate includes all labor, equipment, and material necessary to restore surfaces disturbed during remedial activities in kind. Final surface restorations include 6-inch layer of asphalt pavement, vegetated topsoil, gravel surface cover, and/or concrete sidewalk.

21. Solid waste characterization cost estimate includes the analysis of soil samples (including, but not limited to, PCBs, VOCs, SVOCs, and RCRA Metals). Costs assumes that waste characterization samples would be collected at a frequency of one sample per every 500 tons of material destined for off-site treatment/disposal.

Table 5-6
Cost Estimate for Alternative 7
Removal to 6 NYCRR Part 375-6 Unrestricted Use SCOs, NAPL Recovery, Groundwater Monitoring, and Institutional Controls

22. Solid waste transportation and disposal - C&D debris cost estimate includes labor, equipment, and materials necessary to transport and dispose of excavated surface material (e.g., pavement, concrete, gravel sub-base) as construction and demolition debris. Costs assume excavated material from 0 to 2 feet below grade would be transported off-site for disposal as C&D debris at an assumed density of 1.75 tons per cubic-yard. Cost estimate includes disposal fee; transportation fuel surcharge; and environmental, transportation, and spotting fees. Cost estimate assumes that no material will be recycled or reused.

23. Solid waste transportation and disposal - LTTD cost estimate includes labor, equipment, and materials necessary to transport and thermally treat excavated soil exhibiting toxicity characteristic for benzene at a thermal treatment facility. Cost assumes excavated soil from deeper than 2 feet below grade plus stabilization mixture will be treated/disposed of via LTTD at an estimated density of 1.5 tons per cubic-yard. Cost estimate also assumes soil cuttings generated during well installation activities will be treated/disposed of via LTTD. Cost estimate includes treatment fee, transportation fuel surcharge, and spotting fees. Cost estimate assumes thermally treated soil does not require subsequent treatment or disposal.

24. Install groundwater monitoring wells cost estimate includes all labor, equipment, and materials necessary to install up to 7 groundwater monitoring wells to an average depth of 30 feet below grade. Cost estimate includes oversight by a geologist, and drill rig and crew. Cost estimate assumes no work stoppages during field work due to weather or other potential delays. Cost estimate assumes 2-inch diameter PVC well construction and wells equipped with sumps.

25. Install NAPL collection wells cost estimate includes all labor, equipment, and materials necessary to install up to nine NAPL collection wells to an average depth of 30 feet below grade. Cost estimate includes oversight by a geologist, and drill rig and crew. Cost estimate assumes no work stoppages during field work due to weather or other potential delays. Cost estimate assumes 8-inch diameter stainless steel well construction and wells equipped with minimum 5-foot long sumps. Cost estimate assumes wells will not be installed within roadways and local vehicle traffic patterns will not be affected by well installation activities.

26. Site management plan cost estimate includes all labor necessary to prepare a site management plan to document: the institutional controls that have been established and will be maintained for the site; known locations of remaining soil that contains COCs at concentrations greater than 6 NYCRR Part 375-6 commercial soil cleanup objectives; protocols and requirements for semi-annual NAPL monitoring and annual groundwater monitoring; and protocols for addressing significant changes in COC concentrations in groundwater based on the results obtained from the annual monitoring activities.

27. Establish institutional controls cost estimate includes all legal expenses to institute environmental easements and deed restrictions for the former MGP property and post office property to control intrusive activities that could result in exposure to impacted groundwater and restrict groundwater use. Such institutional controls may include governmental controls, proprietary controls, enforcement tools, and/or informational devices. Estimate does not include potential costs associated with compensation of property owners for easements/deed restrictions.

28. Administration and engineering and construction management costs are based on an assumed 15% of the total capital costs, not including costs for property acquisition or offsite transportation and treatment/disposal of excavated material.

29. Annual permitting/access agreements cost estimate includes all costs necessary to obtain appropriate permits and access agreements to conduct annual groundwater monitoring and semi-annual NAPL monitoring activities.

30. Annual verification of institutional controls cost estimate includes administrative costs for confirming institutional controls to minimize the potential for human exposure to site soil and groundwater are present. Annual costs associated with institutional controls include verifying the status of institutional controls and preparing/submitting notification to the NYSDEC to demonstrate that the institutional controls are being maintained and remain effective.

31. Semi-annual NAPL monitoring and passive recovery cost estimate includes all labor, equipment, and materials necessary to conduct semi-annual NAPL monitoring at up to nine wells. Cost estimate includes passive NAPL recovery via manual bailing or a portable peristaltic pump. Cost estimate assumes two workers will require one day to complete monitoring and recovery per event. Estimate includes field vehicle and equipment.

Table 5-6
Cost Estimate for Alternative 7
Removal to 6 NYCRR Part 375-6 Unrestricted Use SCOs, NAPL Recovery, Groundwater Monitoring, and Institutional Controls

32. Annual groundwater sampling cost estimate includes all labor, equipment, and materials necessary to conduct annual groundwater sampling activities. Cost estimate assumes groundwater samples will be collected from up to 10 groundwater sampling wells using low-flow sampling procedures. Cost estimate assumes two workers will require 4 days to complete the monitoring activities. Estimate includes labor, field vehicle, lodging, subsistence, and equipment rental.

33. Laboratory analysis of groundwater samples cost estimate includes the analysis of groundwater samples for BTEX, PAHs, and cyanide. Estimate assumes laboratory analysis of groundwater samples from up to 10 groundwater monitoring wells from existing and proposed wells and up to 2 QA/QC samples per sampling event.

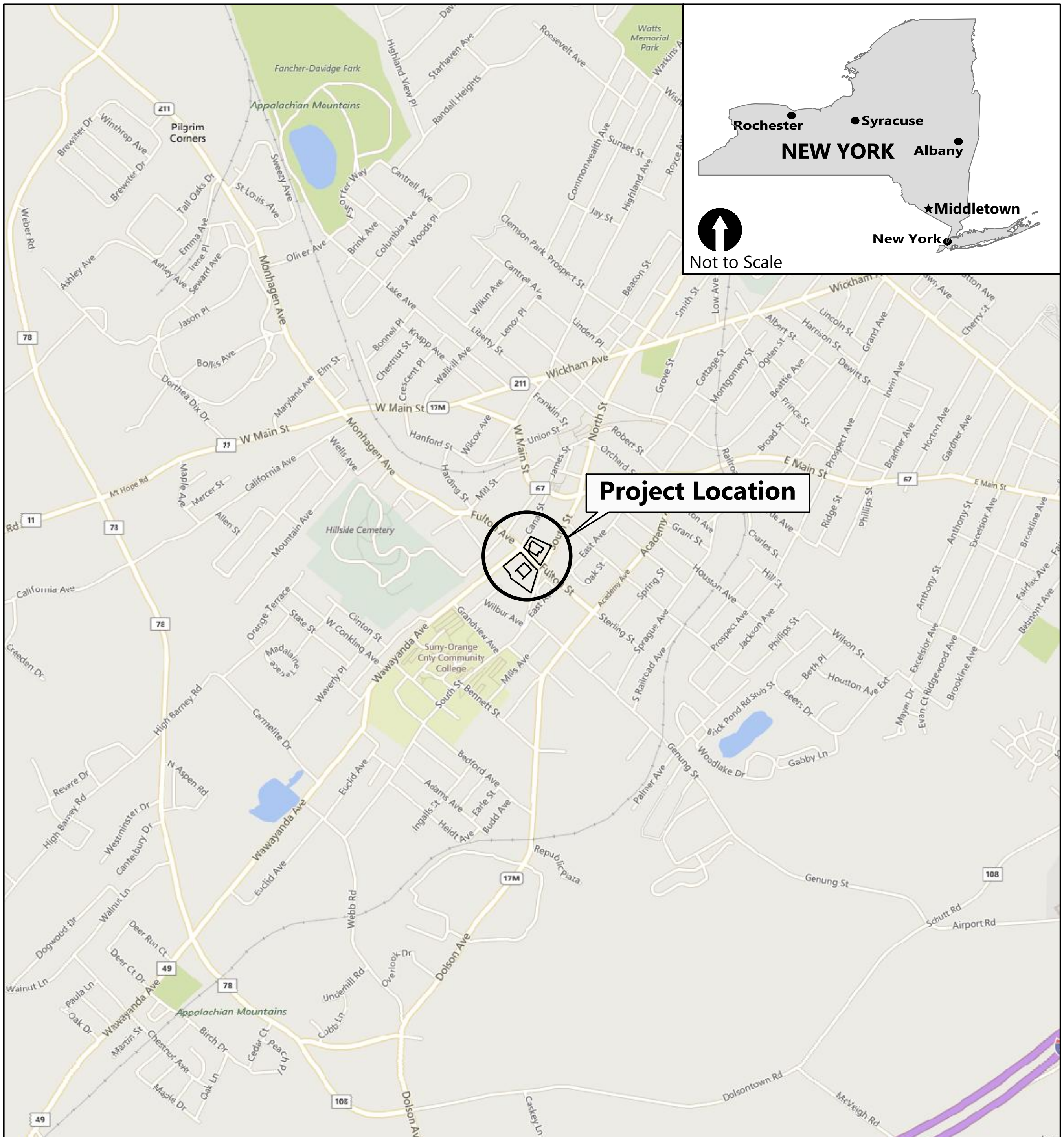
34. Waste disposal cost estimate includes off-site disposal of drummed PPE, disposable sampling equipment, purge water, and NAPL generated/collected during semi-annual NAPL and annual groundwater monitoring activities.

35. Annual summary report cost estimate includes all labor necessary to prepare an annual report summarizing semi-annual NAPL and annual groundwater monitoring activities and results. Annual report to be submitted to NYSDEC.

36. Present worth is estimated based on a 5% beginning-of-year discount rate (adjusted for inflation). It is assumed that "year zero" is 2019.

Abbreviations:
BTEX: benzene, toluene, ethylbenzene, and xylenes
C&D: construction and demolition
COC: constituent of concern
CY: cubic yard
LB: pound
LF: linear foot
LS: lump sum
LTTD: low-temperature thermal desorption
MGP: manufactured gas plant
NAPL: nonaqueous phase liquid
NYCRR: New York Codes, Rules and Regulations
NYSDEC: New York State Department of Environmental Conservation
O&M: operation and maintenance
O&R: Orange & Rockland Utilities, Inc.
PAH: polycyclic aromatic hydrocarbon
PCB: polychlorinated biphenyl
POTW: Publicly Owned Treatment Works
QA/QC: quality assurance/quality control
RCRA: Resource Conservation and Recovery Act
SVOC: semivolatile organic compound
SY: square yard
VLF: vertical linear foot
VOC: volatile organic compound
VSF: vertical square foot

Figures



SOURCE: Background image by Microsoft (Bing).
HORIZONTAL DATUM: New York East Zone, NAD83, U.S. Feet.

0 2000
Feet

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Figure 1-1
Site Location Map

Feasibility Study
Fulton Street Former MGP Site, Middletown, New York
Orange and Rockland Utilities

SOURCE: Based on "Feasibility Study" report figures by ARCADIS US, Inc., 2010 and 2016. See notes for additional references.
HORIZONTAL DATUM: New York East, HARN, U.S. Feet.
VERTICAL DATUM: NAVD88 (presumed)

NOTES:
1. Additional base map references:
   1.1. Survey by Paul James Olszewski, P.L.S., PLLC, Camillus NY on August 31, 2016.
   1.2. GEI Consultants, Inc. Remedial Investigation Report, November 2000.
2. Many locations are approximate. Refer to note 1, item 1.1 above for surveyed locations.
3. Location of former Monhagen Brook inferred based on voids encountered in soil borings SB-16, SB-69, SB-79 and SB-74.

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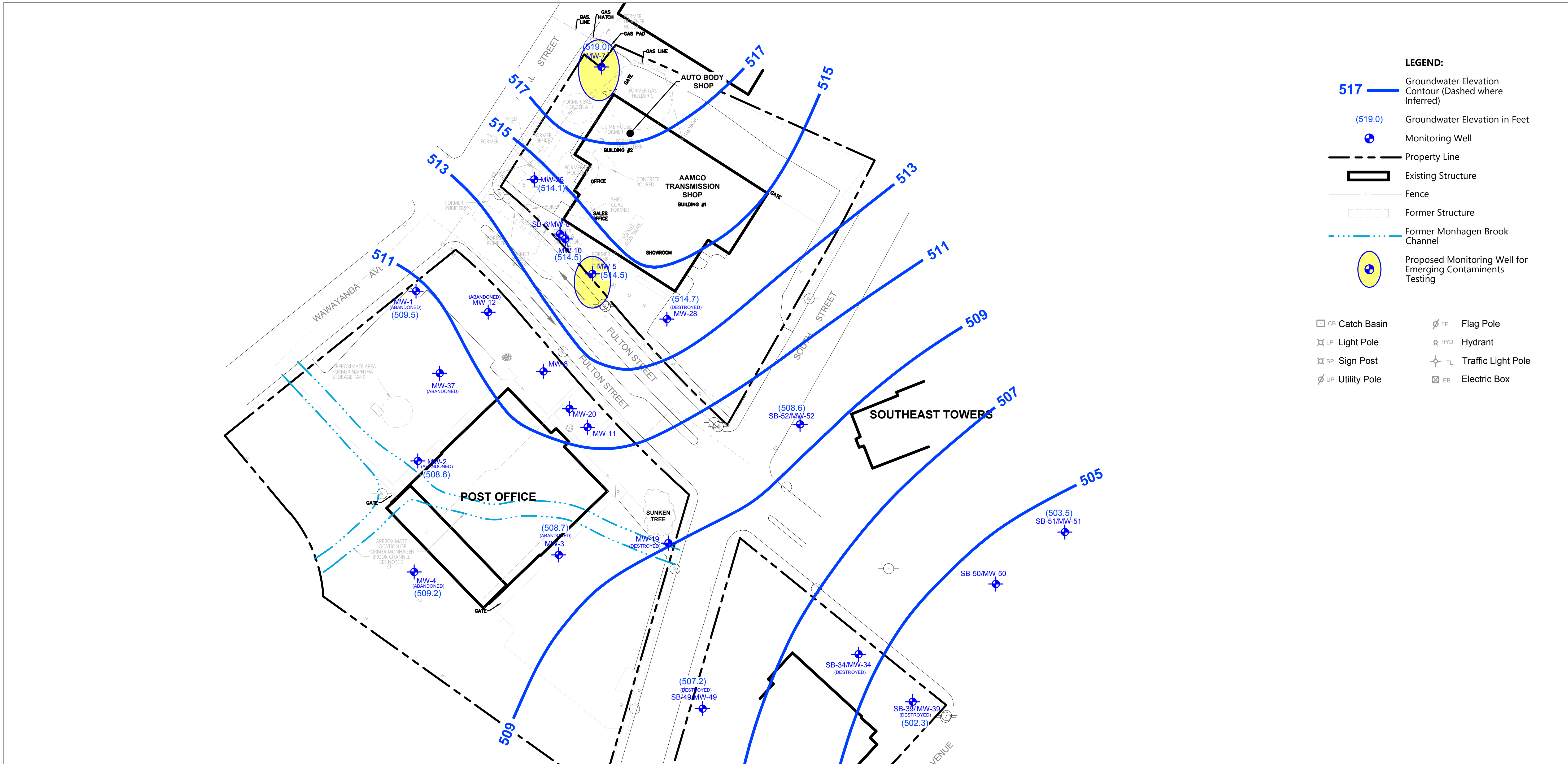
Figure 1-2
Site Plan
Feasibility Study
Fulton Street Former MGP Site, Middletown, New York
Orange and Rockland Utilities



SOURCE: Based on "Feasibility Study" report figures by ARCADIS US, Inc., 2010 and 2016. See notes for additional references.
HORIZONTAL DATUM: New York East, HARN, U.S. Feet.
VERTICAL DATUM: NAVD88 (presumed)

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2. Many locations are approximate. Refer to note 1, item 1.1 above for surveyed locations.
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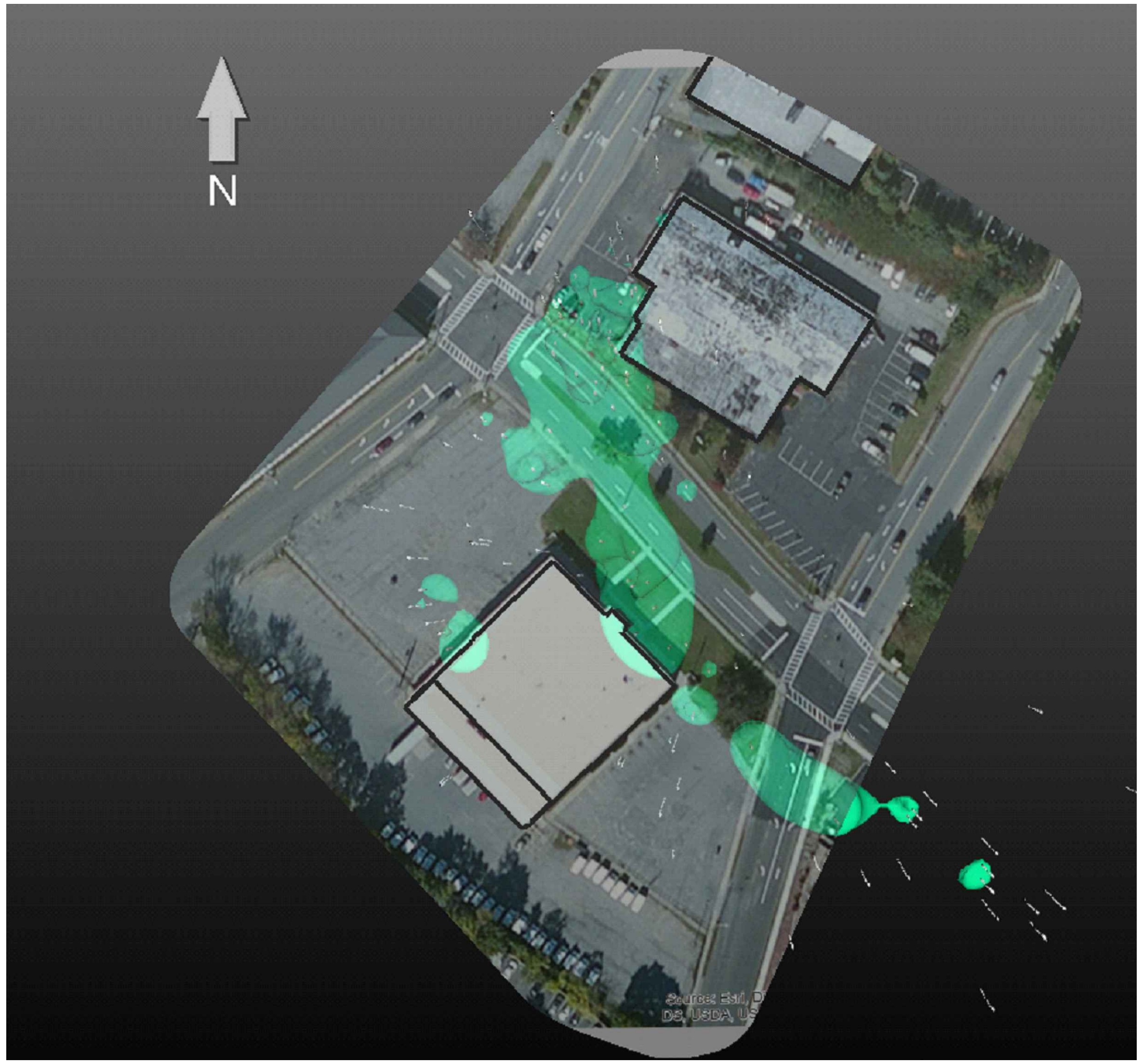
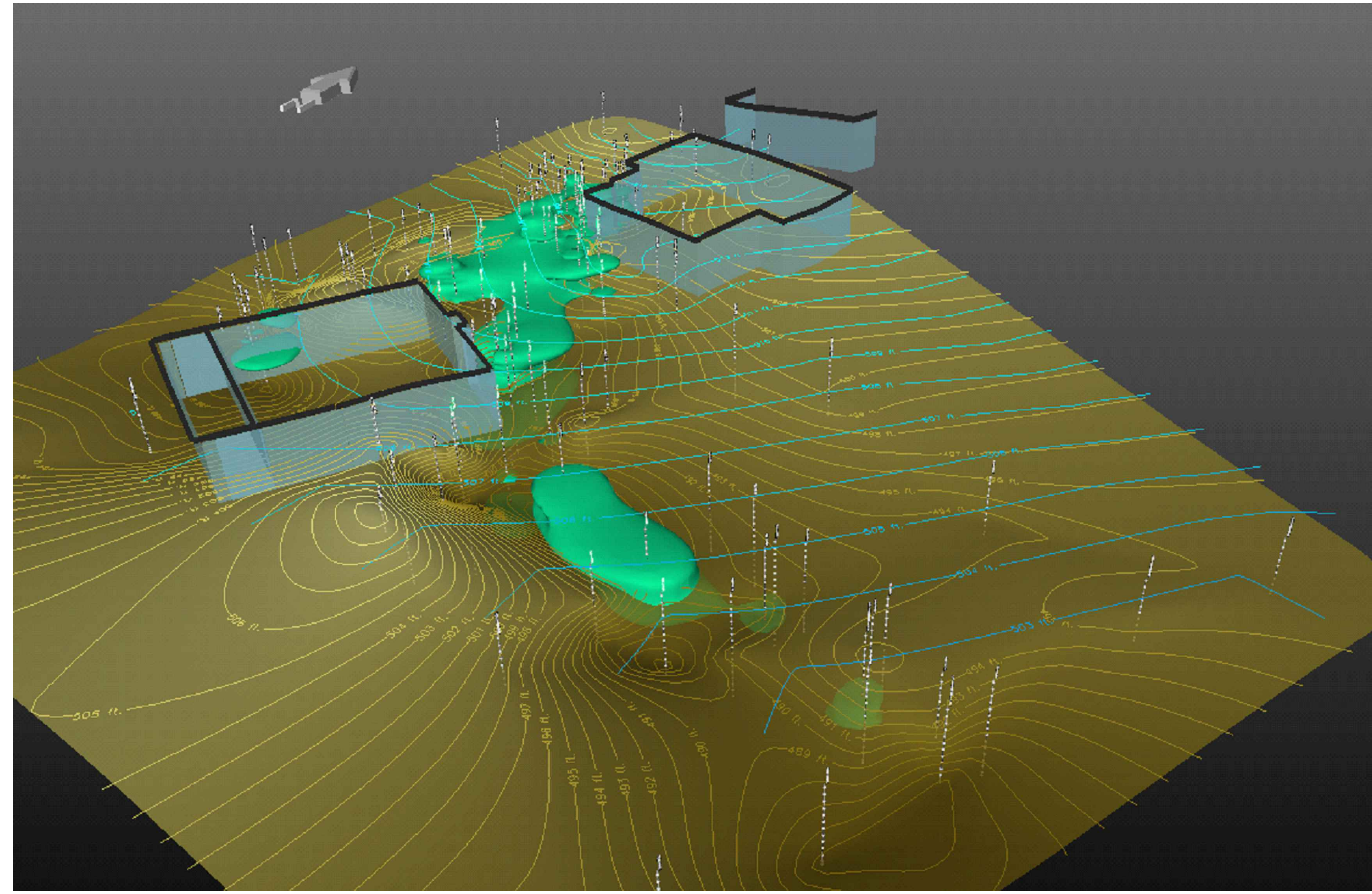
Figure 1-5
Water Table Contours, April 2005

Feasibility Study
Fulton Street Former MGP Site, Middletown, New York
Orange and Rockland Utilities



Plan View



Oblique View – Looking Northwest

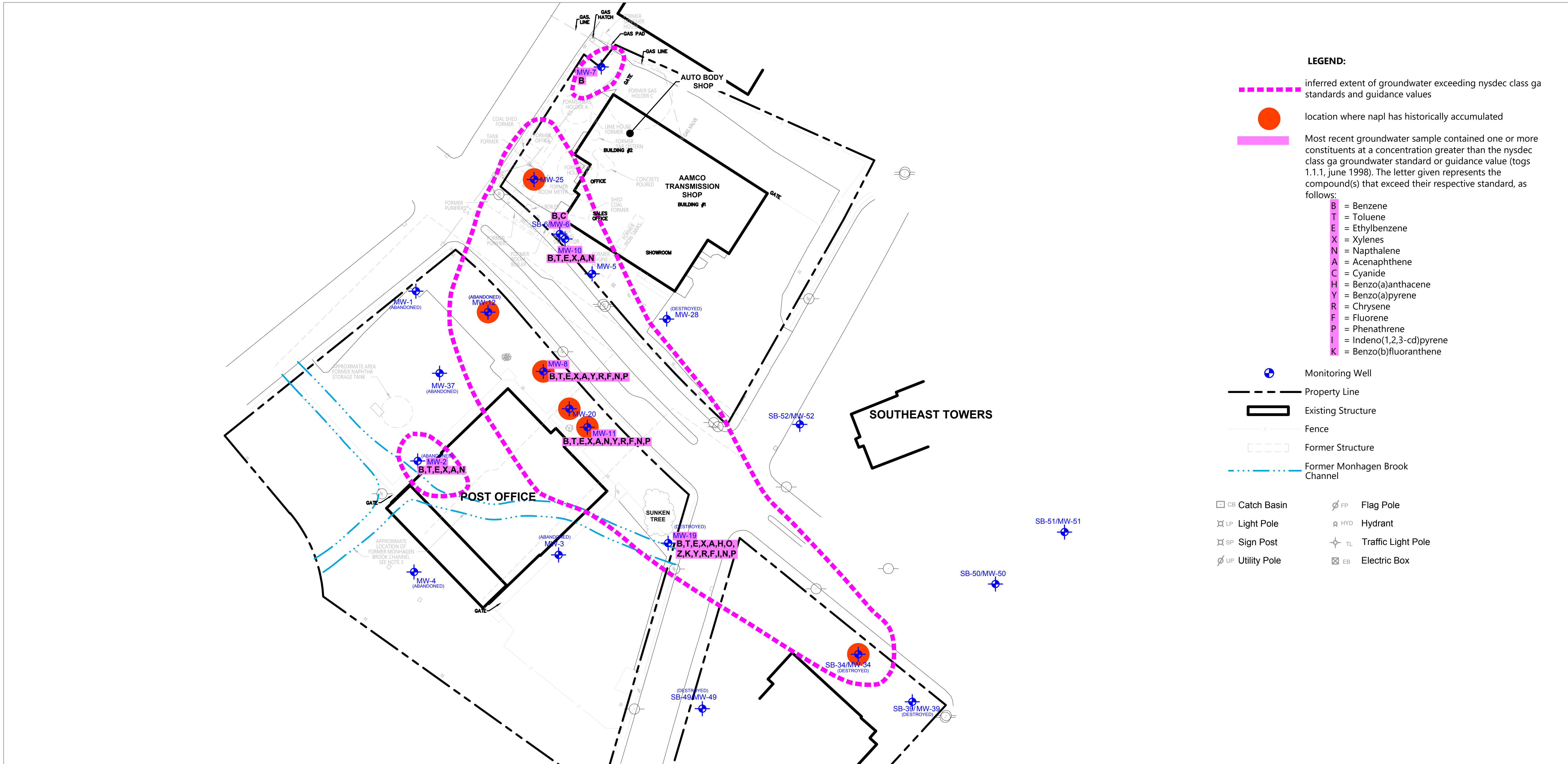
LEGEND

- —508 ft.— WATER TABLE ELEVATION, MEASURED JUNE 1999
- —492 ft.— TOP OF TILL SURFACE ELEVATION
- NAPL AND SHEEN OBSERVATIONS ABOVE THE TILL SURFACE
- NAPL OBSERVATIONS BELOW THE TILL UNIT (OBLIQUE VIEW ONLY)
- TOP OF TILL SURFACE

NAPL = NON AQUEOUS PHASE LIQUID

NOTES

1. ALL LOCATIONS ARE APPROXIMATE
2. DISTRIBUTION OF NAPL BASED ON INFORMATION COLLECTED DURING THE REMEDIAL INVESTIGATION AND FS REFINEMENT STUDY.
3. OBSERVATIONS OF NAPL HAVE BEEN MODELED USING EARTH VISUALIZATION SYSTEM.
4. NAPL OBSERVATIONS INCLUDES SOIL SAMPLES THAT WERE VISUALLY SATURATED WITH NAPL, OR CONTAINED DROPLETS, BLEBS, AND OR SHEENS.



SOURCE: Based on "Feasibility Study" report figures by ARCADIS US, Inc., 2010 and 2016. See notes for additional references.
HORIZONTAL DATUM: New York East, HARN, U.S. Feet.
VERTICAL DATUM: NAVD88 (presumed)

NOTES:

1. Additional base map references:
   1.1. Survey by Paul James Olszewski, P.L.S., PLLC, Camillus NY on August 31, 2016.
   1.2. GEI Consultants, Inc. Remedial Investigation Report, November 2000.
2. Many locations are approximate. Refer to note 1, item 1.1 above for surveyed locations.
3. Location of former Monhagen Brook inferred based on voids encountered in soil borings SB-16, SB-69, SB-79 and SB-74.

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Figure 1-7
Estimated Extent of PAHs and Cyanide Class GA Groundwater Standards and Guidance Values
Feasibility Study
Fulton Street Former MGP Site, Middletown, New York
Orange and Rockland Utilities

SOURCE: Based on "Feasibility Study" report figures by ARCADIS US, Inc., 2010 and 2016. See notes for additional references.
HORIZONTAL DATUM: New York East, HARN, U.S. Feet.
VERTICAL DATUM: NAVD88 (presumed)

NOTES:

1. Additional base map references:
   1.1. Survey by Paul James Olszewski, P.L.S., PLLC, Camillus NY on August 31, 2016.
   1.2. GEI Consultants, Inc. Remedial Investigation Report, November 2000.
2. Many locations are approximate. Refer to note 1, item 1.1 above for surveyed locations.
3. Location of former Monhagen Brook inferred based on voids encountered in soil borings SB-16, SB-69, SB-79 and SB-74.

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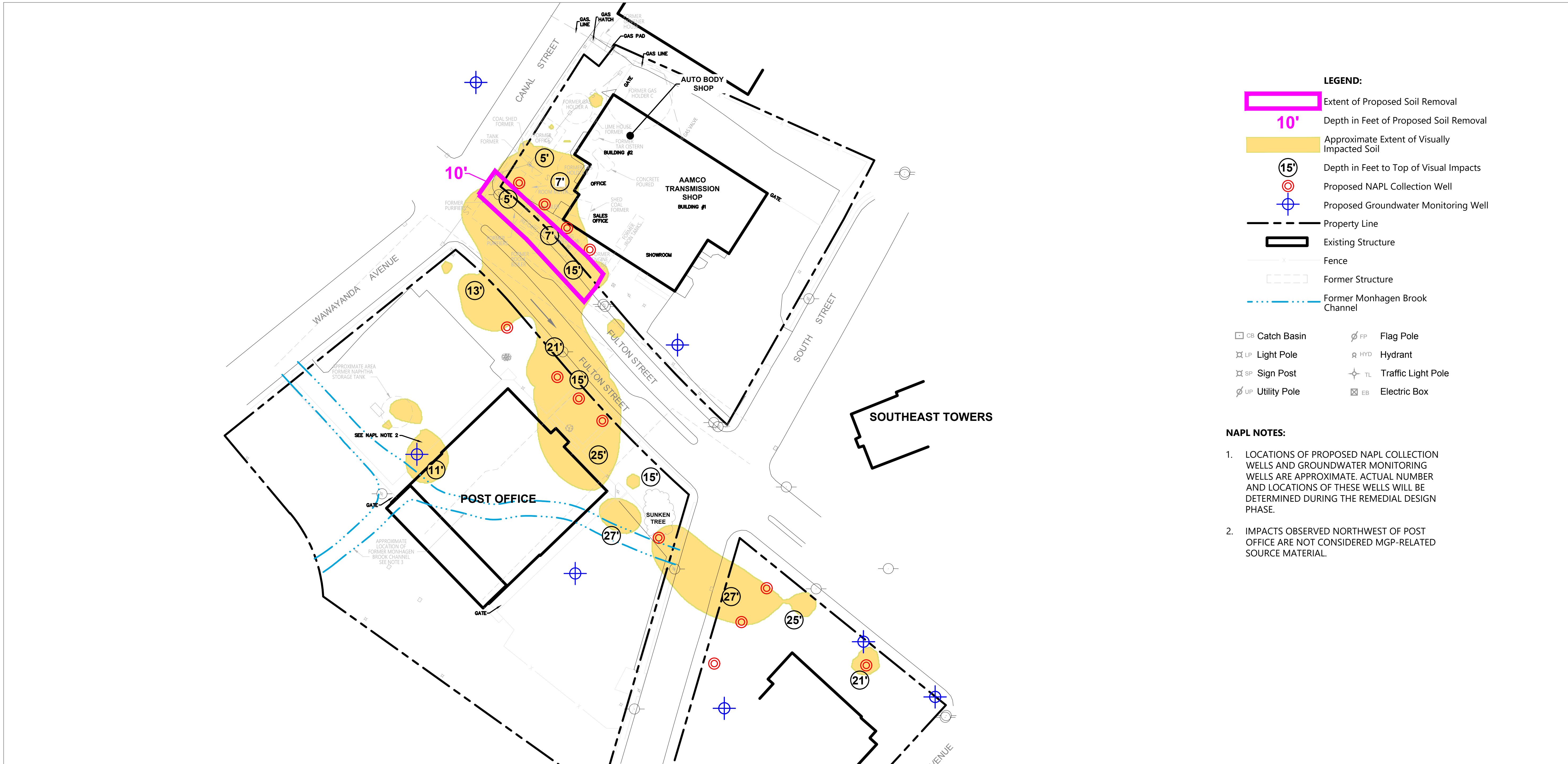
Figure 5-2
Alternative 2
Feasibility Study
Fulton Street Former MGP Site, Middletown, New York
Orange and Rockland Utilities



SOURCE: Based on "Feasibility Study" report figures by ARCADIS US, Inc., 2010 and 2016. See notes for additional references.
HORIZONTAL DATUM: New York East, HARN, U.S. Feet.
VERTICAL DATUM: NAVD88 (presumed)

NOTES:

1. Additional base map references:
   1.1. Survey by Paul James Olszewski, P.L.S., PLLC, Camillus NY on August 31, 2016.
   1.2. GEI Consultants, Inc. Remedial Investigation Report, November 2000.
2. Many locations are approximate. Refer to note 1, item 1.1 above for surveyed locations.
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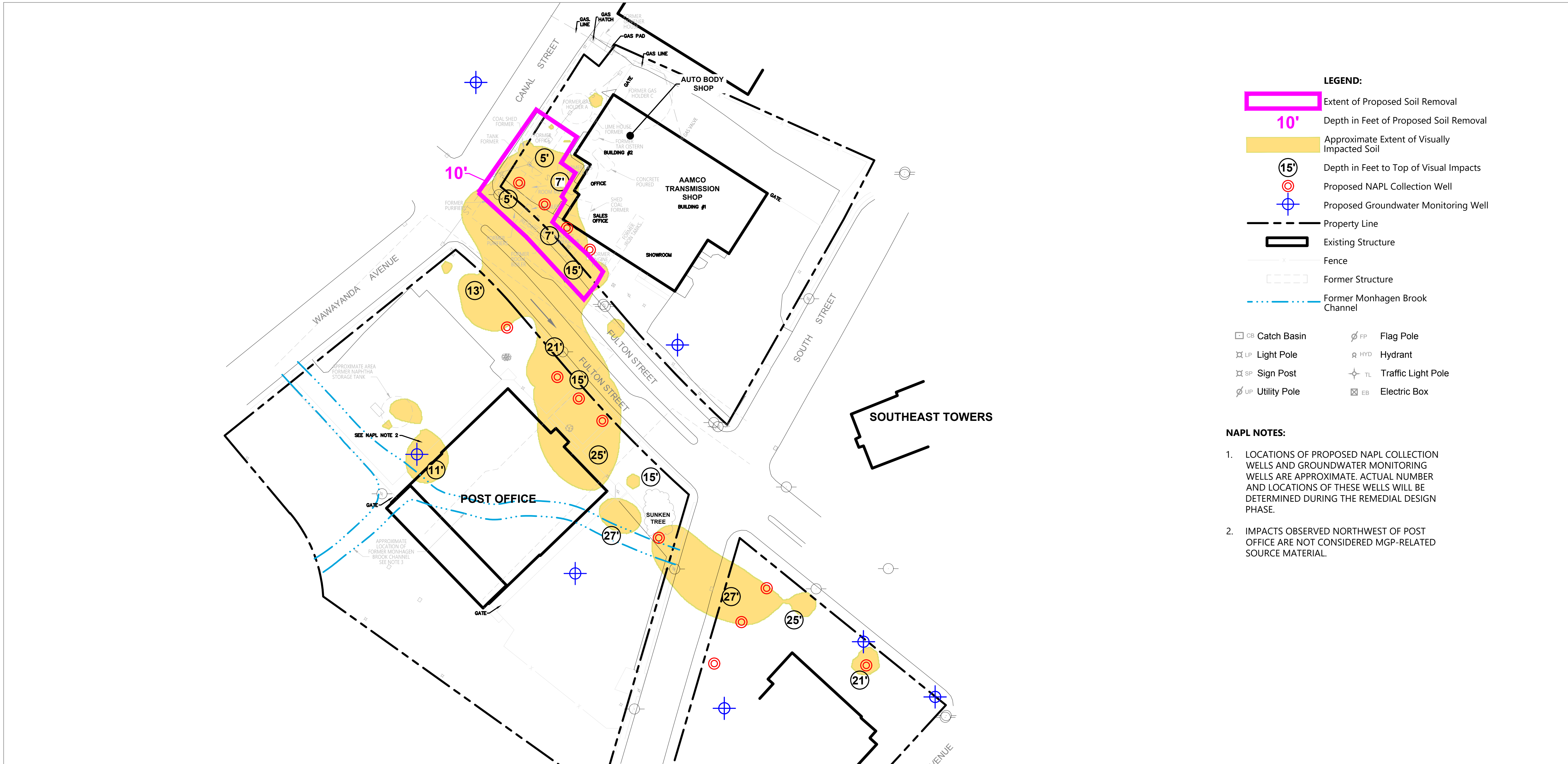
Figure 5-3
Alternative 3
Feasibility Study
Fulton Street Former MGP Site, Middletown, New York
Orange and Rockland Utilities



SOURCE: Based on "Feasibility Study" report figures by ARCADIS US, Inc., 2010 and 2016. See notes for additional references.
HORIZONTAL DATUM: New York East, HARN, U.S. Feet.
VERTICAL DATUM: NAVD88 (presumed)

NOTES:
1. Additional base map references:
   1.1. Survey by Paul James Olszewski, P.L.S., PLLC, Camillus NY on August 31, 2016.
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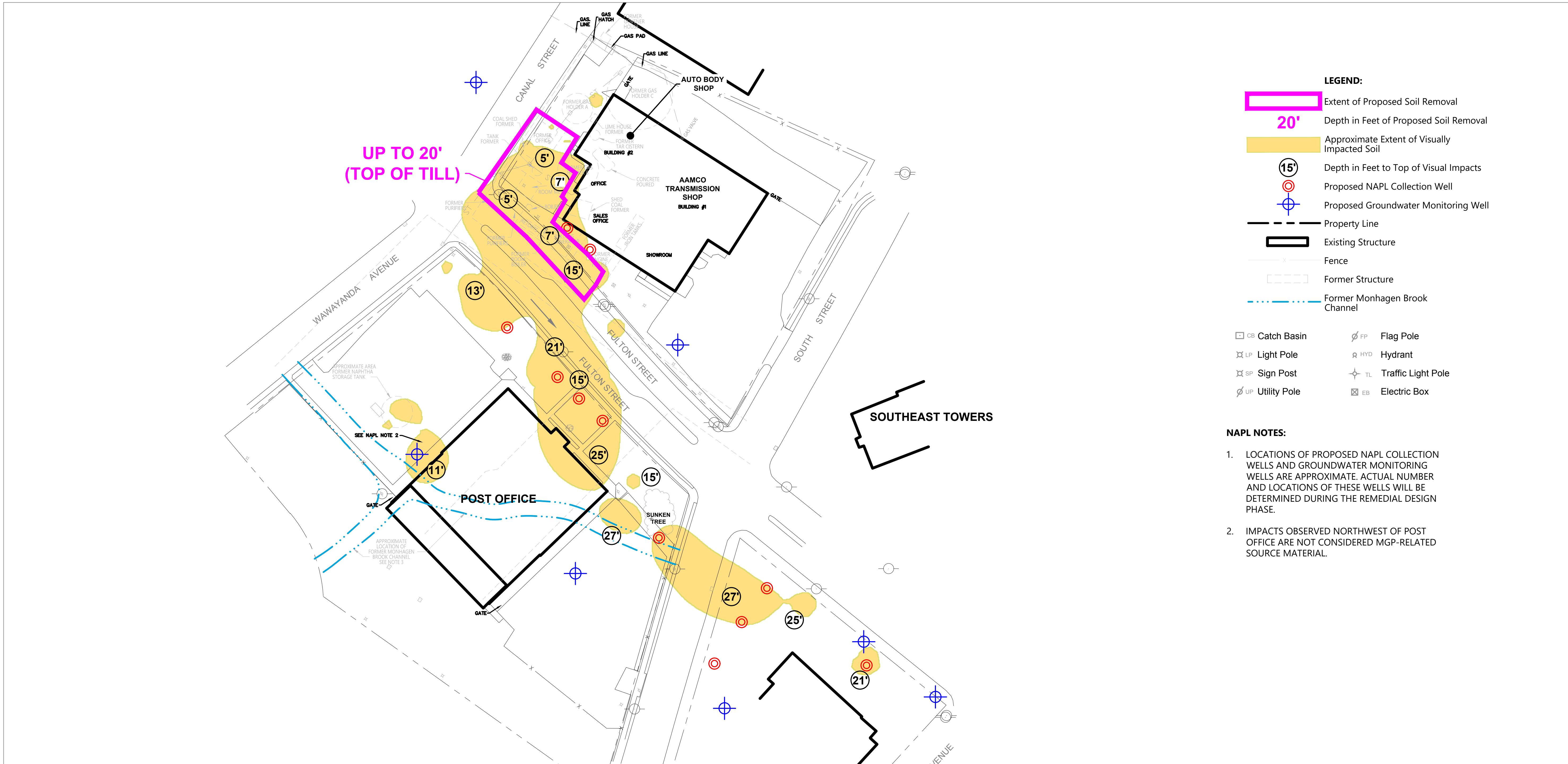
Figure 5-4
Alternative 4
Feasibility Study
Fulton Street Former MGP Site, Middletown, New York
Orange and Rockland Utilities



SOURCE: Based on "Feasibility Study" report figures by ARCADIS US, Inc., 2010 and 2016. See notes for additional references.
HORIZONTAL DATUM: New York East, HARN, U.S. Feet.
VERTICAL DATUM: NAVD88 (presumed)

NOTES:
1. Additional base map references:
1.1. Survey by Paul James Olszewski, P.L.S., PLLC, Camillus NY on August 31, 2016.
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2. Many locations are approximate. Refer to note 1, item 1.1 above for surveyed locations.
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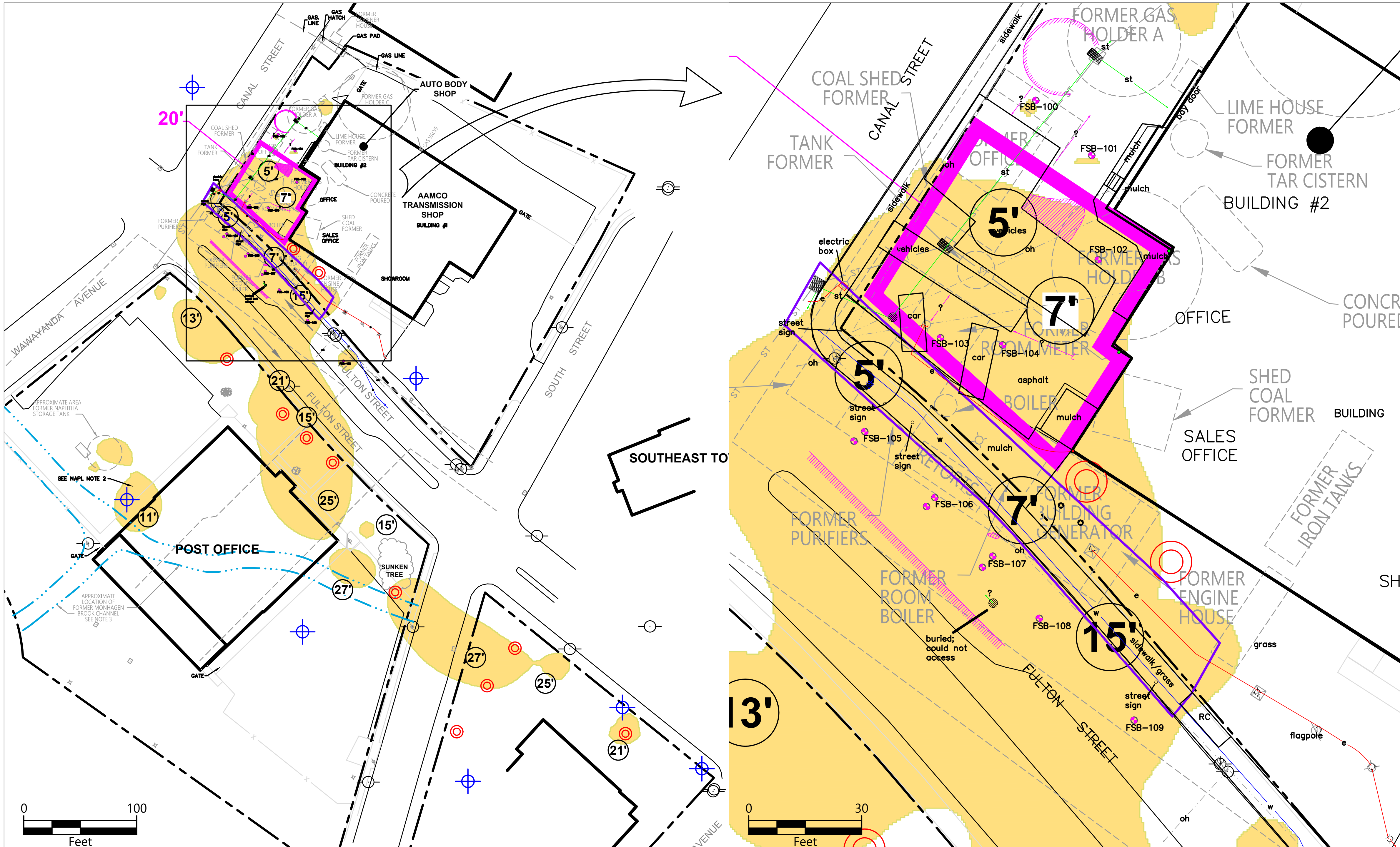
Figure 5-5
Alternative 5
Feasibility Study
Fulton Street Former MGP Site, Middletown, New York
Orange and Rockland Utilities



LEGEND:

- Extent of Proposed Soil Removal
- 20' Depth in Feet of Proposed Soil Removal
- Approximate Extent of Visually Impacted Soil
- Utility Clean Corridor Area
- 15' Depth in Feet to Top of Visual Impacts
- Proposed NAPL Collection Well
- Proposed Groundwater Monitoring Well
- Property Line
- Existing Structure
- Fence
- Former Structure
- Former Monhagen Brook Channel

CB Catch Basin	FP Flag Pole	e electric line	utility pole
LP Light Pole	HYD Hydrant	w water line	catch basin
SP Sign Post	TL Traffic Light Pole	? suspected utility	manhole cover
UP Utility Pole	EB Electric Box	st storm sewer	water valve
		oh overhead line	fire hydrant
		metal-detector anomaly	former light pole
		proposed exploratory boring site	monitoring well

NAPL NOTES:

1. LOCATIONS OF PROPOSED NAPL COLLECTION WELLS AND GROUNDWATER MONITORING WELLS ARE APPROXIMATE. ACTUAL NUMBER AND LOCATIONS OF THESE WELLS WILL BE DETERMINED DURING THE REMEDIAL DESIGN PHASE.
2. IMPACTS OBSERVED NORTHWEST OF POST OFFICE ARE NOT CONSIDERED MGP-RELATED SOURCE MATERIAL.
3. EXTENT OF VISUALLY IMPACTED SOILS BASED ON ANCHOR QEA EVS MODEL DECEMBER, 2017.

HORIZONTAL DATUM: New York East, HARN, U.S. Feet.
VERTICAL DATUM: NAVD88 (presumed)

SOURCE NOTES:

1. Base map references:
   1.1. "Feasibility Study" report figures by ARCADIS US, Inc., 2010 and 2016.
   1.2. Survey by Paul James Olszewski, P.L.S., PLLC, Camillus NY on August 31, 2016.
   1.3. Geophysical Survey by NAEVA Geophysics, Inc. on December 4, 2015.
   1.4. GEI Consultants, Inc. Remedial Investigation Report, November 2000.
2. Many locations are approximate. Refer to note 1, item 1.1 above for surveyed locations.
3. Location of former Monhagen Brook inferred based on voids encountered in soil borings SB-16, SB-69, SB-79 and SB-74.

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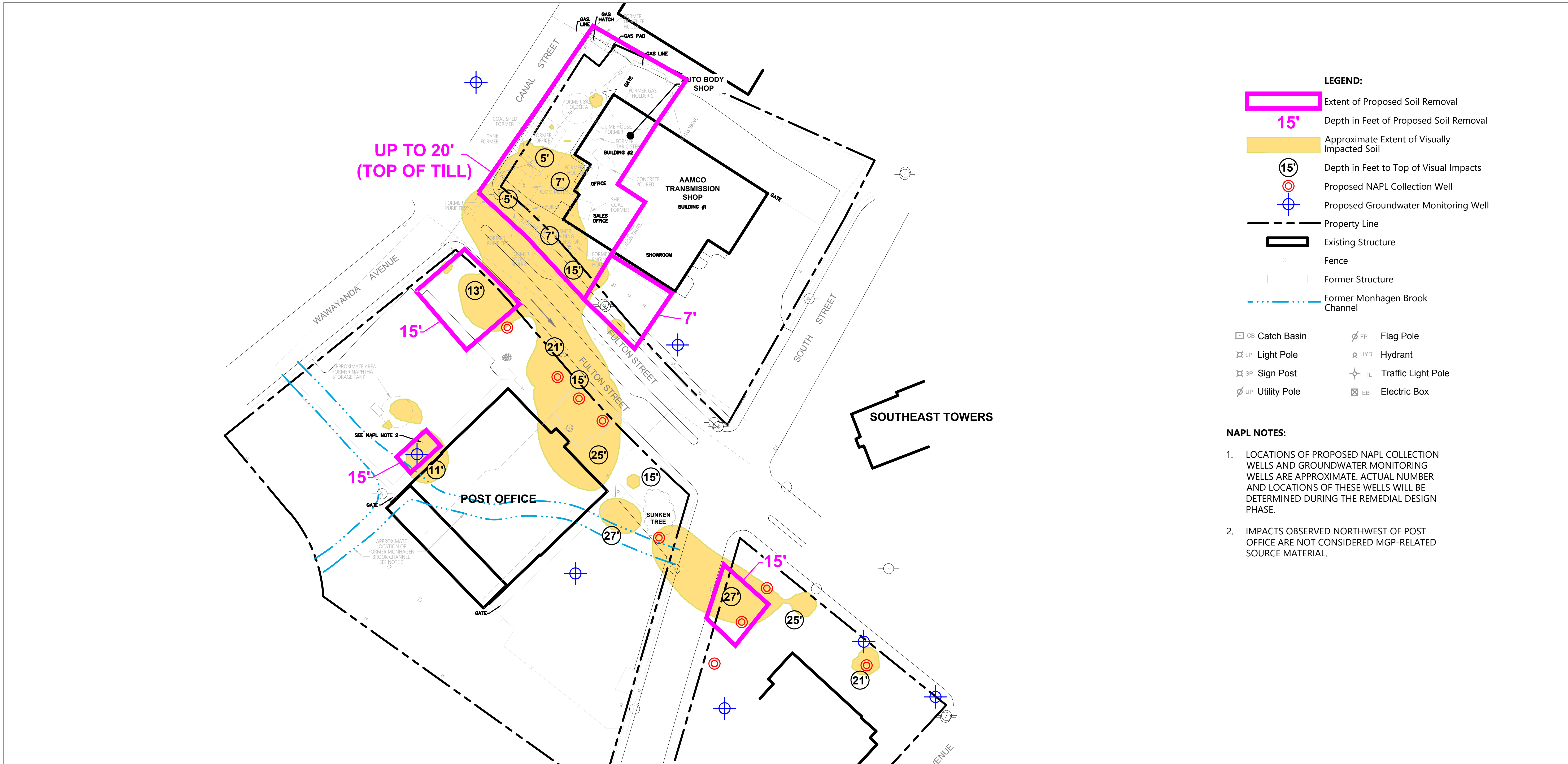
Figure 5-6
Alternative 6
Feasibility Study
Fulton Street Former MGP Site, Middletown, New York
Orange and Rockland Utilities



SOURCE: Based on "Feasibility Study" report figures by ARCADIS US, Inc., 2010 and 2016. See notes for additional references.
HORIZONTAL DATUM: New York East, HARN, U.S. Feet.
VERTICAL DATUM: NAVD88 (presumed)

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Figure 5-7
Alternative 7
Feasibility Study
Fulton Street Former MGP Site, Middletown, New York
Orange and Rockland Utilities

Appendix A
Current Zoning Map for Project Area

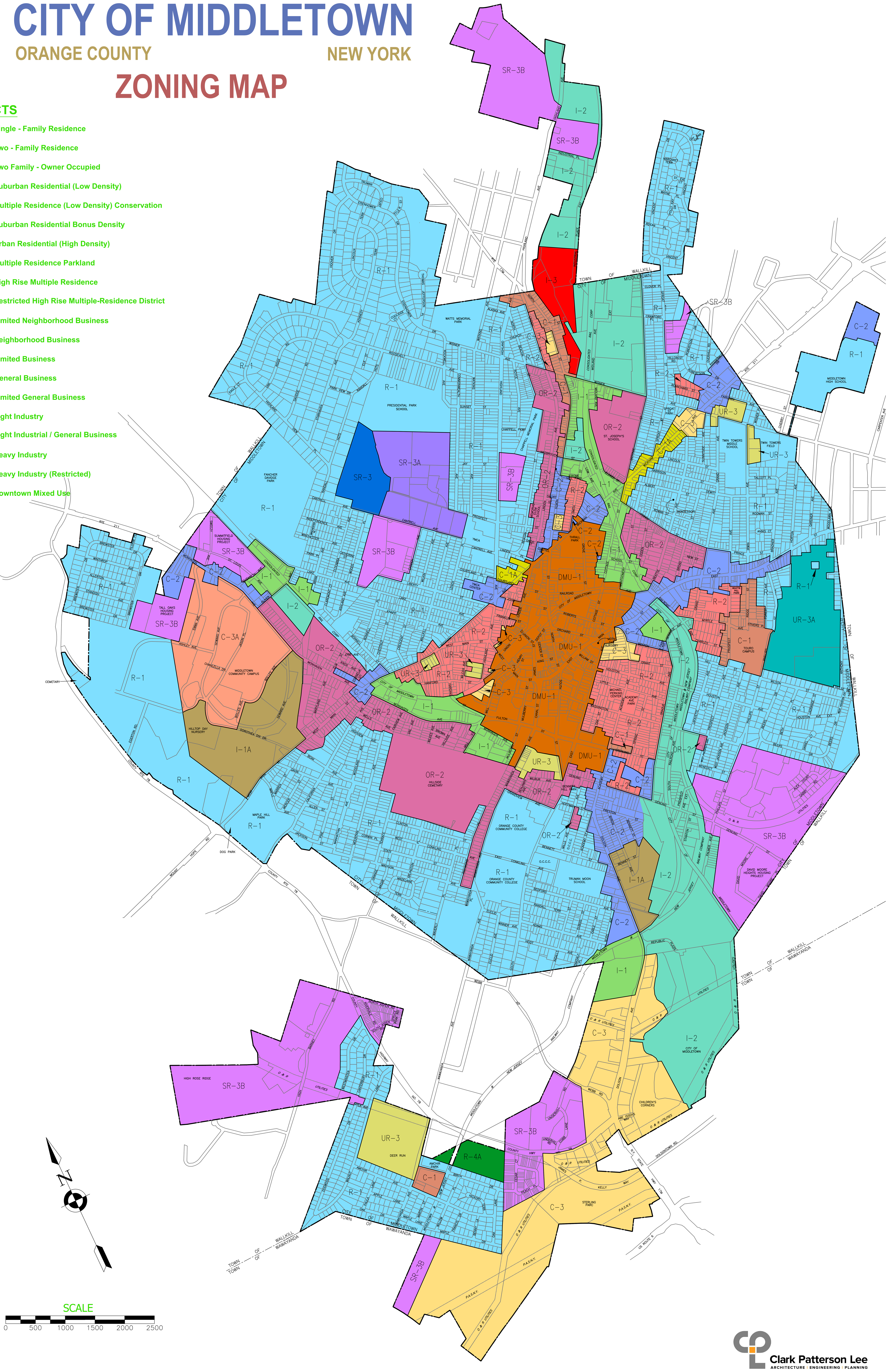
CITY OF MIDDLETOWN

ORANGE COUNTY NEW YORK

ZONING MAP

DISTRICTS

R-1	Single - Family Residence
R-2	Two - Family Residence
0R-2	Two Family - Owner Occupied
SR-3	Suburban Residential (Low Density)
SR-3A	Multiple Residence (Low Density) Conservation
SR-3B	Suburban Residential Bonus Density
UR-3	Urban Residential (High Density)
UR-3A	Multiple Residence Parkland
R-4	High Rise Multiple Residence
R-4A	Restricted High Rise Multiple-Residence District
C-1A	Limited Neighborhood Business
C-1	Neighborhood Business
C-2	Limited Business
C-3	General Business
C-3A	Limited General Business
I-1	Light Industry
I-1A	Light Industrial / General Business
I-2	Heavy Industry
I-3	Heavy Industry (Restricted)
DMU-1	Downtown Mixed Use



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ARCHITECTURE | ENGINEERING | PLANNING

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