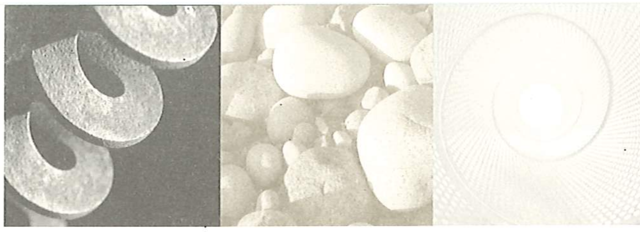

GEI Consultants

Geotechnical
Environmental
Water Resources
Ecological

Feasibility Study Report

Ithaca First Street Former MGP Site
Ithaca, New York

NYSDEC Site No. 7-55-006

Submitted to:
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Appendices

Abbreviations and Acronyms

AOC	Areas of Concern
AST	Above-Ground Storage Tank
AWQS	Ambient Water Quality Standards, Guidance Values, and Groundwater Effluent Limitations
bgs	Below Ground Surface
BTEX	Benzene, Toluene, Ethylbenzene, and Xylene
CAMP	Community Air Monitoring Plan
COCs	Compounds of Concern
CWG	Carbureted Water Gas
CY	Cubic Yard
DEC Soil Cleanup Guidance	Soil Cleanup Guidance DEC Policy, November 4, 2009
DER-10	NYSDEC DER-10 Technical Guidance for Site Investigation and Remediation, May, 2010
DNAPL	Dense Non-Aqueous Phase Liquid
DPW	Department of Public Works
FS	Feasibility Study
GEI	GEI Consultants, Inc.
GRA	General Response Action
HDPE	High-density Polyethylene
IAWWTF	Ithaca Area Wastewater Treatment Facility
IRM	Interim Remedial Measure
IC/ECs	Institutional Controls/Engineering Controls
ISCO	In-Situ Chemical Oxidation
ISS	In-Situ Solidification
LNAPL	Light Non-Aqueous Phase Liquid
LTTD	Low-Temperature Thermal Desorption
MGP	Manufactured Gas Plant
mg/kg	Milligrams per kilogram (equivalent to ppm)
MNA	Monitored Natural Attenuation
NAPL	Non-Aqueous Phase Liquid
NAVD88	North American Vertical Datum 1988
NCP	National Contingency Plan. 40CFR1J Part 300 – National Oil and Hazardous Substances Pollution Contingency Plan
NGVD	National Geodetic Vertical Datum 6 NYCRR Title 6 of the New York Codes, Rules, and Regulations
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
NYSEG	New York State Electric and Gas Corporation
ORC	Oxygen Releasing Compounds
OM&M	Operations, Maintenance and Monitoring
OSHA	Occupational Safety & Health Administration
PAHs	Polycyclic Aromatic Hydrocarbons
ppb	Parts Per Billion
PPE	Personal Protective Equipment

Abbreviations and Acronyms (cont.)

ppm	Parts Per Million (equivalent to mg/kg in soil)
PRAP	Proposed Remedial Action Plan
RAO	Remedial Action Objective
RCRA	Resource Conservation and Recovery Act
RD	Remedial Design
RI	Remedial Investigation
RIR	Remedial Investigation Report
ROD	Record of Decision
ROW	Right-of-way
SCG	Standards, Criteria, and Guidance
SCO	Soil Cleanup Objective
SMP	Site Management Plan
SPDES	State Pollutant Discharge Elimination System
SVOCs	Semi-Volatile Organic Compounds
SWRP	Surface Water Elevation Reference Point
TAGM	Technical and Administrative Guidance Memorandum
TAL	Target Analyte List
TBC	To Be Considered
TOGS	Technical and Operational Guidance Series
U.S. EPA	United States Environmental Protection Agency
UST	Underground Storage Tank
VCO	Voluntary Consent Order
VOCs	Volatile Organic Compounds

Engineer's Certification

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

I, John T. Finn, certify that I am currently a NYS registered professional engineer and that this Report was prepared in accordance with all applicable statutes and regulations and in substantial conformance with the 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.

STATE OF NEW YORK
JOHN T. FINN
073034
LICENSED PROFESSIONAL ENGINEER

12/23/10

Engineer's Seal
GEI Consultants, Inc.

Date

Executive Summary

Introduction and Purpose

This report describes the Feasibility Study (FS) undertaken for a site located on Third Street in the City of Ithaca, New York. The site is the location of a former manufactured gas plant (MGP) which was constructed and operated by NYSEG (New York State Electric and Gas Corporation). The FS was conducted pursuant to a Multi-site Order on Consent between NYSEG and the New York State Department of Environmental Conservation (NYSDEC). The location is shown in Figure 1. The purpose of the FS was to identify and evaluate a range of remedial alternatives and then recommend a remedy.

The FS was based on a series of environmental studies performed at the site and takes into account several soil removal actions conducted at the site. These are described in the Remedial Investigation Report (RIR) of December 2010.

Site Description, History, and Conceptual Site Model

The site is a three acre area located within a parcel of land owned by the City of Ithaca. This parcel is also the current location of the Ithaca Area Wastewater Treatment Facility (IAWWTF). For the purposes of this report, the boundaries of the site are defined as the IAWWTF perimeter fence to the south, east, and west, and the shoreline of Cascadilla Creek to the north. The former MGP was located in the north and northeast area of the site.

The MGP operated for 8 years from 1927 to 1934 using the carbureted water gas (CWG) process. The features of the MGP included the gas production building, two gas holders, four gas purifiers, a scrubber, four coal tar handling structures, a railroad trestle where coal and oil was staged, four oil and tar tanks, a laboratory and meter building, and a repair shop. When natural gas became available in the area, the plant was put on stand-by service. Following the cessation of MGP operations, several of the MGP features were demolished by NYSEG. The property was sold to the City of Ithaca in 1959. Additional MGP features were removed by the City of Ithaca during multiple phases of wastewater treatment plant construction which began in 1959, and culminated in the construction of the current IAWWTF in 1989. Based on a review of available historical information, and on the sampling performed during the RI, it appears that all of the above-grade and below-grade MGP features have been removed from the site. During the construction of the IAWWTF, soil impacted with MGP-related residuals was excavated from several areas of the site and subsequently disposed of off-site by NYSEG.

Petroleum and coal tar non-aqueous phase liquid (NAPL) mixed in the soil matrix was observed in the central area of the site to the west and southwest of the MGP area. Based on borings located along the top of the creek bank, petroleum or coal tar NAPL and MGP-related compounds of concern (COCs) do not appear to be migrating in the subsurface towards Cascadilla Creek. Petroleum or coal tar-impacted soil was not identified deeper than 30 feet bgs within the area of observed impacts. Due to the presence of the IAWWTF digestors, it is unknown whether there is impacted soil beneath the IAWWTF building. Since impacts were observed in the soil borings advanced at locations adjacent to the building foundation, it appears possible that impacted soil may also be present beneath the building. The digestors have deep foundations and are filled with wastewater, therefore it is unlikely that soil vapor intrusion is occurring at the northern portion of the IAWWTF building, in the area adjacent to the observed area of soil impacts.

Hydrology and Hydrogeology

Surface water in the central area of the site is collected in a series of storm water pipes which discharge into Cascadilla Creek. Surface water in the Cayuga Waterfront Trail area drains to the north into Cascadilla Creek by sheet flow.

The water table is found at depths which ranged from approximately 4 to 14 feet bgs across the site. The direction of groundwater flow in the shallow and deeper zones sampled during the RI is away from Cascadilla Creek, generally from the north to the southeast.

Groundwater contains dissolved compounds from the MGP residuals. Groundwater with MGP-related COC in concentrations greater than NYSDEC groundwater standards in both the shallow and deep zones is localized around the areas with impacted soil, and is limited to the central portion of the on-site area. Groundwater is not extracted and/or used in the area investigated during the RI. The City of Ithaca obtains its drinking water from surface water sources which are located several miles east of the site.

Summary of the RI and Exposure Assessment

A qualitative human health exposure assessment was performed for the site and the surrounding areas for current and potential future receptors. The assessment evaluated the potential for an exposure to site-related COC for outdoor utility and maintenance workers, site visitors, trespassers, recreational users, and subsurface utility workers. For all but one of these groups, the potential for an exposure is considered to be low. For a subsurface utility worker who performs subsurface work on the site to repair underground utilities, or for a future construction project, the worker may potentially be exposed to petroleum or coal tar NAPL, impacted soil vapor, and/or impacted groundwater if excavation work is required. It is unlikely that these residuals would be encountered at depths of less than 8 feet bgs; however, it is possible that they may be encountered in deeper excavations. These potential exposures can be mitigated through the use of properly trained personnel and personal protective equipment (PPE). Therefore, subsurface work at the site should only be performed by properly trained and equipped personnel.

General Response Actions (GRAs)

GRAs are categories or approaches to the remedy which may be combined and further defined to create remedial alternatives. To meet the remedial action objectives (RAOs) developed for the site, the following GRAs were identified:

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

Identification and Screening of Technologies

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

The identification and screening of technologies was conducted in three stages, in accordance with DER-10 guidance. An initial screening process was first used to determine the most applicable technologies for the site. For each of the General Response Actions – No action, Institutional Controls/Engineering Controls, Containment, In-Situ Treatment, and Removal - one or more technologies and process options were identified, described, and screened with respect to site-specific applicability.

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

The retained technologies included IC/ECs; groundwater MNA; NAPL recovery and off-site treatment, reuse, or disposal; surface soil cover; and subsurface soil excavation and off-site soil treatment and disposal.

Development and Analysis of Alternatives

The remedial alternatives for the Ithaca First Street site were developed in the context of the previous remedial actions that had been conducted at the site.

Several previous site activities were substantial remedial actions which provided overall protection of human health and the environment. These actions were aligned with the RAOs described in Section 4. These actions included:

1. IAWWTF construction activities removed impacted soil and former all above-grade and below-grade MGP structures.
2. An estimated 8,000 cubic yards (CY) of impacted soil and debris (stockpiled from the IAWWTF construction) was removed from the site during the Interim Remedial Measure (IRM) in 1998.
3. Grading the site and establishing a grass cover during the IRM in 1998.
4. Soil cover and asphalt paving of the Cayuga Waterfront Trail were placed over 39,000 square feet in the northern end of the site in 2010.

A range of alternatives for additional remedial actions were developed for this site, based on the land use approaches, RAOs, and GRAs and the applicable technologies. A total of six alternatives were developed and retained for detailed analysis:

1. No Action (required for comparison purposes by DER-10).
2. Implementation of IC/ECs, including groundwater use restrictions, a Site Management Plan (SMP), a property easement agreement, and site perimeter fencing (Figure 7).
3. IC/ECs, plus a soil cover, as required, and groundwater monitoring (Figure 8).
4. IC/ECs, a soil cover, groundwater monitoring, plus NAPL recovery (Figure 9).
5. IC/ECs, a soil cover, groundwater monitoring, plus removal by partial excavation of soils in the upper 15 feet that exceed 500 mg/kg total polycyclic aromatic hydrocarbons (PAHs) and Industrial soil cleanup objective (SCO) levels for benzene, toluene, ethylbenzene, and xylene (BTEX), with non-accessible and deeper source areas addressed by NAPL recovery (Figure 10).
6. Soil removal by excavation to Unrestricted SCO levels (required for comparison purposes by DER-10, Figure 11).

The following eight criteria defined by DER-10:

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

Community Acceptance, which is the ninth criterion, will be evaluated after the public comment period for the FS, in accordance with DER-10.

Recommended Remedy

Upon consideration of the alternatives and their respective attributes and limitations, and the removal actions that have already occurred at the site, Alternative 4 – NAPL recovery, soil cover, IC/ECs, and groundwater monitoring, emerged as the recommended additional remedy for the site.

The recommended remedy would involve installation and operation of NAPL recovery wells and annual monitoring groundwater, for an estimated total cost of $2.1 million. This cost estimate includes capital costs, operations, maintenance, and monitoring costs, and a 20% contingency. FS cost estimates have a range of accuracy of +50% to - 30%.

The recommended remedy will allow the current future site uses as a municipal sewage treatment plant and a recreational trail. These actions included in the alternative will achieve increased protection of human health and the environment compared to current conditions. Alternative 4 will address source areas and will monitor the long-term groundwater conditions, leading to the achievement of the RAOs, to the extent practicable, given the presence of the IAWWTF (with a known differential settlement problem) and large subsurface sewage pipelines at the site. This alternative does not involve undue short-term risks, and is characterized by a balance of cost and effectiveness.

In accordance with DER-31 Green Remediation, this alternative would have a moderate environmental footprint, primarily associated with the initial installation of NAPL recovery wells, and the ongoing periodic transport, treatment and disposal or re-use of recovered NAPL. During the course of the remedial activities, steps would be taken to mitigate the environmental footprint and provide for sustainable practices, energy usage, and materials. The details of these provisions will be developed in the design phase of the remedy.

This remedial alternative would be accomplished in the following approximate sequence of actions:

- Design and placement of additional soil cover material in the area of surface soil exceedances inside the perimeter fence.
- Pre-design investigation (PDI), pilot testing, design, installation, and operation of NAPL recovery wells in areas which may contain recoverable NAPL. The results of the PDI will be key in optimizing appropriate placement and number of NAPL recovery wells.
- Design and placement of appropriate signs for the perimeter fence.
- Establishment and implementation of a long-term groundwater monitoring program for the site.
- Establishment and implementation of a SMP and Groundwater Use Restriction for the site, to be included in the environmental easement or deed restriction for the property.
- Establishment and implementation of a program for IC/EC inspections, and certifications in Periodic Review Reports.

The design phase for this remedy would have a duration of approximately 6 months. The active site work, including the placement of the additional soil cover and the installation and initial testing of the NAPL recovery wells, would have a duration of approximately 6 months.

The duration of the NAPL recovery operations are difficult to predict prior to initial installation and testing of pilot wells. NAPL recovery operations at similar sites have had typical durations ranging from less than 1 year to more than 10 years.

The duration of the long-term groundwater monitoring program is estimated to be 30 years, with a program review and possible revision typically occurring every 5 years.

The recommended remedy represents a balanced and appropriate approach to address the remaining MGP impacts present on the site, given the current and future planned uses of the property. The remedy will be designed and implemented in coordination with the operations of the IAWWTF and the public use of the Cayuga Waterfront Trail so that scheduling of the on-site activities, traffic flows, parking areas, equipment staging, and other aspects of the work would be coordinated with the maximum efficiency and least short-term impacts, to the ultimate benefit of the City of Ithaca and the surrounding community.

The next step, after NYSDEC issuance of a Proposed Remedial Action Plan (PRAP) for public comment, and a Record of Decision (ROD), will be the design for the remedy with specific work plans detailing each element of the remedy.

1. Introduction and Scope

This report describes the Feasibility Study (FS) undertaken for a site located on Third Street in the City of Ithaca, New York. The site is the location of a former manufactured gas plant (MGP) which was constructed and operated by NYSEG (New York State Electric and Gas Corporation). The FS was conducted pursuant to a Multi-site Order on Consent between NYSEG and the New York State Department of Environmental Conservation (NYSDEC). The location of the site is shown on Figure 1. The purpose of the FS was to identify and evaluate a range of remedial alternatives and then recommend a remedy.

The Ithaca First Street former MGP site consists of a three acre area located within a larger parcel of land owned by the City of Ithaca, as shown on Figure 2. This parcel is also the current location of the Ithaca Area Wastewater Treatment Facility (IAWWTF). For the purposes of this report, the boundaries of the site are defined as the IAWWTF perimeter fence to the south, east, and west, and the shoreline of Cascadilla Creek to the north. The former MGP was located in the north and northeast area of the site. An aerial photograph of the site showing the current IAWWTF is provided as Figure 3.

As requested by the NYSDEC, this FS report has been prepared following the completion of the Remedial Investigation Report (RIR) for the site [GEI, 2010a]. This FS report summarizes the RI findings and potential human health and environmental impacts identified at the site; defines remedial goals, remedial action objectives (RAOs) and standards, criteria and guidance (SCGs) which are used in the selection of a site remedy; develops and evaluates remedial alternatives; and presents a recommended remedy for the site. The balance of the document is divided into the following sections, in accordance with NYSDEC's guidance document DER-10, Technical Guidance for Site Investigation and Remediation [Section 4.4 (b) 4]:

- **Section 2.0 - Site Description and History**. This section provides a description of the current layout of the site, and the history of the MGP.
- **Section 3.0 - Summary of the RI and Exposure Assessment**. This section describes the results of the environmental investigation, and evaluates the resulting potential for current or potential future site users to be exposed to MGP-related residuals.
- **Section 4.0 - Remedial Goals and Remedial Action Objectives**. This section introduces the documents that govern the FS evaluation, and presents the requirements which are applied to the MGP site.
- **Section 5.0 - General Response Actions and Volume Estimates**. This section describes the broad categories of remedies under consideration for this site and provides estimates of the volumes of the impacted media present at the site.

- **Section 6.0 - Identification and Screening of Technologies**. This section names and describes the principal technologies which might be brought to bear for the remedy of the site, and screens these technologies for applicability to the Ithaca First Street site.
- **Section 7.0 - Development and Analysis of Alternatives**. In this section, a range of alternatives consisting of several technologies are described, evaluated in accordance with a standard set of criteria, and compared with one another.
- **Section 8.0 - Recommended Remedy**. This section presents the principal elements and sequence of implementation of the remedy.
- **Section 9.0 - References**.

Cost estimates for the remedial alternatives are provided in Appendix A. The basis of volume estimates for subsurface soil and groundwater are presented in Appendix B.

2. Site History, Description, and Conceptual Site Model

This section provides a summary of the site history and description based on information presented in the RIR for the Ithaca First Street MGP site.

2.1 Site Description

The site is a three acre area of land, situated within a larger (11 acre) parcel which is currently owned by the City of Ithaca. The site is the location of the current IAWWTF. The IAWWTF is operated by a joint commission, which includes the City of Ithaca, the Town of Ithaca, and the Town of Dryden.

The site is bounded to the west, south, and east by the IAWWTF perimeter fence. The site boundary to the north is the shoreline of Cascadilla Creek. As shown on Figure 3, the MGP was located on approximately one acre in the north and northeastern area of the site. During the period of operations, the MGP was located adjacent to First Street (thus the designation of the site as the former First Street MGP). The northwestern portion of First Street (the portion of the roadway on the site) was cut-off after 1964, when the current New York State (NYS) Route 13 was built to the east.

Access to the IAWWTF is from Third Street. A perimeter fence surrounds the facility, and access is limited to IAWWTF employees and other personnel of the City of Ithaca Department of Public Works (DPW). Contractors who access the facility, such as wastewater haulers, must receive prior authorization to use the facility, and sign in and out for each site visit.

The surface of the site is mostly covered by the IAWWTF main wastewater treatment building, and an attached chemical storage building to the north. Additional site buildings include: the Deep Shaft Pilot Building (currently a storage building), the Influent Building, the former Recirculation Building (no longer in service), the Septage Receiving Building, and an Electrical Substation Equipment Building. Around the buildings are asphalt parking lots; gravel and asphalt driveways; and grass, weed, and brush-covered areas at the parcel’s perimeter. The grass-covered areas of the parcel are mowed by employees of the IAWWTF. A gasoline underground storage tank (UST) is present to the southwest of the storage building, which is used to fuel facility vehicles.

The above-ground and subsurface utilities identified during utility clearing activities completed prior to the RI field activities are shown on Figure 3. As shown on the figure, there are overhead electrical lines, and an extensive number of subsurface utilities present at the site around the IAWWTF buildings, and in the yard between the outbuildings and the main wastewater treatment plant building. These subsurface utilities include: storm water drains, the sanitary sewer main line, additional septic influent and discharge pipes, chlorine-feed pipes, process drain pipes, underground electric lines, natural gas supply lines, fiber optic communication lines, water lines, and other utilities associated with the wastewater treatment operations.

Along the north side of the IAWWTF perimeter fence is an approximately 60-foot wide strip of land which parallels Cascadilla Creek. This area is relatively flat up to the top of the bank, and then the land surface slopes steeply down to the shoreline of Cascadilla Creek. The bank of the creek is covered by brush and trees.

A trail was formerly present along the top of the bank which was used for recreational purposes such as walking or biking. The trail was enlarged and improved with asphalt pavement in October 2010 by the City of Ithaca, as part of Phase III of the Cayuga Waterfront Trail project. To determine if soil in the footprint of the trail would need to be managed as impacted material, sampling of this area was performed during the RI. The soil sampling indicated that low-levels of polycyclic aromatic hydrocarbons (PAHs) were present in soil in the footprint of the new trail. Based on this sampling, NYSEG decided to perform the soil grading activities needed to install the new trail and emplaced a 1 foot clean soil cover on either side of the asphalt pavement, using a properly trained contractor. Construction and landscaping associated with the trail have been completed, and the activities associated with NYSEG's work on the project will be reported in the *Project Completion Report for the Soil Management Activities, Cayuga Waterfront Trail* [GEI, 2010b] (in preparation by GEI).

2.2 Site History and Former Structures

The RIR contains a chronology of the site from the 1800's to 2007, which has been compiled from a number of sources, including records obtained from NYSEG and the City of Ithaca. The historical features of the MGP are shown in blue on Figure 3.

Based on the available information, the Ithaca First Street MGP began operations in 1927, using coal and oil to produce gas using the carbureted water gas (CWG) process. The MGP continued operations for 8 years until 1934. The 1935 listings indicate that the Ithaca First Street MGP had been shut down that year, and that natural gas was being piped into the Ithaca area. The MGP was then put on standby service. The final date for the period of stand-by service is not known. The MGP parcel was sold to the City of Ithaca in April 1959.

The historical research identified various former site features which may have been potential source areas or areas of concern (AOCs) for MGP-related residuals and as such, those areas were targeted for investigation during the RI. The key features of the MGP, shown on Figure 3, are summarized as follows:

- **MGP Building –** The building was located in the northeastern area of the MGP. The building contained a Machinery Room/Pump Room, a Water Gas Room/Producer House, and a Boiler Room.
- **Gas Holder A –** Gas Holder A was the storage and distribution holder for the MGP. It was located to the southwest of the MGP Building (Figure 2) and had a capacity of 500,000 cubic feet.
- **Gas Holder B –** Gas Holder B was the relief holder for the MGP. It was also located to the southwest of the MGP Building (Figure 2) and had a capacity of 100,000 cubic feet.
- **Tar Sump A –** A tar sump was present to the north of the Machinery Room.
- **Tar Well B –** Adjacent to, and to the northeast of the MGP Building was a tar handling feature. This feature was labeled as a Clarifying Tank or as a Tar Well on different site figures.
- **Tar Separator C –** A third tar handling feature labeled as a tar separator was shown on the historic maps, also at a location to the northeast of the MGP Building.
- **Tar Separator D –** A fourth tar handling feature was shown on the historic figures. This figure is labeled as a tar and liquor separator on the 1926 proposed plant drawings, and as a tar pit or tar well on later drawings.
- **ASTs E and F –** Two above-ground storage tanks (ASTs) were located to the west of the MGP Building. Based on the available information, it appears that the tanks may have been used to store both tar and oil.
- **Oil Tank A –** Oil Tank A was an above-ground oil tank located to the south of the MGP Building. The tank capacity was 250,000 gallons.
- **Oil Tank B** – A second smaller oil tank was present to the northwest of Oil Tank A. Drawings indicate that the tank was 30-feet in diameter, with a capacity of 100,000 gallons.
- **Purifiers –** To the west of the MGP Building were four gas purifiers. These were above-ground structures.
- **Scrubber –** A gas scrubber was located immediately to the north of the purifiers.
- **Oxide Yard –** Further to the west of the purifiers was an area labeled “Oxide Yard” on a 1946 NYSEG facility map. Oxide yards at MGPs were typically areas where spent lime and spent iron oxide (commonly called purifier box wastes) were staged for management.
- **Work Shop –** A Work Shop was located to the west of the Oxide Yard.
- **Meter Room/Laboratory/Office Building –** To the southwest of the MGP Building, adjacent to Holder A was an outbuilding which was constructed as a Meter Room and a Laboratory/Office building. On the 1946 NYSEG facility map, the building is labeled as a Meter House and a Coal Company Office. A smaller coal shed is also shown to the south of

the building. Coal may have been distributed from this area sometime after the end of MGP operations.

- **MGP Facility Septic Tank and Leaching Well –** Two additional subsurface features were constructed to the west of the MGP Building. These features include the Septic Settling Tank and the Septic Leaching Well.
- **Fuel Storage/Coal Trestle –** To the east of the MGP Building was a railroad track spur which connected a railroad trestle to the main line of the adjacent Lehigh Valley Railroad. This feature was labeled "Fuel Storage/Coal Trestle" on the 1929 Sanborn Map.
- **Process Pipes –** Several subsurface process pipes for the MGP were shown on the historical facility drawings, connecting various site features.

Information regarding the decommissioning of the MGP was not identified during the review of the available historical information performed for the RI. From a 1954 photograph, it appears that NYSEG had removed the above-ground portions of the oil ASTs, the purifiers, the shop, the scrubber, and the gas holders by that time. At the time that the City of Ithaca purchased the property in 1959, only the MGP Building and the Meter Room/Laboratory/Office Building are shown on a site layout plan.

Additional MGP features were removed by the City of Ithaca during multiple phases of wastewater treatment plant construction which began in 1959, and culminated in the construction of the current IAWWTF in 1989. Based on a review of available historical information, and on the sampling performed during the RI, it appears that all of the above-grade and below-grade MGP features have been removed from the site. During the construction of the IAWWTF, soil impacted with MGP-related residuals was excavated from several areas and stockpiled at the site.

NYSEG performed an IRM in 1998 which consisted of the characterization, removal, and disposal of the stockpiled soil which had been generated during the IAWWTF construction activities. The pile had been graded and seeded in 1989 following the completion of the IAWWTF construction. In October 1998, 12,610 tons of soil was transported off site to a permitted solid waste disposal landfill facility. The soil stockpile area was then graded and covered with topsoil.

2.3 Physical Setting and Local Land and Water Use

2.3.1 Topography

The ground surface of the site is highest in the area where the Cayuga Waterfront Trail was constructed. The ground surface elevation in this area is approximately 392 feet North American Vertical Datum 1988 (NAVD88). To the north of the trail, the ground surface slopes to the top of the bank (approximately 387 feet NAVD88), and then slopes steeply down to the shoreline of

Cascadilla Creek (approximately 381 feet NAVD88). The overall change in elevation from the path to the shoreline of the creek is 11 feet.

To the south of the Cayuga Waterfront Trail, the ground surface of the site slopes towards the central area of the site. This area is a relatively flat area. The change in elevation from the path (392 feet NAVD88) to the central area of the IAWWTF yard (388 feet NAVD88) is 4 feet. There is also a slight slope from the IAWWTF building area (390 feet NAVD88) towards the central area of the yard.

2.3.2 Land Use

As described above, the site is used for a combination of industrial and recreational purposes. The majority of the site is industrial and in use as a wastewater treatment facility. The recreation area consists of the strip of land between the IAWWTF northern fence and Cascadilla Creek which is used as a portion of the Cayuga Waterfront Trail.

The surrounding area is also used for a combination of commercial, industrial, and recreational purposes:

- To the north, across Cascadilla Creek, the properties are used for commercial purposes.
- To the east and south the site is bordered by an active freight railroad line. New York State Route 13 is located to the immediate east of the railroad, and a variety of commercial and industrial facilities are located along the highway.
- To the west of the site is the Ithaca Farmers Market.

2.3.3 Zoning

The site is zoned by the City of Ithaca as P-1 (Park). The city has defined this classification with three defined uses:

1. Public recreation.
2. Public and semi-public institution whose purpose is education except that, within 200 feet of a residential district, any use other than classrooms or living accommodations which conform to the regulations of the adjacent residential district is permitted only by special permit of the Board of Appeals (see § 325-9).
3. All municipal public buildings, facilities and functions.

This zoning category encompasses a wide variety of public property uses, and each use has been assigned by the NYSDEC to one of its property use and soil protection categories. These are described as follows:

- Public recreation uses are subdivided by the NYSDEC into two sub-categories: contact, and non-contact recreation. Contact recreation uses include active recreation areas where there is a reasonable potential for soil contact, such as designated picnic areas, playgrounds, or natural grass sports playing fields and unpaved spectators areas. These uses are regulated under **Restricted Residential** use Soil Cleanup Objectives (SCOs). Non-contact recreation areas are defined as having limited potential for soil contact, such as artificial sports fields, paved surfaces, pools, golf courses, and paved (raised) bike or walking paths. These uses are regulated under **Commercial** use SCOs.
- Public education uses as defined by the P-1 classification includes elementary or secondary schools. These site uses are defined under the **Restricted Residential** use category.
- Municipal office buildings are considered as **Commercial** facilities by the NYSDEC. Other municipal facilities and uses generally fall under the **Industrial** use classification, including equipment yards, maintenance facilities and shops, and the wastewater treatment plants.

Given this wide range of allowed uses within a P-1 designated zone, the applicable SCOs for the First Street site must be determined based on the actual and intended future site uses. The majority of the property is associated with the IAWWTF, and therefore an industrial use classification applies. The northern margin of the property which is used for a portion of the Cayuga Waterfront Trail is used for non-contact recreation, and therefore commercial use SCOs would apply.

2.3.4 Utilities and Infrastructure

The site is serviced by a full set of municipal utilities, including water and sanitary sewer service provided by the City of Ithaca, and electric and natural gas services provided by NYSEG. Vehicle access is provided to Third Street. Although the site is bordered by the active Norfolk Southern Railway Corporation railroad line, there is currently no rail access at the site.

Additional site infrastructure is present as part of both the current and former features associated with the IAWWTF. Figure 3 shows the layout and surface features which make up this facility, and the locations of underground lines. Figures 4 and 5 (as well as Figures 7 through 11 which present the remedial alternatives) show the current and former buildings and features which make up the facility. A description of the current and former IAWWTF structures at the site can be found in the RIR [GEI, 2010a].

2.3.5 Water Supply in the Area

Drinking water is supplied to the site and all of the City of Ithaca by the Ithaca Water Department. The source of the water supply is the City's reservoir and water treatment system along Six Mile Creek, approximately 2 miles southeast of the site.

2.4 Site Geology

The subsurface strata at the site have been characterized during the geotechnical investigation performed for the construction of the IAWWTF (to bedrock at a depth of 430 feet bgs), and during the RI (to a depth of 50 feet bgs).

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

- **Fill –** The presence and thickness of anthropogenic fill material at the site is very variable, and was not observed at all of the RI sampling locations. Where identified, the fill was comprised of gray to dark brown sand and gravel and silt with varying amounts of ash, bricks, cinders, wood, and concrete. The fill was thickest (approximately 13 feet thick) in the central area of the site at MW8S.
- **Clayey Silt –** Beneath the fill is a soft to stiff, gray to gray-brown clayey silt with occasional seams of fine sand. This clayey silt unit was identified in the majority of the RI soil borings; however, the unit was not observed to be laterally continuous across the site.
- **Silty Sand and Sandy Silt –** Brownish-gray silty sand and sandy silt units were encountered at each of the RI soil boring locations. Although described by the field geologist as being separate units, these units have very similar characteristics and appearance. These units were, as a whole, observed to be laterally continuous across the site.
- **Sand –** Inter-bedded within the sandy silt/silty sands is a sand unit. The sand unit was not observed to be laterally continuous beneath the site. Where identified, the sand unit was observed to range in thickness from 7 to 13 feet thick.
- **Gravel –** Occasional lenses of gravel were observed at several of the RI boring locations. The gravel was infrequently observed, and is not a laterally continuous unit at the site.
- **Lower Clayey Silt –** A lower clayey silt unit was identified at each of the RI soil boring or well locations. The unit was observed to be laterally continuous across the site. As discussed above, the target depth for the soil borings advanced during the RI was to a depth several feet into the surface of this unit.

Soils deeper than 50 feet below ground surface (bgs) were characterized during the geotechnical investigations. The deeper subsurface units which were encountered are summarized as follows:

Channel Fill

- The Channel Fill Deposit was described to be loose to medium compact, gray sand with trace amounts of gravel and silt. The unit was only observed in borings completed in the fill area to the west of the site (current Farmers Market location).

Foreset Beds

- This unit was described as being compact to very compact, gray gravelly sand to sandy gravel with trace amounts of silt, with occasional silty sand seams or layers. Generally this unit was encountered between 70 and 90 feet bgs.

Bottomset Beds

- This unit was described as loose to very compact gray to brown silt, with trace to some fine sand and clay, to silty medium to fine sand with occasional silty clay seams and layers. The unit was generally observed at depths ranging from 100 to 125 feet bgs.

Glacial Fluvial Deposits

- Beneath the inter-bedded topset and bottomset deltaic alluvial deposits are layers of glacial-lacustrine sediments comprised of soft to hard, gray to brown inter-bedded silts, clays and sand with lesser amounts of gravel. The deposits were first encountered at depths of approximately 130 to 189 feet bgs, and are present down to the surface of the bedrock.

Bedrock

- Bedrock was identified at a depth of 430 feet bgs in the footprint of the IAWWTF Deep Shaft Pilot Study Building.

2.5 Surface Water Hydrology

Cascadilla Creek

Cascadilla Creek flows northwesterly along the northern boundary of the site and into the Cayuga Inlet, which in turn flows into Cayuga Lake. The surface water elevation in Cascadilla Creek, Cayuga Inlet, and Cayuga Lake is seasonally controlled by a lock system at Mudlock, which is located at the northern end of Cayuga Lake. The high and low lake levels are typically regulated at elevations of 382.5 feet NAVD88 and 378.5 feet NAVD88 during the warmer months (generally May to October) and the colder months (generally November to April) seasons, respectively. On the day that the synoptic groundwater elevation measurements were obtained for the RI (August 9, 2010), the elevation of surface water in the creek at a surface water elevation reference point (SWRP1) was 381.64 feet NAVD88.

Site Surface Water and Drainage

The Cayuga Waterfront Trail is a surface water drainage divide for the site. Surface water runoff from the trail to the north follows the slope of the ground surface towards the creek. Surface water runoff from the trail to the south is towards the central area of the IAWWTF yard. In this area, several catch basins have been constructed to capture storm water, and direct the storm water to the creek in three storm water outlet pipes. Heavy rain storms occurred several times during the RI field activities. Storm water was not observed to be present in the IAWWTF yard for extended periods of time.

2.6 Site Hydrogeology

Two groundwater zones beneath the site were monitored during the RI. These include the zone at the water table (shallow zone), and the zone above the clayey silt unit (deep zone).

Shallow Zone Groundwater Flow Direction

The depth to groundwater in the central area of the IAWWTF yard was measured during the RI at approximately 8 feet bgs. Based on the measurements from the shallow zone wells, and the measurement obtained for the surface water elevation reference point, the surface of the water table slopes away from the creek towards the central area of the IAWWTF yard, towards well MW3S. This well had the lowest elevation measured (379.76 feet NAVD88). The horizontal gradient from the creek (381.64 ft NAVD88), to MW3S (379.76 ft NAVD88) is 0.008 feet/foot. There is also a component of shallow groundwater flow from the off-site area to the east of the site towards the central area of the IAWWTF yard. The shallow groundwater flow from both directions is towards an area where the subsurface strata of the site has been highly disturbed by the construction of deep buildings, deep utility trench excavations below the water table, and foundation friction piles. It is possible that these deep features and/or the installation of the deep piles may be affecting the flow direction for groundwater across the site.

Deep Groundwater Zone Flow Direction

The highest elevations of the piezometric surface were observed for wells adjacent to Cascadilla Creek. Groundwater flow direction for the deeper wells is generally from the north/northwest to the southeast. The direction of groundwater flow is similar to the direction observed in the shallow zone; however, for this group of wells the lowest elevation of the piezometric surface was identified at MW1D (378.90 feet NAVD88).

Vertical Hydraulic Gradient

Vertical hydraulic gradients were evaluated during the RI by reviewing groundwater elevation data for those shallow zone and deeper zone wells that are in close proximity to each other.

Based on the data obtained during the RI, there appears to be a downward trend for flow potential in the western area of the site, and in the eastern perimeter of the site. There appears to be an upward trend in the direction of flow potential for the wells adjacent to Cascadilla Creek, and in the central area of the site, with the exception of the wells MW8S and MW8D, where there was a slight downward direction of flow potential. Overall, the data appears to be variable, and a consistent pattern for the direction of flow potential across the entire site was not identified.

Estimate of Hydraulic Conductivity

The hydraulic conductivity of the silt and sand units was estimated by E.C. Jordan, with the results included in the Task 2 Addendum Report [E.C. Jordan, 1989]. The hydraulic conductivity for the silt unit was estimated to range from 3.0 x 10^{-5} to 5.5 x 10^{-5} cm/sec. The hydraulic conductivity for the silty sand unit was estimated to range from 1.0 x 10^{-4} to 3.4 x 10^{-3} cm/sec. These ranges of estimated values of hydraulic conductivity are consistent with the conductivity anticipated for these unconsolidated deposits [Freeze and Cherry, 1979]. To obtain an estimate of the horizontal groundwater flow rate, a porosity of 0.3 for the sand, and a gradient of between 0.2 to 0.004 feet/foot were used. The estimate of horizontal groundwater flow rate within the silty sand was 7.74 feet/year [E.C. Jordan, 1989].

3. Summary of the RI and Exposure Assessment

This section describes the results of the environmental investigation, and evaluates the resulting potential for current or potential future site users to be exposed to impacts associated with the former MGP.

3.1 Extent of Impacts and Conceptual Site Model

3.1.1 Nature and Extent of Contamination

Each area of concern associated with the former MGP was investigated during the RI. From the background information reviewed, and the sampling performed for the RI, it appears that all of the above-grade and below-grade former MGP features have been removed from the site.

Media which were investigated at the site included surface soil, subsurface soil, groundwater, surface water, and sediments. Conclusions for each are summarized below.

Surface Soil

- The concentrations of compounds of concern (COC) identified in the surface soil samples were generally low-level concentrations, which were only slightly elevated above the Commercial Use SCOs.
- Surface soil is no longer exposed at the Cayuga Waterfront Trail area. This area has been covered by a 1-foot thick soil layer, or is covered by the asphalt trail.

Subsurface Soil

- Subsurface soil with visible petroleum and coal tar non-aqueous phase liquid (NAPL) mixed in the soil matrix, and/or COC with concentrations greater than Industrial Use SCOs, is present in the central area of the site. The most visibly impacted interval was from 8 to 24 feet bgs. Petroleum or coal tar NAPL in the soil matrix was not observed at depths deeper than 30 feet bgs.
- Drilling could not be performed in the footprint of the IAWWTF primary and secondary digestors, therefore it is not known whether impacted soil is present beneath the IAWWTF building.
- Based on borings and wells installed between the known areas of impact and Cascadilla Creek, petroleum and coal tar NAPL identified in the subsurface does not appear to be migrating in the subsurface to the north in the direction of the creek.

Groundwater

- Impacted groundwater is localized around the areas with observed petroleum and coal tar NAPL-impacted soil. The greatest concentrations of COC are in the central area of the site.
- Groundwater with concentrations of volatile organic compounds (VOCs) and semi-volatile organic compounds (SVOCs) exceeding NYSDEC groundwater standards is limited to the on-site area.
- Total cyanide was detected in four shallow zone wells in concentrations slightly greater than the NYSDEC groundwater standard.
- Light non-aqueous phase liquid (LNAPL) or dense non-aqueous phase liquid (DNAPL) has not been observed to accumulate in any of the 27 monitoring wells installed at the site.

Surface Water

Surface water in Cascadilla Creek has been found not to be impacted by the former MGP site. The investigations have found that there is not a pathway for migration of groundwater or NAPL from the site to the creek. Precipitation runoff from the site to the creek is limited to the area associated with the Cayuga Waterfront Trail; precipitation which falls within the IAWWTF is directed to a set of catch basins.

Sediments

Low-level concentrations of PAH compounds were identified in sediments in Cascadilla Creek. The concentrations of PAHs in the area adjacent to the site were similar to the concentrations detected for the background samples collected in the upstream area. MGP-related residuals do not appear to be migrating from the site towards the creek in either subsurface soil or groundwater. A chemical forensic data evaluation of site soil data and data from the creek sediments indicates that the PAH compounds in the creek sediments are likely present due to urban run-off sources, and are not related to the former MGP site.

3.1.2 Fate and Transport Mechanisms

Four media were investigated at the site: surface soil, subsurface soil, groundwater, and sediments. Test trenches and soil borings were completed in and around MGP features to determine the presence of structures and the condition of subsurface soil, and in locations outside of the MGP to determine the extent of the MGP-related residuals. Conclusions for each media are summarized below.

Surface Soil

Surface soil at the site contains PAHs in low-level concentrations which are not significantly elevated above the Commercial Use SCOs. Surface soil in the Cayuga Waterfront Trail area has been covered by the new trail paved with asphalt and clean imported soil which can be anticipated to eliminate the potential for direct contact of soil by a user of the trail. Surface soil in the IAWWTF yard is covered by grass, weeds, brush and gravel and asphalt roadways, or by the treatment plant buildings. Based on the short duration of the work performed in this area and the low concentrations of COC detected, the potential for an exposure to COC in surface soil at the yard is considered to be low.

Subsurface Soil

Petroleum and coal tar NAPL mixed in the soil matrix was observed in the central area of the site to the west and southwest of the MGP area. Based on borings located along the top of the creek bank, petroleum or coal tar NAPL and MGP-related COCs do not appear to be migrating in the subsurface towards Cascadilla Creek. Petroleum or coal tar-impacted soil was not identified deeper than 30 feet bgs within the area of observed impacts. Due to the presence of the IAWWTF digestors, it is unknown whether there is impacted soil beneath the IAWWTF building. Since impacts were observed in the soil borings advanced at locations adjacent to the building foundation, it appears likely that impacted soil may also be present beneath the building. The digestors have deep foundations and are filled with wastewater, therefore it is unlikely that soil vapor intrusion is occurring at the northern portion of the IAWWTF building, in the area adjacent to the observed area of soil impacts.

Groundwater

Groundwater contains dissolved compounds from the MGP residuals. Groundwater with MGP-related COC in concentrations greater than NYSDEC groundwater standards in both the shallow and deep zones is localized around the areas with impacted soil, and is limited to the central portion of the on-site area. Groundwater is not extracted and/or used in the area investigated during the RI. The City of Ithaca obtains its drinking water from surface water sources which are located approximately two miles southeast of the site.

Sediments

The potential for exposure of ecological receptor to a MGP site-related residual is not considered to be likely because Cascadilla Creek is outside of the area impacted by MGP-related residuals, and the RI did not find a migration pathway by which residuals would move to the creek.

3.2 Exposure Pathways and Potential Receptors

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

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

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

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

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

- On-site facility workers
- On-site outdoor maintenance workers
- On-site subsurface utility or construction workers
- Site visitors or trespassers
- Recreation path users
- Off-site commercial property workers
- Off-site Farmer’s Market users

The human health exposure assessment completed for the RI has evaluated the different types of human populations (e.g., resident, workers, recreational visitors, etc.) who might come into contact with media impacted by MGP-related COC at the site under current and future site use conditions. Section 6 of the RIR presents an assessment of the exposure pathways at the various properties that comprise the site study area. The assessment identified the potential exposure pathways (e.g., ingestion of impacted water, inhalation of chemicals in air, dermal contact with impacted soil) that may occur for each population. The exposure assessment found that one potentially complete exposure pathway exists at the site, but only if excavation or construction were to occur. An exposure would be unlikely at depths less than 8 feet bgs; however, petroleum and/or coal tar NAPL may be encountered at the deeper excavation depths. For all but one potential receptor group, the potential for an exposure to a MGP site-related COC is considered to be low, or a potentially complete pathway was not identified. Subsurface utility or construction workers who may perform subsurface excavation work on the IAWWTF parcel may contact petroleum or coal tar NAPL residuals in soil and groundwater. It is unlikely that residuals would be encountered in excavations less than 8 feet bgs (which is also the approximate depth to groundwater in this area of the site); however, should deeper excavation work be needed in this area the workers may be exposed to MGP-related residuals. Only properly trained and equipped personnel should complete work in this area.

4. Remedial Goals and Remedial Action Objectives

4.1 Standards, Criteria, and Guidance (SCGs)

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

The principal SCGs applicable to this site are:

- *6 NYCRR § 375-1: General Remedial Program Requirements;*
- *6 NYCRR§ 375-2: Inactive Hazardous Waste Disposal Site Remedial Program;*
- *6 NYCRR§ 375-6: Remedial Program Soil Cleanup Objectives;*
- *NYSDEC Policy Memorandum CP-51 on Soil Cleanup Guidance (Soil Cleanup Memo), October 21, 2010;*
- *NYSDEC Technical and Operational Guidance Series (TOGS)1.1.1 Ambient Water Quality Standards and Guidance Values and Groundwater Effluent Limitations;*
- *Guidance for Evaluating Soil Vapor Intrusion in New York;*
- *DER-10 Technical Guidance for Site Investigation and Remediation;*
- *DER-31 Green Remediation;*
- *TAGM 4030-Selection of Remedial Actions at Inactive Hazardous Waste Sites; and*
- *NYSDEC Technical Guidance for Screening Contaminated Sediments.*

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

The site-specific cleanup levels for the MGP-related COC in soil and groundwater are the SCGs that will be used to define the RAOs and to develop the remedial alternatives.

4.2 Soil Cleanup Levels

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

1. *The applicable regulatory program*, which for this site is the Inactive Hazardous Waste Program;

2. *Whether the groundwater beneath or downgradient of the site is or may become contaminated with site related compounds*, which for this site is confirmed by the RIR. This FS proposes an exception to Unrestricted SCOs, allowing a Restricted Use approach as well, as further described below;
3. *Whether ecological resources constitute an important component of the environment at or adjacent to the site, and which are, or may be, impacted by site-related contaminants.* Ecological resource considerations do not apply for this FS, as established in the RIR; and
4. *Other impacted environmental media such as surface water, sediment, and soil vapor*. These considerations are not applicable for this site, as described in the RIR and Section 2, above. Soil vapor is not applicable to this site.

After evaluating the nature and extent of the soil impacts on the site, this FS presents alternatives based on Approach 2: Restricted Use SCOs, as described in the NYSDEC Soil Cleanup Memo CP-51, Soil Cleanup Guidelines. Within the Restricted Use approach, the Industrial Use SCOs are applicable for the site soils. The development of these SCOs is described in more detail below.

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

- *The groundwater standard contravention is the result of an on-site source which is addressed by the remedial program.* In order for this condition to be met, the remedial alternatives in this FS that are based on the Restricted Use approach include technologies that address the on-site source areas.
- *An environmental easement or other institutional control will be put in place which provides for a groundwater use restriction*. This provision has been included in the alternatives in this FS that are based on the Restricted Use approach.
- *DEC determines that contaminated groundwater at the site:*
  a) *Is not migrating, nor likely to migrate, off-site*. No substantial off-site migration of groundwater with MGP-related COC was found to be occurring. *or*
  b) *Is migrating, or likely to migrate, off-site; however, the remedy includes active groundwater management to address off-site migration.* Not applicable.
- *DEC determines that groundwater quality will improve over time*. Groundwater quality improvements over time have been documented at a large number of MGP sites. A recent scientific report of a 14-year monitoring program at an MGP site has demonstrated that monitored natural attenuation (MNA) is a viable remedial strategy for groundwater after the original source is removed, stabilized, or contained [Neuhauser, et al, 2009]. While complete groundwater restoration is not expected at this site, due to the inaccessible impacts remaining

after remediation (as further discussed in Section 6), the groundwater quality is anticipated to improve over time.

4.3 Land Use and Cleanup Objectives

4.3.1 Soil Cleanup Levels

The SCOs as defined in 6 NYCRR Part 375-6 which apply to the site are determined based on the site use. As described previously, the majority of the site is part of the IAWWTF, with the strip of land between the IAWWTF northern fence and Cascadilla Creek used as a portion of the Cayuga Waterfront Trail. The future site ownerships and use is projected to remain as it is today. The following SCOs have been selected for the site:

- **Commercial Use Soil Standards:** These SCOs will be applied to the portion of the site used for the Cayuga Waterfront Trail, as the trail is considered to be a non-contact recreation area [DER-10, Section 1.12(b)3.iv(7)]. The SCOs for individual BTEX and PAH compounds are applied to surface soil and subsurface soil to a depth of 15 feet bgs after source removal. It should be noted however that the construction of the trail in the fall of 2010 resulted in covering the trail area with an asphalt cover and with 1 foot of clean soil.

  Industrial Use Soil Standards: The area inside the IAWWTF perimeter fence is subject to these SCOs. Surface soils exceeding Industrial SCOs are to be addressed according to 6 NYCRR Part 375-6. Subsurface soils are to be addressed which exceed 500 mg/kg Total PAHs and Part 375 Industrial SCOs for individual BTEX compounds, applicable to soils down to 15 feet bgs after source removal. Source removal is applicable to soils deeper than 15 feet.

  The Part 375 Industrial SCOs for BTEX compounds are as follows:

Benzene	89 mg/kg
Toluene	1,000 mg/kg
Ethylbenzene	780 mg/kg
Xylene	1,000 mg/kg

  Note that the BTEX compounds are the volatiles exceeding SCOs at the site which are associated with MGP residuals. All other VOCs found during the RI were either artifacts of the laboratory analyses (lab contaminants) or were found at concentrations below the SCOs.

  Source removal refers to the removal of a discrete source area, which is defined in DER-10 1.3 (b) 70 as containing "*contaminants in soil in sufficient concentrations to migrate in soil, or to release significant levels of contaminants to another environmental medium, which could*

result in a threat to public health and the environment. A source area typically includes, but is not limited to, a portion of a site where a substantial quantity of any of the following is present:
i. concentrated solid or semi-solid hazardous substances;
ii. non-aqueous phase liquids; or
iii. grossly contaminated media. [see 6 NYCRR 375-1.2(au)]"

4.3.2 Groundwater Cleanup Levels

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

4.4 Remedial Action Objectives (RAOs)

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

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

<u>Groundwater</u>

RAOs for Public Health Protection

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

RAOs for Environmental Protection

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

<u>Soil</u>

RAOs for Public Health Protection

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

RAOs for Environmental Protection

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

<u>Surface Water</u>

- Not Applicable. The concentrations of COCs in surface water were below the levels of concern, as described in the RI. Therefore, RAOs for surface water are not applicable to this site. Prevention of potential future impacts to sediment is addressed by the other RAOs with the addition of surface water in the groundwater and soil RAOs.

<u>Sediment</u>

- Not Applicable. The concentrations of COCs in sediments were below the levels of concern, as established in the RI. Therefore, RAOs for sediment are not applicable to this site. Prevention of potential future impacts to sediment is addressed by the other RAOs with the addition of sediments in the groundwater and soil RAOs.

<u>Soil Vapor</u>

RAOs for Public Health Protection

- Prevent inhalation of soil vapor contaminants due to soil vapor intrusion into current or potential future buildings at the site.

5. General Response Actions and Estimated Volumes

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

5.1 Range of General Response Actions (GRAs)

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

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

5.2 General Extent of Impacts

The nature and extent of impacts in surface soil, subsurface soil, sediments, and groundwater were described in Section 2. In accordance with the guidance provided in DER-10, this section presents the estimated extent of impacts in soil and groundwater. The extent of impacts was determined with reference to the data presented in the RIR. Laboratory data from the RI were tabulated and compared to chemical-specific SCGs for surface soil, subsurface soil, and groundwater in the RIR. The estimated areal extent of soil impacts, defined as exceedances of Part 375 Unrestricted SCOs, is shown in Figure 4. The estimated extent of groundwater impacts, defined as exceedances of NYSDEC Ambient Water Quality Standards, is shown in Figure 5.

5.3 Volume Estimates

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

Table 5-1 Estimated Volumes of Impacted Media

Medium	Estimated Volume
Impacted Subsurface Soil Previously Removed	8,000 CY
Subsurface Soil Exceeding:	
1. Unrestricted SCOs (total, including soil beneath buildings and pipelines)	292,000 CY
2. Soils exceeding 500 TPAH and BTEX Industrial SCOs (0 to 15 ft, total, including soil beneath and close to buildings and pipelines)	11,000 CY
3. Soils exceeding 500 TPAH and BTEX Industrial SCOs (0-15 ft, soil not beneath or close to buildings and pipelines)	8,000 CY
4. Deeper NAPL-impacted soil[1] (15 ft and deeper, including soil beneath or near buildings and pipelines)	12,000 CY
5. Deeper NAPL-impacted soil[1] (15 ft and deeper, soil not beneath or near buildings and pipelines)	11,000 CY
Groundwater exceeding NYSDEC Ambient Water Quality Standards	12 million gallons, or 60,000 CY

Table Notes:

[1]NAPL-impacted soil was defined as NAPL-coated or NAPL-saturated soil observed in RI borings.

5.3.1 Surface Soils

Most surface soils with exceedances of Industrial SCOs were addressed during the property development action that included construction of the Cayuga Waterfront Trail and the provision of a 1-foot soil cover over these soils [GEI, 2010b]. The remainder of surface soils exceeding Industrial SCOs appear to be associated with a single exceedance for benzo(a)pyrene at location SS8, which lies within the fenced area of the IAWWTF grassed area.

5.3.2 Subsurface Soils

The previous removal of subsurface soils at the site during the IAWWTF construction activities included a substantial quantity of impacted soils and former MGP structures, as described in the RIR and in Section 2.2, above. Example photographs showing the nature of this work are presented in Figure 6. The quantity of impacted soil that was documented as removed during the 1998 Interim Remedial Measure (IRM) was 12,610 tons. Assuming 1.6 tons of soil per in-place cubic yard (CY), the total volume removed was estimated to be 8,000 CY.

The extent of impacted soil remaining on site was estimated based on the observations and analytical laboratory results reported in the RIR and the exceedance criteria. The soil volumes were estimated as the product of the applicable areal extent and the applicable impacted depths, excluding soils that had been previously removed during the IAWWTF construction activities. The volume estimates shown in Table 5-1 represent the impacted soil volumes only. Actual volumes required for removal of deeper soils would be greater because non-impacted soils above the deep soils would need to be excavated to gain access to the deeper impacted soils. Volume calculation sheets are provided in Appendix B. All soil volumes were rounded to the nearest 1,000 CY, as reported in Table 5-1.

The total volume of soil exceeding the Unrestricted SCOs was estimated to provide a maximum impacted soil volume, for comparison purposes. The horizontal extent of soil exceeding the Unrestricted SCOs is shown in Figure 4. The horizontal and vertical extent for this volume was estimated without regard to the accessibility of the soil; soil beneath buildings and beneath critical utility pipelines was included in the estimate. The vertical extent was assumed to be 36 feet bgs, the approximate depth of the silty clay lens underlying the affected area.

As discussed in Sections 3 and 4, the site use is currently classified as Industrial due to the operation of the wastewater treatment facility, which is its planned future use for the foreseeable future. Therefore, Industrial Use SCOs (for industrial use and, passive recreational use), provided the basis for soil volume estimates in accordance with NYS Part 375 and the NYSDEC CP-51. The soil volumes were first estimated for total extent, without regard to accessibility, and then for accessible soils only. Table 5-1 provides these soil volumes for soils less than 15 feet in depth bgs and exceeding 500 mg/Kg total PAHs and the Industrial SCOs for individual BTEX compounds. Included in this volume are observed source areas that may not have been sampled for laboratory analysis (source areas were assumed to exceed 500 mg/Kg total PAHs). Table 5-1 also provides estimates of source areas deeper than 15 feet bgs, with observed source areas from the RIR used to develop the areal extent and depth. Further discussion of the accessibility of soils for remedial action is provided in Sections 6 and 7.

5.3.3 Groundwater

The area of impacted groundwater is shown in Figure 5. The total volume of impacted water was estimated for the shallow zone and the deep zone described in the RIR. Assuming a 25% soil porosity and an average impacted saturated thickness of 12 feet for the shallow zone, and 25 feet for the deep zone, is approximately 12,000,000 gallons or 60,000 CYs (in units comparable to the impacted soil volume estimates).

6. Identification and Screening of Technologies

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

The identification and screening of technologies was conducted in three stages, in accordance with DER-10 guidance. An initial screening process was first used determine the most applicable technologies for the site, using literature sources and GEI's experience at similar sites [FRTR, 2002; GRI, 1997; ITRC, 2002; NYSDEC, 1992]. For each of the GRAs identified in Section 5.1 – No action, Institutional Controls/Engineering Controls, Containment, In-Situ Treatment, and Removal – one or more technologies and process options were identified, described, and screened with respect to site-specific applicability. The outcome of this initial screening is presented on Table 6-1 for groundwater technologies, Table 6-2 for surface soil, and Table 6-3 for subsurface soil.

Next, the technologies that were not eliminated from consideration due to site-specific applicability were further refined and evaluated for this site. The evaluation at this stage used the criteria of effectiveness, implementability, and relative cost, in accordance with the DER-10 guidance. The outcome of this screening evaluation is presented on Table 6-4 for groundwater technologies, Table 6-5 for surface soil, and Table 6-6 for subsurface soil.

Finally, a more in-depth evaluation was conducted and technologies were then combined to form alternatives for analysis, as presented in Section 7.

The remainder of this section provides additional brief descriptions of the technologies and a discussion of the evaluation issues for groundwater, surface soil, and subsurface soil.

6.1 Groundwater Technologies

6.1.1 Institutional Controls and Engineering Controls (IC/ECs)

Site controls do not involve direct management of the impacted media, and therefore they are not effective in volume reduction, or treatment. However, they can effectively prevent exposures for potential receptors. They consist of IC/ECs. Site controls are included in an alternative if the remedy does not immediately achieve RAOs and use restrictions can be applied.

The institutional controls for groundwater that may be applicable to alternatives for this site include an environmental easement or site use agreement between NYSEG and the site owners for groundwater use and site use, and a municipal ordinance restricting construction and use of new groundwater wells.

6.1.2 Groundwater Containment Technologies

Groundwater containment technologies include soil cover, low-permeability caps such as asphalt parking lots, subsurface vertical barriers such as steel sheet pile walls, and active process barriers such as biologically active zones which form treatment walls preventing off-site migration of contaminants. These technologies are most applicable to sites characterized by off-site migration of contaminated groundwater. The groundwater impacts at the Ithaca First Street MGP site are primarily confined to the site property and no substantial off-site migration is occurring. Therefore, while these technologies may be potentially applicable for alternative development, they were not brought forward into the development of alternatives for this site.

6.1.3 In-Situ Treatment

Groundwater MNA relies upon the natural degradation and mitigation processes which occur in the subsurface to remedy groundwater impacts over time. The natural attenuation processes include a variety of physical, chemical, or biological processes that, under favorable conditions, act without human intervention to reduce the mass, toxicity, mobility, volume, or concentration of contaminants in soil or groundwater. These processes include biodegradation, dispersion, dilution, sorption, volatilization, and chemical or biological stabilization, transformation, or destruction of contaminants. A recent study of MNA at an MGP site has shown its effectiveness following source removal and with favorable subsurface conditions [Neuhauser, et al, 2009]. The extent to which groundwater concentrations of COC decrease by MNA is limited by the presence of residual NAPL in the saturated zone. Implementation is determined as a function of an evaluation of physical and chemical soil and groundwater characteristics including soil and groundwater chemistry, groundwater hydraulics, and biodegradation processes associated with microbial activity related to such compounds as oxygen, carbon dioxide, nitrate, sulfate and iron. Groundwater MNA was retained for alternative development because although its effectiveness will be limited by the presence of NAPL, it is readily implementable, with low cost.

Other in-situ treatment technologies, including ISS, in-situ chemical oxidation (ISCO), and enhanced in-situ groundwater bioremediation, were not retained for alternative development.

ISS results in the formation of a solid monolith of relatively impermeable material in the saturated zone. Groundwater is forced around and under the ISS monolith, thus preventing contact of groundwater with the COC contained in the monolith. ISS would have limited implementability at this site due to several combined factors, including the active and abandoned subsurface utilities and pilings at the site, which would limit active subsurface soil mixing. ISS results in an expansion of about 30% in the volume of treated soil, thus requiring pre-excavation of an equivalent soil volume in order to maintain continuity with the surrounding soil surface grades. In addition, it would require restrictions on excavation within the ISS material on site. These factors, and its high mobilization costs for the accessible soil available for ISS at the site, resulted in ISS not being retained for alternative development.

ISCO would have limitations regarding its effectiveness at this site, as highly impacted soils and NAPL would have limited treatability. Of more concern is the effect of corrosive oxidants of the critical process piping of the IAWWTF over time. Therefore, it was not retained for alternative development.

Enhanced bioremediation relies on changing the nutrient and oxygenation characteristics in the subsurface by distribution of active agents throughout the affected saturated zone. However, the presence of fine-grained soils, highly impacted soil, and NAPL can limit this distribution and limit the enhancement of bioremediation beyond natural attenuation. With the additional effectiveness of this technology substantially limited by the presence of NAPL beneath buildings and subsurface utilities, this technology was not retained for alternative development.

6.1.4 Removal Technologies for Addressing Groundwater

Removal technologies included conventional soil excavation, groundwater extraction and treatment, and NAPL recovery.

Technologies for excavation include use of conventional trackhoe equipment for excavation to depths of 20 feet, extended arm trackhoe equipment for excavation to depths of 40 feet, and crane-mounted Kellybar/clam shell equipment for excavation to depths of 100 feet or more [Hayward Baker, 2005]. At this site, excavation for removal of impacted soils would most likely extend to a depth of 15 feet, but could extend to depths of approximately 45 feet under some alternative scenarios. A combination of conventional trackhoe and extended arm trackhoe technologies, and staged, shored excavations, would be used to accomplish the excavation work and are therefore carried forward for the development of the alternatives.

Groundwater extraction and treatment has been found to have limited overall effectiveness at many sites [EPA, 1998]. It would have limited effectiveness and implementability at this site due to the presence of source areas beneath the IAWWTF buildings and subsurface utilities, and due to the proximity of Cascadilla Creek. Dewatering near the existing IAWWTF structures would present risks for subsidence and potential structural damage. These factors resulted in this technology not being retained for alternative development.

NAPL recovery can reduce the mass of NAPL in the subsurface and also can, by recovering the flowable fraction, reduce the mobility of residual NAPL. Typical recovery systems include specially constructed wells and/or recovery trenches. Collection may be passive or may require an active pumping system. Several NAPL pumping systems are available, including low-flow NAPL only pumps which for many systems allow for the greatest NAPL recovery [EPRI, 2000]. Recovery of viscous and weathered NAPL may be difficult, and low rates of recovery may indicate that there is not a substantial flowable NAPL fraction. Selection of specific NAPL recovery techniques, well locations and spacing, and recovery pumping, control, and storage equipment, will be conducted during the design and construction phase of the remedy. Pre-design NAPL recovery testing, including pilot wells and recovery testing to determine the effective recovery rates and radius of NAPL recovery influence, will be necessary to develop information for the full-scale design of NAPL recovery at this site.

6.2 Surface Soil Technologies

6.2.1 IC/ECs

A Site Management Plan (SMP) would be applicable as an institutional control that would establish protocols for soil-disturbing activities at the affected areas of the site, and was retained for alternative development.

The most applicable engineering control for surface soils at the site is the perimeter fence which already exists around the IAWWTF yard and buildings. This technology was retained for alternative development.

6.2.2 Surface Soil Containment

Surface soil containment technologies include vegetated surface cover soil and low-permeability caps such as paved areas. These are effective for controlling exposure from surface soils. Vegetated surface soil cover currently exists over most of the MGP site area and was retained for alternative development.

6.2.3 Surface Soil Removal

Surface soil removal by conventional excavators and graders was retained as a possible technology for alternative development. Removal alone has limited effectiveness if the soil beneath the surface soil is also impacted. Therefore, this technology was retained for possible use as grading in combination with placement of soil cover materials, as was already accomplished during the recent soil cover placement in the recreational pathway area [GEI, 2010b].

6.3 Subsurface Soil Technologies

6.3.1 IC/ECs

A SMP would be applicable as an institutional control that would establish protocols for soil-disturbing activities at the affected areas of the site, and was retained for alternative development.

The most applicable engineering control for surface soils include signage to warn against excavation, and subsurface demarcation barriers, such as orange matting or snow fencing, are important engineering controls which provide visual indications of impacted soil areas. These were retained for alternative development.

6.3.2 In-situ Treatment of Subsurface Soil

Subsurface soil treatment technologies include ISS, ISCO, and enhanced in-situ bioremediation. The evaluation of these for subsurface soil is very similar to that for groundwater for this site, as they would largely occur in the saturated zone. Therefore, the discussion included under 6.1.2 is applicable. These technologies were not retained for development of alternatives.

6.3.3 Subsurface Soil Removal

Subsurface soil removal by conventional trackhoe equipment in shored excavations would be as described under 6.1.4 and was retained for alternative development.

6.3.4 Subsurface Soil Off-site Treatment and Disposal

Subsurface soil off-site treatment and disposal technologies include conventional landfilling, low-temperature thermal desorption, and disposal in waste-to-energy facilities. Each of these technologies has its place as a potentially applicable approach for certain soils or solid debris, and may be advantageous under particular conditions. Therefore, all were retained for alternative development.

7. Development and Analysis of Alternatives

In this section, the remedial alternatives for the Ithaca First Street site are developed and evaluated. A comparison of alternatives is presented at the conclusion of this section. A summary of how the alternatives address the RAOs is provided in Table 7-1. A summary and comparison of the remedial alternatives is provided in Table 7-2. The recommended alternative is further described in Section 8.

7.1 Previous Remedial Actions

Several previous site activities were substantial remedial actions which provided overall protection of human health and the environment. These actions were aligned with the RAOs described in Section 4. These actions include:

1. Removal of impacted soil and all above-grade and below-grade former MGP structures during IAWWTP construction activities.
2. Off-site disposal of an estimated 8,000 CY of material during the IRM in 1998.
3. Grading the site and establishing a grass cover during the IRM in 1998.
4. A 1 foot clean soil cover and asphalt paving the Cayuga Waterfront Trail placed over 39,000 square feet in the northern end of the site in 2010.

These previous remedial actions were taken into account in the development of alternatives and are included in the figures that depict each alternative.

7.2 Development of Alternatives for Additional Remedial Actions

A range of alternatives for additional remedial actions were developed for this site, based on the land use approaches, RAOs and GRAs identified in Sections 3, 4 and 5, and the applicable technologies identified in Section 6. A total of six alternatives were developed and retained for detailed analysis:

1. No Action (required for comparison purposes by DER-10).
2. Implementation of IC/ECs, including groundwater use restrictions, a SMP, a property easement agreement, and site perimeter fencing.
3. IC/ECs, plus a soil cover, as required, and groundwater monitoring.
4. IC/ECs, a soil cover, groundwater monitoring, plus NAPL recovery.
5. IC/ECs, a soil cover, groundwater monitoring, plus removal of accessible soils in the upper 15 feet that exceed 500 mg/kg total PAHs and Industrial SCO levels for BTEX, with non-accessible and deeper source areas addressed by NAPL recovery.
6. Soil removal to Unrestricted SCO levels (required for comparison purposes by DER-10).

7.3 Detailed Analysis of Alternatives

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

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

Community Acceptance, which is the ninth criterion, will be evaluated after the public comment period for the FS, in accordance with DER-10.

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

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

7.3.1 Alternative 1: No Action

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

7.3.2 Alternative 2: Implementation of IC/ECs

Description

This alternative provides for protection of human health and the environment while having low short-term impacts and remedial action cost by implementation of IC/ECs, including groundwater use restrictions, a SMP, a property easement agreement, and site perimeter fencing. The remedy would allow the current Industrial land use as a wastewater treatment facility/recreational trail to continue, provided a SMP is in place to address control of any future excavation within the impacted areas.

This remedial alternative is depicted in Figure 7, and includes the existing site perimeter fencing and the existing soil cover features, as highlighted in the figure. The approximate extent of the previous soil excavations conducted during IAWWTF construction are also shown in the figure.

An environmental easement or similar agreement would be established between NYSEG and the City of Ithaca as property owner, in accordance with Draft DER-33. A SMP would be established such that any future excavation in the impacted areas would be conducted under a NYSDEC-approved work plan with review by NYSEG. Although the design plans are not yet finalized, it is anticipated that the planned construction will involve substantial removal of soil, including impacted subsurface soil exceeding the Industrial cleanup levels described in Section 4.3.1, above. The excavated impacted soils would be disposed of off site at a permitted facility. The work would be conducted and reported in compliance with DER-10.

There are currently no wells for groundwater use on the site, and future installation of wells and groundwater use on the properties would be restricted by the property agreements and deed attachments established under this alternative.

The site fencing existing at the site would be augmented with appropriate signs regarding restrictions to excavation at the site. The soil cover, fencing, and signs would be inspected annually and a Periodic Review Report would be prepared in accordance with DER-10.

Overall Protection of Human Health and the Environment

This remedial alternative is protective of human health and the environment. The potential for contact with COCs in surface soils, subsurface soils, and groundwater would be mitigated by the existing soil cover and by the IC/ECs.

Conformance with SCGs

This alternative does not immediately conform to the applicable SCGs for groundwater or soil. It would conform to the applicable soil SCGs through the implementation of soil removal over time, to the extent that portions of the site are excavated for maintenance or construction, in accordance with the SMP. Sources of contaminants contributing to the exceedances of the NYSDEC Ambient

Groundwater Water Quality Standards will be present beneath the IAWWTF building and other remaining subsurface soils. Table 7-1 provides a summary of how this alternative addresses the RAOs.

Long-term Effectiveness and Permanence

The long-term effectiveness and permanence for this alternative would vary, depending on the eventual extent of soil removal in accordance with the SMP. The COC that remain in subsurface soil will be addressed by institutional controls.

The COC which remain in groundwater poses minimal risk to human health and are not likely to increase in concentration over time. Remaining NAPL and impacted soils which may act as a source of COC to groundwater will remain.

Reduction of Mobility, Toxicity, or Volume Through Treatment

This remedial alternative will not reduce the toxicity, mobility, or volume of COC in surface soil, subsurface soil, NAPL, or groundwater at the site, except to the extent that soil is removed over time in accordance with the SMP.

Short-term Impacts and Effectiveness of Controls

Implementation of this alternative does not pose any short-term risks because no remedial activities would be performed on the site.

Implementability

Technical Feasibility. This action is readily implementable from a technical standpoint.
Administrative Feasibility. This alternative is administratively feasible to the extent that site access agreements and property restriction agreements with the current owners could be obtained because NYSEG does not own the property.
Availability of Services and Materials. The services and materials required for this alternative are readily available.

Cost Effectiveness

This alternative has a moderate cost effectiveness because some of the remedial objectives are addressed over a long time period and there is considerable uncertainty regarding future soil removal activities.

The projected costs for this alternative are as follows:

Capital and Engineering Cost	$0.13 million	
OM&M Cost	$0.16 million	
Contingency	$0.06 million	(20% for undefined costs and conditions)
Rounded Total	$0.35 million	

The marginal costs to NYSEG associated with the excavation and removal of impacted soils over time in accordance with the SMP is not included in this cost estimate. Details of the cost estimate are provided in Appendix A.

Land Use

The current and planned future land uses for the site as a sewage treatment plant and recreational trail would be allowed to continue under this alternative.

7.3.3 Alternative 3: IC/ECs, Additional Soil Cover, and Groundwater Monitoring

Description

This alternative provides for protection of human health and the environment while having low short-term impacts and remedial action cost by implementation of IC/ECs as described in Alternative 2, providing additional soil cover over the surface soil exceedance area inside the fence, and long-term groundwater monitoring of natural attenuation.

This remedial alternative is depicted in Figure 8, and includes the existing site perimeter fencing and the existing and additional soil cover features. The previous soil excavations are also shown in the figure.

The groundwater monitoring wells are highlighted in the figure. Groundwater monitoring over the course of several years would indicate any trends in concentrations of COC and track the progress of natural attenuation to address groundwater impacts over time. The details of the monitoring program, including the number and location of the wells and frequency of sampling, will be described in a NYSDEC-approved SMP prepared during remedial design. For the purposes of the cost estimate in the FS, it was assumed that groundwater sampling of 16 wells would occur twice per year for a period of 30 years.

The additional soil cover addresses a single PAH exceedance in surface soil. It is shown in Figure 8 as an area approximately 15 feet wide and 30 feet long. The actual area to be covered would be determined during the design of the remedy, which would include additional sampling for delineation of the area.

Overall Protection of Human Health and the Environment

This remedial alternative is protective of human health and the environment. The potential for contact with COCs in surface soils, subsurface soils, and groundwater would be mitigated by the existing soil cover, additional soil cover, and by the IC/ECs.

Conformance with SCGs

This alternative does not immediately conform to the applicable SCGs for groundwater or soil. It conforms to the applicable soil SCGs through the implementation of soil removal over time, as the site may eventually be excavated for redevelopment, in accordance with the SMP. Sources of contaminants contributing to the exceedances of the NYSDEC Ambient Groundwater Water Quality Standards will be present beneath the IAWWTF building and other remaining subsurface soils. Table 7-1 provides a summary of how this alternative addresses the RAOs.

Long-term Effectiveness and Permanence

The long-term effectiveness and permanence for this alternative would vary, depending on the eventual extent of soil removal in accordance with the SMP. The COC that remain in subsurface soil will be addressed by institutional controls.

The COC which remain in groundwater poses minimal risk to human health and are not likely to increase in concentration over time. Remaining NAPL and impacted soils which may act as a source of COC to groundwater will remain.

Reduction of Mobility, Toxicity, or Volume Through Treatment

This remedial alternative will not reduce the toxicity, mobility, or volume of COC in surface soil, subsurface soil (except for the extent of soil removal in accordance with the SMP), NAPL, sediments, or groundwater at the site.

Short-term Impacts and Effectiveness of Controls

Implementation of this alternative poses very minimal short-term risks due to the loading and grading of the additional soil cover.

Protection of Community. During the implementation of this alternative, measures would be taken to monitor and reduce the potential for air emissions during the soil placement actions.
Protection of Workers. Workers involved in the remedial and OM&M activities will wear the appropriate personal protective equipment (PPE) as required in a site-specific health and safety plan.
Environmental Impacts. The potential for negative environmental impacts from this alternative would be very low, as no invasive work would be done.
Time Until Response Objectives are Achieved. The timeframe for this alternative would be the assumed 30 year monitoring period.

Implementability

Technical Feasibility. This action is readily implementable from a technical standpoint.
Administrative Feasibility. This alternative is administratively feasible to the extent that site access agreements and property restriction agreements with the current owners could be obtained because NYSEG does not own the property.

Availability of Services and Materials. The services and materials required for this alternative are readily available.

Cost Effectiveness

This alternative has a moderate cost effectiveness because some of the remedial objectives are addressed over a long time period and there is considerable uncertainty regarding future soil removal activities.

The projected costs for this alternative are as follows:

Capital and Engineering Cost	$0.14 million	
OM&M Cost	$0.89 million	
Contingency	$0.21 million	(20% for undefined costs and conditions)
Rounded Total	$1.2 million	

The marginal costs to NYSEG associated with the excavation and removal of impacted soils over time in accordance with the SMP is not included in this cost estimate. Details of the cost estimate are provided in Appendix A.

Land Use

The current and planned future land uses for the site as a sewage treatment plant and recreational trail would be allowed to continue under this alternative.

7.3.4 Alternative 4: IC/ECs, Additional Soil Cover, NAPL Recovery, and Groundwater Monitoring

Description

This alternative provides for additional protection of human health and the environment while having low short-term impacts and remedial action cost by implementation of IC/ECs, soil cover, and groundwater monitoring as described in Alternative 3, and addressing source areas by the installation and operation of NAPL recovery wells.

This remedial alternative is depicted in Figure 9. The highlighted remedial actions include those shown for Alternative 3, with the addition of a NAPL recovery zone where recovery wells would be placed.

Recovery wells are shown in this area conceptually, with a total of 12 wells. The actual number, location, depth and construction details of the wells will be determined during the design phase of the remedy. It is anticipated that a pre-design investigation (PDI) would be conducted to determine the lateral and vertical extent of NAPL-containing soil in the recovery zone. The PDI study area would be the conceptual NAPL recovery zone shown in Figure 9, which would include the areas and depths where lenses of NAPL-containing soil were observed during the RI. One or more pilot recovery wells would then be installed in the most promising locations, and the ability to recover NAPL would be determined. Although NAPL had not yet been observed to accumulate in the monitoring wells installed during the RI, NAPL accumulation often takes several months before it is observed, especially in the small, 2-inch diameter monitoring wells installed during the RI. The pilot recovery wells would be 6-inches in diameter and would be specially constructed to enable NAPL recovery. If NAPL is not shown to be recoverable in an area, then the NAPL is not sufficiently mobile or present in sufficient quantities to move into a recovery well. As shown in Figure 9, we anticipate that the recovery wells would be installed in several clusters corresponding to areas with the most recoverable NAPL. NAPL would be recovered either by periodic hand bailing of wells, or by an automated system to recover passively collected NAPL, depending on the rates of recovery observed. It is recognized that IAWWTF construction activities planned for the near future may require adjustment of the schedule of implementation and/or location of the NAPL recovery wells. The locations of the wells and recovery system equipment would be coordinated with future building construction plans of the IAWWTF. The recovered NAPL would be temporarily stored on site and then transported off site for treatment and disposal at a permitted facility. The NAPL recovery would continue until the quantity of NAPL recovered was no longer substantial. Cessation of NAPL recovery would take place in coordination with and the approval of the NYSDEC. The recovery period is difficult to predict with certainty. Some systems have operated for 15 years, other systems have stopped recovering substantial NAPL after less than one year. For the purposes of the FS cost estimate, the recovery period was assumed to be 10 years.

After NAPL recovery operations have ended, groundwater monitoring would be continued and would address groundwater impacts over time, as in Alternative 3. The details of the program will be described in a NYSDEC-approved Groundwater Management Work Plan prepared during remedial design.

Overall Protection of Human Health and the Environment

This remedial alternative is protective of human health and the environment. The potential for contact with COCs in surface soils, subsurface soils, and groundwater would be mitigated by the existing soil cover, the additional soil cover, and by the IC/ECs.

Conformance with SCGs

This alternative does not immediately conform to the applicable SCGs for groundwater or soil. It conforms to the applicable soil SCGs through the implementation of soil removal over time, as source areas would be addressed over time by NAPL recovery. In addition, the site may eventually be excavated for IAWWTF construction and redevelopment, in accordance with the SMP. Sources of contaminants contributing to the exceedances of the NYSDEC Ambient Groundwater Water Quality Standards will be present beneath the IAWWTF building and other remaining subsurface soils. Table 7-1 provides a summary of how this alternative addresses the RAOs.

Long-term Effectiveness and Permanence

The long-term effectiveness and permanence for this alternative would vary, depending on the actual amount of NAPL removed through recovery wells and the eventual extent of soil removal in accordance with the SMP. Removal of NAPL represents a long-term effective and permanent action.

While NAPL recovery would be effective in removing a portion of the mobile NAPL, continuing sources of contaminants contributing to the exceedances of the NYSDEC Ambient Groundwater Water Quality Standards will be present at the site. Continuing sources would include residual NAPL remaining in the NAPL recovery zone, and in areas beneath the IAWWTF buildings and the utility corridors on the site.

Reduction of Mobility, Toxicity, or Volume Through Treatment

This remedial alternative will result in reduction of volume of COCs present at the site by removal of NAPL. The NAPL material would be removed from the site and treated and disposed of at off-site facilities.

Short-term Impacts and Effectiveness of Controls

The primary short-term impacts of this alternative are associated with the drilling of the NAPL recovery wells. Greenhouse gas emissions and other green remediation considerations would be relatively favorable for this alternative.

Protection of Community. During the implementation of this alternative, measures would be taken to monitor and reduce the potential for air emissions during the recovery well installation and NAPL removal actions.

Protection of Workers. Workers involved in the remedial and OM&M activities will wear the appropriate PPE as required in a site-specific health and safety plan.

Environmental Impacts. The potential for negative environmental impacts from this alternative would be low. Impacts during the NAPL removal operations will be addressed by use of spill prevention and control measures.

Time Until Response Objectives are Achieved. The timeframe for this alternative would be the 10 year NAPL recovery period and an assumed 30 year groundwater monitoring period.

Implementability

Technical Feasibility. NAPL recovery is technically feasible using conventional equipment and construction methods. Groundwater monitoring has been demonstrated as a technically feasible approach at similar MGP sites.

Administrative Feasibility. This alternative is administratively feasible to the extent that site access agreements and property restriction agreements with the current owner could be obtained because NYSEG does not own the property.

Availability of Services and Materials. The services and materials required for this alternative are readily available.

Cost Effectiveness

This alternative has a high cost effectiveness because the remedial objectives are addressed over a long time period and there is considerable uncertainty regarding future soil removal activities.

The projected costs for this alternative are as follows:

Capital and Engineering Cost	$1.2 million	
OM&M Cost	$0.6 million	
Contingency	$0.3 million	(20% for undefined costs and conditions)
Rounded Total	$2.1 million	

The marginal costs to NYSEG associated with the excavation and removal of impacted soils over time in accordance with the SMP is not included in this cost estimate. Details of the cost estimate are provided in Appendix A.

Land Use

The current and planned future land uses for the site as a sewage treatment plant and recreational trail would be allowed to continue under this alternative.

7.3.5 Alternative 5: IC/ECs, Additional Soil Cover, Excavation of Soil to 15 Feet, NAPL Recovery, and Groundwater Monitoring

Description

This alternative provides for protection of human health and the environment while having moderate short-term impacts, substantial risk and relatively high remedial action cost by implementation of IC/ECs, soil cover, NAPL recovery, and groundwater monitoring as described in Alternative 4, and soil excavation. Alternative 5 adds removal of accessible impacted soil. Soil exceeding the industrial criteria for MGP sites of 500 mg/kg TPAH and BTEX Industrial SCOs would be removed to a depth of 15 feet bgs. Source impacts greater than 15 feet in depth would be addressed by NAPL recovery. Impacted soil beneath or near IAWWTF buildings and pipelines would necessarily remain on site.

This remedial alternative is depicted in Figure 10. The highlighted remedial actions include those shown for Alternative 4, with the addition of an excavation area. Approximately 8,000 CY of soil would be removed by excavation in this alternative. This represents only approximately 35% of the total volume of the impacted soil on site. Several factors combine to make this excavation complex and risk-prone. The groundwater is at approximately 8 feet bgs in this area, therefore a 15 foot excavation would be 7 feet below the water table. The excavation, if done under dewatered conditions as is typical of remediation excavations, would involve continuous removal of water flowing into the excavation. This dewatering of the surrounding soils would pose a risk to the structural stability of the nearby IAWWTF buildings and large underground pipelines, and would need to be carefully controlled. For the purposes of this FS, the excavation was assumed to be conducted not as one large open pit, but in smaller cells to allow for greater control of groundwater. In addition, excavation would be off-set from the building structures by 15 feet (horizontal) as shown conceptually by the footprint of the excavation area in Figure 10. A robust system of grouted secant piles and steel shoring was assumed to be designed and installed under this alternative to prevent substantial movement of the surrounding soil and damage to the IAWWTF buildings. Even with the implementation of the best available technology, the risk to the long-term structural stability of the nearby IAWWTF buildings and pipelines would not be eliminated, especially considering that the main building already has structural damage which is apparently caused by differential settlement of its foundation (Town of Dryden, 2010). Costs for monitoring and documentation of the structural conditions and special insurance requirements are included in this alternative.

Soil impacts greater than the industrial criteria for MGP sites are very likely to be present beneath the two main digesters and other components that are critical to the operation of the IAWWTF. Excavating beneath these heavily loaded structures was considered, but determined not to be technically feasible or safe. Therefore, the excavation zone, as shown in Figure 10, has a 15-foot horizontal offset from the main IAWWTF building housing the two main digesters.

Similarly, excavation for removal of source areas deeper than the 15-feet bgs, was considered. However, to be effective, this excavation would need to extend at least 10 additional feet bgs. This was not considered prudent to include in this alternative, given the current structural condition of the IAWWTF and the additional risks and costs this deeper excavation would entail.

NAPL recovery wells would be installed after excavation, and would include the area beneath the excavation to address deeper source areas and non-accessible source areas. Figure 10 shows a conceptual layout of 10 recovery wells. However, as described above in Section 7.3.4, the number, location, depth, and construction details of recovery wells would be determined during the design phase of the remedy. Other aspects of the design, installation and operation of the NAPL recovery system would be as described under Alternative 4, Section 7.3.4.

After NAPL recovery operations have ended, groundwater monitoring would continue and would address groundwater impacts over time, as in Alternative 4. The details of the program will be described in a NYSDEC-approved Groundwater Management Work Plan prepared during remedial design.

Overall Protection of Human Health and the Environment

This remedial alternative is protective of human health and the environment. The potential for contact with COCs in surface soils, subsurface soils, and groundwater would be mitigated by the existing soil cover, the additional soil cover, and by the IC/ECs.

Conformance with SCGs

This alternative does not immediately conform to the applicable SCGs for groundwater or soil. It partially conforms to the applicable soil SCGs through the removal of accessible impacted soil, and implementation of soil removal over time, as non-accessible portions of the site may eventually be excavated during IAWWTF construction, in accordance with the SMP. Deeper source areas would be addressed over time by NAPL recovery. Sources of contaminants contributing to the exceedances of the NYSDEC Ambient Groundwater Water Quality Standards will be present beneath the IAWWTF building and other remaining subsurface soils. Table 7-1 provides a summary of how this alternative addresses the RAOs.

Long-term Effectiveness and Permanence

The long-term effectiveness and permanence for this alternative would vary, depending on the eventual extent of soil removal in accordance with the SMP. Removal of the soil to a depth of 15 feet bgs and removal of NAPL represent long-term effective and permanent actions. However, both of these actions are necessarily incomplete because they involve only partial removals.

While NAPL recovery would be effective in removing a portion of the mobile NAPL, continuing sources of contaminants contributing to the exceedances of the NYSDEC Ambient Groundwater Water Quality Standards will be present at the site. Continuing sources would include residual NAPL remaining in the NAPL recovery zone, and in areas beneath the IAWWTF buildings and the utility corridors on the site.

Reduction of Mobility, Toxicity, or Volume Through Treatment

This remedial alternative will result in reduction of volume of COCs present at the site by removal of 8,000 CY of soil and removal of NAPL. The soil and NAPL material would be removed from the site and treated and disposed of at off-site facilities.

Short-term Impacts and Effectiveness of Controls

The primary short-term impacts of this alternative are associated with the excavation of soil and the drilling of the NAPL recovery wells. The major risk of this alternative is involved in the installation of shoring, the excavation of soil, and dewatering, close to the IAWWTF buildings and pipelines, which are especially sensitive to structural damage. Structural failure of the large underground pipelines would cause a catastrophic release of sewage and treatment chemicals. The main IAWWTF building is currently undergoing an evaluation of concrete cracks and displacement possibly due to differential settling of slabs and walls that could cause leaks and cracks, as noted in the description of this alternative, above. The excavation wall shoring and dewatering required for the excavation included in Alternative 5 would involve significant risks with regard to the structural stability of the building and pipelines.

Greenhouse gas emissions and other green remediation considerations would be relatively substantial for this alternative. Transportation of the 8,000 CY to the low-temperature thermal desorption (LTTD) treatment facility in Ft. Edward, New York would require approximately 400 truckloads and 165,000 round trip truck miles.

Protection of Community. During the implementation of this alternative, measures would be taken to monitor and reduce the potential for air emissions during the excavation, recovery well installation, and NAPL removal actions. Truck traffic from the operations would be a negative short-term impact. Truck traffic would include mobilization and demobilization of heavy construction equipment, trucking of impacted material from the site, and trucking of backfill material onto the site. A temporary fabric structure would be used for the excavations.

Protection of Workers. Workers involved in the remedial excavation, drilling, and OM&M activities will wear the appropriate PPE as required in a site-specific health and safety plan.

Environmental Impacts. The potential for negative environmental impacts from this alternative would be moderate. Potential impacts during the excavation and NAPL removal operations will be addressed by use of spill prevention and control measures.

Time Until Response Objectives are Achieved. The timeframe for this alternative would be the assumed 30 year monitoring period.

Implementability

Technical Feasibility. Excavation close to the sensitive IAWWTF buildings would require complete structural protection of the building, which may not be technically feasible. NAPL recovery is technically feasible using conventional equipment and construction methods. Groundwater monitoring has been demonstrated as a technically feasible approach at similar MGP sites.

Administrative Feasibility. This alternative is administratively feasible to the extent that site access agreements and property restriction agreements with the current owner could be obtained because NYSEG does not own the property.

Availability of Services and Materials. The services and materials required for this alternative are readily available.

Cost Effectiveness

This alternative has a low cost effectiveness because the remedial objectives are addressed over a long time period, yet there is a high cost for soil removal and treatment activities.

The projected costs for this alternative are as follows:

Capital and Engineering Cost	$6.5 million	
OM&M Cost	$1.1 million	
Contingency	$1.5 million	(20% for undefined costs and conditions)
Rounded Total	$9.1 million	

The marginal costs to NYSEG associated with the excavation and removal of impacted soils over time in accordance with the SMP is not included in this cost estimate. Details of the cost estimate are provided in Appendix A.

Land Use

The current and planned future land uses for the site as a sewage treatment plant and recreational trail would be allowed to continue under this alternative.

7.3.6 Alternative 6: Removal of All Soil Exceeding Unrestricted SCOs, with Confirmatory Groundwater Monitoring

Description

This alternative provides for protection of human health and the environment, but has extremely high short-term impacts and remedial action costs.

This remedial alternative is depicted in Figure 11. The highlighted remedial actions consist of replacement and removal of the main IAWWTF building and associated pipelines, and excavation and replacement of approximately 292,000 CY of soil. Although soil impacts exceeding Unrestricted SCOs are not anticipated to extend beneath the entire building, they are very likely to be present beneath the two main digesters and other components that are critical to the operation of the IAWWTF. Excavating beneath these heavily loaded structures was considered, but determined not to be technically feasible or safe. Removal of only the affected portion of the building was also considered, but also would have substantial technical and safety problems. Therefore, for the purposes of this FS, this alternative includes construction of a new wastewater treatment plant facility, and then demolition of the old buildings to allow excavation beneath them.

Because of the completeness of the removal, no NAPL recovery, in-situ treatment and MNA, or IC/ECs would be applicable.

After excavation is completed, confirmatory groundwater monitoring would occur for a period of 3 years.

Overall Protection of Human Health and the Environment

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

Conformance with SCGs

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

Long-term Effectiveness and Permanence

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

Reduction of Mobility, Toxicity, or Volume Through Treatment

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

Short-term Impacts and Effectiveness

The primary short-term impacts of this alternative are associated with the removal of the IAWWTF buildings. The extensive and deep excavation and backfilling in the soil removal area would also have a very large negative short-term impact. Greenhouse gas emissions and other green remediation considerations would be extremely high for this alternative.

Protection of Community. During the implementation of this alternative, measures would be taken to monitor and reduce the potential for air emissions during source removal actions and transportation off site. A temporary fabric structure would be used for the excavations.

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

Protection of Workers. Workers would be protected during implementation of this alternative as direct contact with impacted material will be minimized by use of heavy equipment to perform the excavation and loading activities. Workers involved in the remedial activities will wear the appropriate PPE as required in a site-specific health and safety plan.

Environmental Impacts. The potential for negative environmental impacts for this alternative would be high. Potential releases during the removal of MGP source areas will be addressed by the use of spill prevention and air emission control measures. The extremely large impacts from trucking and LTTD treatment of soil will include the generation of greenhouse gasses.

Time Until Response Objectives are Achieved. The SCOs would be met upon completion of the removal, which is estimated to take a total of at least 24 months to complete, including the demolition of buildings and the re-routing of the critical utilities. Groundwater objectives would be met after a final attenuation period, estimated to have a duration of 3 years.

Implementability

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

Administrative Feasibility. This alternative is not administratively feasible because it requires a new IAWWTF plant to be reconstructed, and the buildings on site to be demolished, and sufficient adjacent land area for these activities does not appear to be available.

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

Cost Effectiveness

This remedy would not be cost effective, as the extremely high costs would not have a commensurately high value in additional environmental protection or increase in actual land use since the land uses, as the sewage treatment plant and recreational trail are the only current and planned future uses.

The projected costs for this alternative are as follows:

Capital and Engineering Cost	$137. million	
OM&M Cost	$ 0.13 million	
Contingency	$ 28. million	(20% for undefined costs and conditions)
Rounded Total	$165. million	

Details of the cost estimate are provided in Appendix A.

Land Use

This alternative would remediate the properties to allow for any use. However, the implementation of this alternative would substantially disrupt the current use as a sewage treatment plant and recreational trail in the short term. These are the only current and planned future uses.

7.4 Comparison of Alternatives

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

Overall Protection of Human Health and the Environment

All five of the substantive alternatives include common elements that would result in overall protection of human health and the environment. All five alternatives would be protective of human health and the environment by eliminating potential exposure pathways or maintaining barriers to potential exposure pathways, either by removal or institutional and engineering controls.

For all but the total removal action of Alternative 6, SCGs for groundwater would not be met because of the residual impacts remaining in areas not practicably accessible for excavation or other removal technologies.

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

1. Alternative 6 would be the most protective, because it would involve the most complete removal of impacted materials.
2. Alternative 5 would be the next most protective, as removal of impacted soil would decrease potential for accidental exposure from uncontrolled future excavation activities.
3. Alternatives 3 and 4 would rank together as the next most protective because they would achieve substantially similar protection, with the addition of the soil cover included in both alternatives. The NAPL recovery added in Alternative 4 would not add substantial protection because the NAPL is below the surface and exposure pathways are not complete under current conditions.
4. Alternative 2 would be slightly less protective because, while the IC/ECs would be in place (including the existing soil cover and Cayuga Waterfront Trail), it would not include the additional protective soil cover at the single surface soil exceedance within the fenced area on site.

Conformance with SCGs

Alternatives 2, 3, 4 and 5 would provide substantial conformance with the SCGs appropriate for the current and future land uses for each alternative, to the extent practicable, in accordance with the RAOs. Alternative 6 would provide additional conformance to SCGs, as it could result in meeting groundwater RAOs within a few years, if it were effective in removing all soils exceeding Unrestricted Use levels. Additional comparisons of the alternatives with regard to the RAOs are provided in Table 7-1.

Long-term Effectiveness and Permanence

For all but the total removal action of Alternative 6, long-term effectiveness and permanence of the actions would be limited by the practicability aspect of not being able to remove the majority of source areas and impacted soil remaining at the site. SCGs for groundwater would not be achieved for the limited area of groundwater impacts on site, because of the residual impacts remaining in areas not practicably accessible for excavation or other removal technologies.

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

1. Alternative 6 would be the most effective and permanent, because it would involve the most complete removal of impacted materials.
2. Alternatives 4 and 5 would rank as the next most effective and permanent. Both of these alternatives include NAPL removal and the provision of a SMP addressing additional soil

removal during IAWWTF construction. The additional soil removal included in Alternative 5 would not substantially increase overall effectiveness. NAPL recovery would add substantial overall effectiveness and permanence because the NAPL recovery would address much of the flowable NAPL in source areas. Soil excavation would remove only approximately 35% of the total source areas and impacted soil remaining at the site.

3. Alternatives 2 and 3 would be ranked together as the least effective and permanent. The IC/ECs and soil cover would not be as effective or permanent as the other alternatives.

Reduction of Toxicity, Mobility, or Volume

For all but the total removal action of Alternative 6, reductions of toxicity, mobility, or volume would be limited by the practicability aspect of not being able to remove the majority of source areas and impacted soil remaining at the site.

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

1. Alternative 6 would result in the most reduction, because it would involve the most complete removal of impacted materials.
2. Alternative 5 would result in the next most reduction because of the combination of NAPL recovery and soil removal.
3. Alternative 4 would rank next because the NAPL recovery featured in Alternative 4.
4. Alternatives 2 and 3 would not involve substantial reduction of toxicity, mobility, or volume.

Short-term Impacts and Effectiveness of Controls

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

1. Alternative 2 would have the least short-term impact because it would not involve any invasive actions.
2. Alternative 3 would involve primarily a small quantity of additional soil cover and seeding, which would have a very slight short-term impact and effective controls on potential impacts.
3. Alternative 4 would rank next because the slightly greater short-term impacts resulting from installation and operation of NAPL recovery wells. The methods available to control these impacts would be reliable and effective.
4. Alternative 5 would rank next because of the short-term impacts resulting from truck traffic and other potential impacts from excavation and backfilling. This alternative would entail substantial shoring and water management, and significant structural risks to the adjacent IAWWTF building would be increased, as discussed above in Section 7.3.5. The methods available to control these impacts would be available, but risk of further structural damage to the building and large underground pipelines would remain. In addition, there would be some short-term impacts resulting from installation and operation of NAPL recovery wells.
5. Alternative 6 would involve the greatest excavation quantities and depths, resulting in the greatest negative short-term impacts, with great disruption of the Cayuga Waterfront Trail,

the Ithaca Farmers Market and other surrounding properties during construction of the new wastewater treatment plant, demolition, excavation and backfilling. A very large truck traffic volume would be required.

Implementability

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

1. Alternative 2 and 3 would be most implementable, because they involve the least intrusive site work, with little uncertainty with regard to means and methods.
2. Alternative 4 would rank as next most implementable, because recovery well installation, while readily implementable, would involve some uncertainty with regard to the installation of a large number of wells in an active sewage treatment plant area.
3. Alternative 5 would be much less implementable, because excavation near the sensitive IAWWTF building, while achievable, would entail substantial shoring and water management and risks to infrastructure (with known differential settlement issues) would be increased as discussed in Section 7.3.
4. Alternative 6 would not be implementable, primarily because of the disturbance to the IAWWTF. The larger excavation, to a depth of an estimated 36 feet bgs, would require a great level of staging and coordination. Dewatering will also be a concern at these greater depths and will add to the complexity and uncertainty associated with this alternative.

Cost Effectiveness

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

1. Alternative 4 is the most cost-effective as it provides for the current and future land use, addresses source areas, and has a relatively moderate total cost of approximately $2.1 million.
2. Alternatives 2, 3 and 5 are equally cost effective, as each provides for more or less overall effectiveness for their estimated costs, of $0.35 million, $1.2 million and $9.1 million, respectively.
3. Alternative 6 is the least cost effective as its extremely high costs of $165 million would not have a commensurately high value in additional environmental protection or increase in actual land use additional to the current and future planned land use.

Land Use

The alternatives are ranked as follows with respect to land use:

1. Alternatives 3, 4 and 5 are equally supportive of current and future planned land uses.
2. Alternative 2, IC/ECs, would rank next as it is supportive of the Cayuga Waterfront Trail land use, and nearly supportive of the IAWWTF land uses.

3. Alternative 6 would disrupt the current land uses and therefore would rank last for this criterion among the active alternatives.

8 Recommended Remedy

Upon consideration of the alternatives and their respective attributes and limitations, Alternative 4 emerged as the recommended remedy for the Ithaca First Street former MGP site. This alternative would include placement of a 1-foot of soil cover over a portion of the site, installation and operation of a series of NAPL recovery wells, establishment of IC/ECs, and implementation of a long-term groundwater monitoring program. These actions would be taken in addition to the previous removal of all above-grade and below grade MGP structures, the substantial removal of contaminated soil already accomplished by the IRM of 1998, and the additionally protective measures of the 1 foot clean soil cover and Cayuga Waterfront Trail constructed in the fall of 2010.

As summarized in the comparative analysis, Alternative 4 will allow the current site and future site uses as a municipal sewage treatment plant and a recreational trail. These actions included in the alternative will achieve increased protection of human health and the environment compared to current conditions. Alternative 4 will address source areas and will monitor the long-term groundwater conditions, leading to the achievement of the RAOs, to the extent practicable, given the presence of the IAWWTF building and infrastructure at the site. This alternative does not involve undue short-term risks, particularly to the IAWWTF building with known differential settlement issues, and is characterized by a balance of cost and effectiveness.

In accordance with DER-31 Green Remediation, this alternative would have a moderate environmental footprint, primarily associated with the initial installation of NAPL recovery wells, and the ongoing periodic transport, treatment, and disposal or re-use of recovered NAPL. During the course of the remedial activities, steps would be taken to mitigate the environmental footprint and provide for sustainable practices, energy usage, and materials. The details of these provisions will be developed in the design phase of the remedy.

This remedial alternative would be accomplished in the following approximate sequence of actions:

- Design and placement of additional soil cover material in the area of surface soil exceedances inside the perimeter fence;
- Pre-design investigation, pilot testing, design, installation, and operation of NAPL recovery wells in areas which may contain recoverable NAPL;
- Design and placement of appropriate signs for the perimeter fence;
- Establishment and implementation of a SMP, with a long-term groundwater monitoring program for the site and Groundwater Use Restriction for the site, to be included in the environmental deed restriction for the property; and
- Establishment and implementation of a program for IC/EC inspections, and certifications in Periodic Review Reports.

The design phase for this remedy would have a duration of approximately 6 months. The active site work, including the placement of the additional soil cover and the installation and initial testing of the NAPL recovery wells, would have a duration of approximately 6 months.

The duration of the NAPL recovery operations are difficult to predict prior to initial installation and testing of pilot wells. NAPL recovery operations at similar sites have had typical durations ranging from less than 1 year to more than 10 years.

The duration of the long-term groundwater monitoring program is estimated to be 30 years, with a program review and possible revision typically occurring every 5 years.

The recommended remedy represents a balanced and appropriate approach to address the remaining MGP impacts present on the site, given the current and future planned uses of the property. The remedy will be designed and implemented in coordination with the operations of the IAWWTF and the public use of the Cayuga Waterfront Trail so that scheduling of the on-site activities, traffic flows, parking areas, equipment staging, and other aspects of the work would be coordinated with the maximum efficiency and least short-term impacts, to the ultimate benefit of the City of Ithaca and the surrounding community.

The next step, after NYSDEC issuance of a Proposed Remedial Action Plan (PRAP) for public comment, and a Record of Decision (ROD), will be the design for the remedy with specific work plans detailing each element of the remedy.

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Tables

Table 3-1
Chemical-Specific Standards, Criteria, and Guidance
Ithaca First Street MGP

Media	Requirements	Citation	Description	SCG or TBC	Comment
Soil	NYSDEC Soil Cleanup Objectives (SCOs) for Inactive Hazardous Waste Sites	NYSDEC DER-10, May 2010	Establishes recommended soil cleanup objectives, soil cleanup objectives for protection of groundwater quality, and groundwater standards/criteria .	SCG	Specified screening-level goals may be applicable in determining site-specific soil objectives.
	NYSDEC Guidance for implementing SCOs	NYSDEC Policy Memorandum on Soil cleanup Guidance CP-51, October 2010	Provides guidance on use of SCOs.	TBC	Guidance may be applicable to site-specific soil cleanup alternatives. Provides modification to SCOs for MGP sites.
	NYSDEC Remedial Program Soil Cleanup Objectives (SCOs)	6 NYCRR Part 375 Subpart 375-6	Establishes soil clean-up objectives based on residential, commercial, and industrial land use; protection of ecological resources; and protection of groundwater quality.	SCG	Specified screening-level goals may be applicable in determining site-specific soil objectives.
Groundwater	NYSDEC Groundwater Objectives	6 NYCRR Part 700-706 NYSDEC, Division of Water, TOGS (1.1.1) - 6 NYCRR 703.5	Establishes guidance or standard values for groundwater quality objectives.	SCG	May be applicable in determining site-specific groundwater objectives.
Sediment	NYSDEC Sediment Quality Criteria development process	Technical Guidance for Screening Contaminated Sediments (NYSDEC 1999). Evaluating Ecological Risk to Invertebrate Receptors From PAHs in Sediments at Hazardous Waste Sites (USEPA, 2009)	Describes process for developing sediment quality criteria in the State of New York.	TBC	Not Applicable to this site. Sediment impacts were not observed.
	Bioavailablilty Methods	ASTM D-7363-07 Standard Test Method for Solid-Phase Micro Extraction and PAH anlaysis	Describes an updated process for developing sediment quality criteria.	TBC	Not Applicable to this site. Sediment impacts were not observed.
Soil Vapor	Indoor Air Quality objectives	NYSDOH Soil Vapor Intrusion Guidance October, 2006	Establishes methods and guidance regarding data acquisition,interpretation, and mitigation.	TBC	Not Applicable to this site. Soil vapor intrusion not a concern at this industrial site.

Notes:

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

Table 3-2
Action-Specific Standards, Criteria, and Guidance
Ithaca First Street MGP

Action	Requirements	Citation	Description	SCG or TBC	Comment
Water Treatment Discharge	NYSDEC Ambient Water Quality Standards and Guidance Values and Groundwater Effluent Limitations	Division of Water Technical and Operational Guidance Series (TOGS) 1.1.1.	Compilation of ambient water quality standards and guidance values for toxic and non-conventional pollutants for use in NYSDEC programs (i.e., SPDES).	TBC	These standards and guidance values are applicable in establishing discharge limitations to surface waters.
	NYSDEC Industrial SPDES Permit Drafting Strategy for Surface Waters	TOGS 1.2.1	Guidance for developing effluent and monitoring limits for point source releases to surface water.	TBC	These standards and guidance values are applicable in establishing discharge limitations to surface waters .
	Clean Water Act	Section 401	Water Quality Certification	SCG	Potentially Applicable
	SPDES	6 NYCRR Parts 750-01, 750-02	Requirements for obtaining a SPDES permit and requirements for operating in accordance with a SPDES permit.	SCG	Potentially Applicable to constructing and operating a water treatment system for discharge to surface water
	IAWWTF	TOGS 1.3.8	Limits on new or changed discharges to Publicly Owned Treatment Works (POTWs), strict requirements regarding bioaccumulative and persistent substances, plus other considerations.	TBC	Potentially Applicable to constructing and operating a water treatment system for discharge to Publicly Owned Treatment Works
Construction Stormwater	SPDES Permit	NYSDEC SPDES General Permit for Stormwater Discharge	Requirements to protect stormwater from construction impacts including preparation of a stormwater Pollution Prevention Plan (SWPPP).	SCG	Potentially not applicable.
***In Situ* Treatment of Soils and Groundwater**	Underground Injection Control Program	40 CFR Part 144	Includes requirements for injection of chemicals.	SCG	Potentially Applicable for In Situ Chemical Oxidation.
	NYSDEC Ambient Water Quality Standards and Guidance Values	Division of Water Technical and Operational Guidance Series (TOGS) 2.1.2	Applicability of SPDES permits and groundwater effluent standards to the use of underground injection/recirculation as a remediation measure.	SCG	Potentially Applicable
Indoor Air	NYSDOH Background Air Levels	Guidance for Evaluating Soil Vapor Intrusion in the State of New York	Includes a database of background indoor air concentrations and description of decision making process for remediation of indoor air impacts.	TBC	Not applicable. No exposures have been identified
Waste Management	Solid Waste Management Facility	6 NYCRR 360	Includes solid waste management facility requirements.	SCG	Applicable if soil or NAPL are removed.
	Waste Transporter Permits	6 NYCRR 364	Regulates collection, transport and delivery of regulated waste. Requires that wastes be transported by permitted waste haulers.	SCG	Applicable if soil or NAPL are removed.
		DER-10 3.3(e)	Disposal of Drill Cuttings	SCG	Potentially Applicable during the installation of NAPL recovery wells or new monitoring wells.
MGP-Impacted Soil and Sediment	Management of soil and sediment contaminated with coal tar from Manufactured Gas Plants	NYSDEC TAGM 4060 and NYSDEC DER-4	This guidance outlines the criteria for MGP coal tar waste. Soils and sediment only exhibiting the toxicity characteristic for benzene (D018) may be conditionally excluded from the requirements of 6 NYCRR Parts 370-374 and 376 when they are destined for permanent thermal treatment.	SCG	Applicable for off-site treatment and disposal of soil.

Table 3-2
Action-Specific Standards, Criteria, and Guidance
Ithaca First Street MGP

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

Table 3-2
Action-Specific Standards, Criteria, and Guidance
Ithaca First Street MGP

Action	Requirements	Citation	Description	SCG or TBC	Comment
Institutional Controls	Institution of an Environmental Easement	NYSDEC Policy on Environmental Easements: Environmental Conservation Law (ECL) Article 71, Title 36	NYSDEC has developed a draft standard form and procedure for establishing environmental easements.	TBC	Institutional controls will be established in accordance with NYSDEC policy
Monitored Natural Attenuation	Provides specific requirement for implementation of MNA	*Use of MNA at Superfund, RCRA Corrective Action and UST Sites* (USEPA, 1997)	This guidance document establishes the technical basis for implementing MNA.	TBC	Monitored Natural attenuation will be implemented in accordance with USEPA guidance
Site Management Plan (SMP)	Template document intended to expedite development and approval of a site-specific SMP by providing format and general content guidelines.	*Site Management Plan Template* (NYSDEC, April 2009)	NYSDEC has developed a Site Management Plan template for remedial projects performed under the management of the NYSDEC Division of Environmental Remediation.	TBC	An SMP will be utilized following remedial action, to address the means for implementing the Institutional Controls and Engineering Controls that will be required by an Environmental Easement for the site.
Land Disturbing Activities	Excavation of Impacted Soil	DER-10; Technical Guidance for Site Investigation and Remediation	Requirements for collection and analysis of compliance and documentation samples.	TBC	Applicable
			Requirements for CAMP implementation.	TBC	Applicable
	Backfill	DER-10; Technical Guidance for Site Investigation and Remediation	Requirements for procedures to ensure that imported backfill is not impacted by COC.	TBC	Applicable

Table 3-3
Location-Specific Standards, Criteria, and Guidance
Ithaca First Street MGP

Location	Requirements	Citation	Description	SCG or TBC	Comment
Entire Site	Tomkins County	General regulations	County transportation and site use regulations	TBC	Requirements of County, Town, and City would be applicable to all remediation alternatives, especially those requiring transportation.
	City of Ithaca	Redevelopment Plans	Cayuga Waterfront Trail master plan.	TBC	The master plan for redevelopment will be considered when planning future land use at the site.
	City of Ithaca	General ordinances	City regulations regarding transportation, noise, zoning, building permits, etc.	TBC	Requirements of County, Town, and City would be applicable to all remediation alternatives, especially those requiring transportation.
Floodplains	Executive Order 11988 -Floodplain Management	40 CFR Part 6, Subpart A; 40 CFR Part 6.302	Activities taking place within floodplains must be done to avoid adverse impacts and preserve the beneficial values in floodplains	SCG	Applicable
	Floodplain Management Regulations	6 NYCRR Part 500	Establishes floodplain management requirements	SCG	Applicable
	100-year floodplain regulations	Federal Emergency Management Agency	Administers floodplain management requirements	SCG	Applicable
Wetlands/Waters of the U.S.	Executive Order 11990 -Protection of Wetlands	40 CFR Part 6, Subpart A	Activities taking place within wetlands must be done to avoid adverse impacts	SCG	Not applicable. No wetlands are present at the site.
	Dredging and Filling regulations	Clean Water Act, Section 404; Rivers and Harbors Act	Regulates the discharge of dredged or fill material into waters of the United States. Requires a permit from the ACOE.	SCG	Not applicable.
	Wetlands regulations	NYSDEC Freshwater Wetlands Act	Regulates use and development of freshwater wetlands	SCG	Not applicable. No wetlands are present at the site.
	Protection of water regulations	6 NYCRR Part 608	Protection of Water Permit/ Water Quality Certification	SCG	Applicable.
Critical Habitat	Endangered Species Act and Fish and Wildlife Coordination Act	16 USC 661; 16 USC 1531	Actions must be taken to conserve critical habitat in areas where there are endangered or threatened species.	SCG	No endangered or threatened species were identified at the site. Not applicable.
Historic Preservation	National Historic Preservation Act	16 USC 470	Establishes requirements for the identification and preservation of historic and cultural resources.	SCG	Applicable to the management of historic or archeological artifacts identified on the site. A "No Findings" determination is required prior to excavation.
	New York State Department of Parks, Recreation, and Historic Preservation	Historic Preservation Act	Establishes requirements for the identification and preservation of historic and cultural resources.	SCG	Applicable to the management of historic or archeological artifacts identified on the site. A "No Findings" determination is required prior to excavation.

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

Table 6-1
Initial Technology Screening for Groundwater
Ithaca First Street MGP

General Response Action	Remedial Technology Type	Technology Process Option	Description	Site-Specific Screening Evaluation
No Action	**No Action**	No Action	No additional remedial action. Substantial remedial action has taken place previously at this site.	No Action is included for comparison purposes in accordance with NYSDEC DER-10.
Institutional Controls and Engineering Controls (IC/ECs)	**ICs**	Environmental Easement/ Deed Restriction	Legal agreement or notice restricting site use in accordance with NYSDEC DER-10.	Deed restriction agreement between NYSEG and the property owner is possible. Retained for further evaluation.
		Local Groundwater Use Ordinance	Legal restriction placed by the local municipality preventing installation of new wells or use of existing wells.	Retained for further evaluation.
		Site Management Plan	Contingency plans for property owner actions, such as use of site groundwater and handling of groundwater during excavations for underground utilities or basements. They are administered through environmental easements, deed restrictions or third-party property agreements.	Retained for further evaluation.
	ECs	Fencing	Fencing or other physical barriers prevent potential receptors from exposures. For groundwater, this would include temporary fencing during excavation in which groundwater was encountered.	Retained for further evaluation.
		Signage	Signs, which deter potential receptors from exposures, such as well water usage.	Retained for further evaluation.
Containment	**Surface Barriers Cover Soil and Caps**	Soil covers	One foot clean soil cover (for Industrial Site use), with site grading for drainage.	Can decrease infiltration of precipitation and therefore have a positive effect on groundwater quality. Retained for further evaluation.
		Low permeability surface caps	Includes low permeability covers including pavement and concrete building pads.	Surface barriers minimize infiltration of precipitation to source areas, reducing migration of dissolved contaminants. Retained for further evaluation.
	Subsurface Vertical Barriers	Steel Sheet Piling	Interlocking steel sheets are driven by vibration or hammer to pre-determined depths.	All have limited applicability due to buildings, subsurface utilities and infrastructure on site. All are potentially effective for minimizing migration of NAPL and directing groundwater flow. Retained for further evaluation.
		Bentonite/Cement Slurry Walls	Slurry walls involve excavation of a 1.5 to 5 foot wide trench followed by immediate placement of slurry which hardens to form the barrier.	
		HDPE Sheeting Walls	HDPE interlocking sheeting is installed through a slurry-supported trench.	
		Drilled grout and solidified earth column walls	Overlapping columns are drilled and filled with grout or grout/soil mixture to form a barrier wall with low permeabilities.	
		Jet grout column walls	High pressure jet grouting displaces soil to form a grout column. Overlapping grout columns form a barrier wall.	

General Response Action	Remedial Technology Type	Technology Process Option	Description	Site-Specific Screening Evaluation
Containment (Cont'd.)	Process Barriers	Biological containment	Containment by a line of wells downgradient of the impacted area, which are used to stimulate microbial activity, usually by air sparging. The groundwater is treated in-situ before it migrates off site.	All of these technologies have potential use at this site. Retained for further evaluation.
		Chemical containment	Containment by a line of wells downgradient of the impacted area, which are used to chemically degrade the contaminants, usually by addition of an oxidant such as ozone, hydrogen peroxide, or potassium permanganate. The groundwater is treated in-situ before it migrates off site.	
		Permeable reactive barrier	Containment by construction of a vertical treatment zone downgradient of the impacted area, which is used to chemically and biologically degrade the contaminants, usually by the placement of a reactive material such as iron filings or activated carbon. This can also be combined with NAPL capture, biological and chemical in-situ treatment. The groundwater is treated in-situ before it migrates off site.	
		Hydraulic containment	Containment by extracting groundwater by wells or trenches around the impacted area. Just enough groundwater is captured so that an inward hydraulic gradient is maintained and off-site migration does not occur. The captured groundwater is treated prior to discharge to surface water or the local sewage treatment system.	
In-Situ Treatment	**Monitored Natural Attenuation (MNA)**	Monitored Natural Attenuation (MNA)	MNA refers to the reliance on natural treatment processes to achieve site-specific remedial objectives. The natural attenuation processes include a variety of physical, chemical, or biological processes that, under favorable conditions, act without human intervention to reduce the mass, toxicity, mobility, volume, or concentration of contaminants in soil or groundwater. These processes include biodegradation, dispersion, dilution, sorption, volatilization, and chemical or biological stabilization, transformation, or destruction of contaminants.	Retained for further evaluation.
	In-Situ Solidification (ISS)	Auger mixing	Overlapping columns are augered as a grout/soil mixture to form a solid monolith of low permeability. Constructable to a depth of approximately 40 feet.	All have limited applicability due to buildings, subsurface utilities and infrastructure on site. Pilings from former building will be substantial subsurface barriers to implementation. Effective for meeting groundwater and soil-related RAOs. Physically binds or encloses a COC mass and/or induces a chemical reaction between the stabilizing agent and the COCs to reduce their mobility within the subsurface and to decrease permeability of the mass so that groundwater does not contact the COCs. Retained for further evaluation.
		Pressure grouting	High pressure jet grouting displaces soil to form a grout column. Overlapping grout columns form a solid monolith of low permeability. Constructable to a depth of approximately 40 feet.	
		Excavator Bucket Mixing	Bulk soil is mixed into a grout/soil mixture to form a solid monolith of low permeability. Constructable to a depth of approximately 20 feet.	
	In-Situ Chemical Oxidation (ISCO)	In-Situ Chemical Oxidation (ISCO)	Treatment by a field of wells in the impacted area, which are used to chemically degrade the contaminants, usually by addition of an oxidant such as ozone, hydrogen peroxide, or potassium permanganate. This technology is in the demonstration phase.	Limited applicability due to technology uncertainty. Retained for further evaluation.
	Enhanced In-situ Bioremediation: Aerobic and Anaerobic biodegradation of PAHs and BTEX	Two process options:	Treatment by a field of wells in the impacted area, which are used to biologically degrade the contaminants. The natural groundwater conditions are modified in order to facilitate bioremediation of the COCs to innocuous end-products.	Retained for further evaluation.
		Aerobic biodegradation	Air Sparging, Oxygen Injection and Addition of Oxygen Releasing Compounds (ORC).	
		Anaerobic biodegradation	Addition of a carbon substrate or electron acceptor as a reducing agent to maintain anaerobic conditions.	
	Air Sparging/Soil Vapor Extraction	Air Sparging/Soil Vapor Extraction	This technology is the injection of pressurized air into the subsurface below the water table to induce volatilization of dissolved phase COCs.	Effective for VOCs in groundwater and soil vapor. Not effective for SVOCs, which are important COCs at this site. Not Retained.

General Response Action	Remedial Technology Type	Technology Process Option	Description	Site-Specific Screening Evaluation
Removal	**Excavation/Removal of Soil/Source Material**	Two process options:	This technology involves mechanical removal of impacted soil/source material, which thereby addresses groundwater impacts. Usually combined with transportation to an appropriate disposal facility (i.e. landfill or soil treatment facility). Usually requires construction dewatering and earth support structures.	Limited applicability due to buildings, subsurface utilities and infrastructure on site. Retained for further evaluation.
		Conventional and long-stick excavators/Shoring	Typically for excavations to approximately 20 feet. Shoring and benching required for deeper excavations.	
		Slurry trench excavation	Excavations deeper than the typical reach of an excavator, with flowing sand and artesian conditions. A slurry is used to maintain sidewall support. Requires additional equipment and more extensive dewatering and earth support structures.	
	Groundwater Extraction and Treatment	Groundwater pumping via centralized extraction wells, with on-site treatment.	Removal of contaminated groundwater by extracting groundwater by wells in the impacted area. The captured groundwater is treated prior to discharge to surface water or the local sewage treatment system.	Limited applicability due to buildings, subsurface utilities and infrastructure on site. Dewatering near existing structures may cause subsidence and potential damage. Dewatering near Cascadilla Creek may cause inflow that may be prohibitive to manage. Retained for further evaluation.
	NAPL Recovery	Recovery wells and trenches	This technology involves the extraction of free-phase NAPL from wells or trenches. The NAPL accumulates in the well, and is then pumped into a holding tank prior to offsite disposal or recycling at an appropriate facility. Partially addresses source material and aids in meeting groundwater and soil-related RAOs. Effective at removing free-phase NAPL from the subsurface; and therefore reducing the COC flux into the groundwater. Pilot tests are typically required to determine recovery rates, NAPL recoverability, well or trench design, pumping and control equipment.	Limited applicability due to buildings, subsurface utilities and infrastructure on site. NAPL recoverability is uncertain. Retained for further evaluation.
	Enhance Recovery Technologies	Steam/Hot Water	Uses injected steam and/or hot water to heat subsurface soil and groundwater and enhance mobility to allow for more effective treatment or extraction. This technology is in the experimental phase. Substantial risk of uncontrolled migration of contaminants.	Experimental technologies with a substantial risk for uncontrolled migration. High cost. Not retained.
		Electro-thermal	Uses electrical current to heat subsurface soil and groundwater and enhance mobility to allow for more effective treatment or extraction. This technology is in the experimental phase. Substantial risk of uncontrolled migration of steam and contaminants.	Experimental technologies with a substantial risk for uncontrolled migration. High cost. Not retained.
		Surfactants	Uses surfactant chemicals (soap formulations) injected in the subsurface to enhance mobility to allow for more effective treatment or extraction. This technology is in the experimental phase. Substantial risk of uncontrolled migration of contaminants.	Experimental technologies with a substantial risk for uncontrolled migration. Not retained.
		Acoustic vibrations	Uses sound to vibrate subsurface soil and groundwater and enhance mobility to allow for more effective treatment or extraction. This technology is in the experimental phase. Substantial risk of uncontrolled migration of contaminants.	Experimental technologies with a substantial risk for uncontrolled migration. Not retained.

Table 6-2
Initial Technology Screening for Surface Soil
Ithaca First Street MGP

General Response Action	Remedial Technology Type	Technology Process Option	Description	Site-Specific Screening Evaluation
No Action	**No Action**	No Action	No additional remedial action.	No Action is included for comparison purposes in accordance with NYSDEC DER-10.
Institutional Controls and Engineering Controls (IC/ECs)	**ICs**	Environmental Easement / Deed Restriction	Legal agreement or notice restricting site use in accordance with NYSDEC DER-10.	Deed restriction agreement between NYSEG and the property owner is possible. Retained for further evaluation.
		Site Management Plan	Contingency plans for property owner actions, such as procedures for excavation and handling of surface soil. They are administered through environmental easements, deed restrictions or third-party property agreements.	Retained for further evaluation
	ECs	Fencing	Fencing or other physical barriers prevent potential receptors from exposures. For surface soil, this would include site perimeter fencing.	Retained for further evaluation
		Signage	Signs, which deter potential receptors from exposures, such as trespassing on surface soil.	Retained for further evaluation
Containment	**Surface Barriers Cover Soil and Caps**	Soil covers	One foot clean soil cover, for Industrial site use, with site grading for drainage.	Eliminates exposure pathway to surface soils. Retained for further evaluation
		Low permeability surface caps	Includes low permeability covers including pavement and concrete building pads.	Eliminates exposure pathway to surface soils. Retained for further evaluation
Removal	**Excavation/Replacement of Soil**	Conventional and excavators and graders	Excavation and replacement of the top one-foot of soil (for Industrial site use). Replacement of soil necessary if soil below surface soil is also impacted.	Eliminates exposure pathway to surface soils. Retained for further evaluation.

Table 6-3
Initial Technology Screening for Subsurface Soil
Ithaca First Street MGP

General Response Action	Remedial Technology Type	Technology Process Option	Description	Site-Specific Screening Evaluation
No Action	**No Action**	No Action	No additional remedial action.	No Action is included for comparison purposes in accordance with NYSDEC DER-10.
Institutional Controls and Engineering Controls (IC/ECs)	**ICs**	Environmental Easement / Deed Restriction	Legal agreement or notice restricting site use in accordance with NYSDEC DER-10.	Deed restriction agreement between NYSEG and the property owner is possible. Retained for further evaluation.
		Site Management Plan	Contingency plans for property owner actions, such as procedures for handling subsurface soil during excavations for underground utilities or basements. They are administered through, environmental easements, deed restrictions or third-party property agreements.	Retained for further evaluation
	ECs	Fencing	Fencing or other physical barriers prevent potential receptors from exposures. For subsurface soil, this would include temporary fencing during excavation in which subsurface soil was encountered.	Retained for further evaluation
		Signage	Signs, which deter potential receptors from exposures.	Retained for further evaluation
Containment	**Subsurface Vertical Barriers**	Steel Sheet Piling Bentonite/Cement Slurry Walls HDPE Sheeting Walls, Drilled grout and solidified earth column walls Jet grout column walls	(See Table 5-1, Initial Technology Screening for Groundwater, for descriptions)	Barrier walls do not directly address subsurface soil, but are retained for the purpose of excavation shoring.
	Process Barriers	Biological containment, Chemical containment, Permeable reactive barrier, Hydraulic containment.	(See Table 5-1, Initial Technology Screening for Groundwater, for descriptions)	Barrier walls are not applicable to subsurface soil. Not retained.
In-Situ Treatment	**Monitored Natural Attenuation (MNA)**	Monitored Natural Attenuation	See Table 5-1, Initial Technology Screening for Groundwater, for description)	MNA is not applicable to subsurface soil. Not retained.
	In-Situ Solidification (ISS)	Auger mixing	Overlapping columns are augered as a grout/soil mixture to form a solid monolith of low permeability. Constructable to a depth of approximately 40 feet. Physically binds or encloses a COC mass and/or induces a chemical reaction between the stabilizing agent and the COCs to reduce their mobility within the subsurface and to decrease permeability of the mass so that groundwater does not contact the COCs.	All have limited applicability due to buildings, subsurface utilities and infrastructure on site. Pilings from former building will be substantial subsurface barriers to implementation. Effective for meeting soil-related RAOs. Retained for further evaluation.
		Pressure grouting	High pressure jet grouting displaces soil to form a grout column. Overlapping grout columns form a solid monolith of low permeability. Constructable to a depth of approximately 40 feet.	
		Excavator Bucket Mixing	Bulk soil is mixed into a grout/soil mixture to form a solid monolith of low permeability. Constructable to a depth of approximately 20 feet.	
	In-Situ Chemical Oxidation (ISCO)	In-Situ Chemical Oxidation	Treatment by a field of wells in the impacted area, which are used to chemically degrade the contaminants, usually by addition of an oxidant such as ozone, hydrogen peroxide, or potassium permanganate. This technology is in the demonstration phase.	Limited applicability due to technology uncertainty. Retained for further evaluation.

General Response Action	Remedial Technology Type	Technology Process Option	Description	Site-Specific Screening Evaluation
In-Situ Treatment (Cont'd.)	**Enhanced In-situ Bioremediation:** Aerobic and Anaerobic biodegradation of PAHs and BTEX	Two process options:	Treatment by a field of wells in the impacted area, which are used to biologically degrade the contaminants. The natural groundwater conditions are modified in order to facilitate bioremediation of the COCs to innocuous end-products. Most applicable to saturated subsurface soils. Could use infiltration to treat unsaturated zone.	Retained for further evaluation.
		Aerobic biodegradation	Air Sparging, Oxygen Injection and Addition of Oxygen Releasing Compounds (ORC).	
		Anaerobic biodegradation	Addition of a carbon substrate or electron acceptor as a reducing agent to maintain anaerobic conditions.	
	Air Sparging/Soil Vapor Extraction	Air Sparging/Soil Vapor Extraction	This technology is the injection of pressurized air into the subsurface below the water table to induce volatilization of dissolved phase COCs.	Effective for VOCs in groundwater and soil vapor. Not effective for SVOCs, which are important COCs at this site. Not Retained.
Removal	**Excavation/Removal of Soil:**	Two process options:	This technology involves mechanical removal of impacted soil. Usually combined with transportation to an appropriate disposal facility (i.e. landfill or soil treatment facility). Usually requires construction dewatering and earth support structures.	Limited applicability due to buildings, subsurface utilities and infrastructure on site. Retained for further evaluation.
		Conventional and long-stick excavators/ Shoring.	For excavations to approximately 20 feet. Shoring and benching required for deeper excavations	
		Slurry trench excavation	Excavations deeper than the typical reach of an excavator, with flowing sand and artesian conditions. A slurry is used to maintain sidewall support. Requires additional equipment and more extensive dewatering and earth support structures.	
	Enhanced Recovery technologies	Steam	Uses injected steam to heat subsurface soil and groundwater and enhance mobility to allow for more effective treatment or extraction. This technology is in the experimental phase. Substantial risk of uncontrolled migration of contaminants.	Experimental technologies with a substantial risk for uncontrolled migration. Not retained.
		Electro-thermal	Uses electrical current to heat subsurface soil and groundwater and enhance mobility to allow for more effective treatment or extraction. This technology is in the experimental phase. Substantial risk of uncontrolled migration of contaminants.	
		Surfactants	Uses surfactant chemicals (soap formulations) injected in the subsurface to enhance mobility to allow for more effective treatment or extraction. This technology is in the experimental phase. Substantial risk of uncontrolled migration of contaminants.	
		Acoustic vibrations	Uses sound to vibrate subsurface soil and groundwater and enhance mobility to allow for more effective treatment or extraction. This technology is in the experimental phase. Substantial risk of uncontrolled migration of contaminants.	

Table 6-3 (Cont'd.)
Initial Technology Screening for Subsurface Soil
Ithaca First Street MGP

General Response Action	Remedial Technology Type	Technology Process Option	Description	Site-Specific Screening Evaluation
Treatment and Disposal	**Off-site Treatment and Disposal**	Landfill	Disposal at a permitted off-site landfill.	A widely used conventional technology. Retained for further evaluation.
		Low-Temperature Thermal Desorption	Treatment at a permitted thermal desorption facility. The soil is heated in order to volatilize contaminants, which are then destroyed in an afterburner.	A widely used conventional technology for MGP impacted soils. Retained for further evaluation.
		Waste-to-Energy	Co-fired boiler or other waste-to-energy facilities, resulting in destruction of contaminants and energy production.	Retained for further evaluation.
		Soil Washing/ Chemical Treatment	Soil washing and chemical treatment by addition of oxidants.	Not applicable for MGP impacted soils. Not Retained.
		Biological Treatment	Landfarming or soil windrow tilling to enhance biological treatment of contaminants in soil.	No active facilities are available for MGP impacted soils. Not Retained.
	On-Site Treatment and Disposal	Landfill	Disposal at an on-site location constructed as a permitted landfill.	Insufficient land area available at this site. Not likely to be acceptable to surrounding community or site owner. Not retained.
		Low-Temperature Thermal Desorption	Treatment on site with a mobile permitted thermal desorption facility. The soil is heated in order to volatilize contaminants, which are then destroyed in an afterburner.	Insufficient land area available at this site. Not likely to be acceptable to surrounding community or site owner. Not retained.
		Incineration	High temperature burning on site with a mobile permitted incinerator.	Insufficient land area available at this site. Not likely to be acceptable to surrounding community or site owner. Not retained.
		Soil Washing/ Chemical Treatment	Soil washing and chemical treatment by addition of oxidants.	Not applicable to MGP impacted soils. Not retained.
		Biological Treatment	Landfarming or soil windrow tilling to enhance biological treatment of contaminants in soil.	Insufficient land area available at this site. Not likely to be acceptable to surrounding community or site owner. Not retained.

Table 6-4
Technology Evaluation for Groundwater
Ithaca First Street MGP

General Response Action	Technology	Effectiveness	Implementability	Relative Cost	Site-Specific Applicability and Screening Evaluation
No Action	**No Action**	Not effective for achieving RAOs for groundwater in an acceptable timeframe.	Readily implemented.	No Cost	No Action is included for comparison purposes in accordance with NYSDEC DER-10. Retained for Alternative Development.
Institutional Controls and Engineering Controls (IC/ECs)	**ICs**	Effective in preventing exposures to construction/utility workers and residents. Not effective in limiting subsurface migration of contaminants, volume reduction, or treatment.	Readily implemented.	Low	Retained for alternative development.
	ECs	Effective in preventing exposures for construction/utility workers and residents. Not effective in limiting subsurface migration of contaminants, volume reduction, or treatment.	Readily implemented.	Low	Retained for alternative development.
Containment	**Surface Soil Cover**	Provides additional protection and supports surface vegetation.	Readily implemented.	Low	Potentially applicable; however, off-site migration of contaminated groundwater is not a substantial issue at this site. Not retained for alternative development.
	Surface Low Permeability Caps	Includes low permeability barriers, such as plastic liners and asphalt pavements, to minimize infiltration of precipitation to source areas.	Readily implemented.	Low	Potentially applicable; however, off-site migration of contaminated groundwater is not a substantial issue at this site. Not retained for alternative development.
	Subsurface Vertical Barriers Steel Sheet Piling Bentonite/Cement Slurry Walls HDPE Sheeting Drilled grout and solidified earth column walls Jet grout column walls	Effective for minimizing migration of DNAPL and directing groundwater flow. Steel sheet piling can also serve as excavation shoring.	Technology proven and readily implemented. Limited by existing buildings, subsurface utilities or subsurface infrastructure such as pilings.	Moderate	Potentially applicable; however, off-site migration of contaminated groundwater is not a substantial issue at this site. Not retained for alternative development.
	Process Barriers Biological containment Chemical containment Permeable reactive barrier Hydraulic containment	Effective for meeting groundwater RAOs. Treats groundwater in-situ before it can migrate off site.	Implementable. This site has a low groundwater gradient and slow groundwater movement, enhancing implementability.	Moderate	Biological containment is potentially applicable as the representative process option for alternative development. Potentially applicable; however, off-site migration of contaminated groundwater is not a substantial issue at this site. Not retained for alternative development.
In-Situ Treatment	**Monitored Natural Attenuation (MNA)**	Effective over time for meeting groundwater RAOs once sources of groundwater impacts have been addressed. If sources cannot be fully addressed, MNA is effective in providing a decreasing trend of groundwater contaminants.	Implementable	Low	Retained for alternative development.
	In-Situ Solidification (ISS): Auger Mixing Excavator Bucket Mixing Pressure Grouting	Effective for meeting groundwater RAOs. Physically binds or encloses a COC mass and/or induces a chemical reaction between the stabilizing agent and the COCs to reduce their mobility within the subsurface and to decrease permeability of the mass so that groundwater does not contact the COCs.	Technology proven and implementable under some conditions. Limited by existing buildings, subsurface utilities or subsurface infrastructure such as pilings.	High mobilization costs. Costs of ISS for saturated soils can be less than excavation/off-site disposal.	Not retained due to site-specific limitations.
	In-Situ Chemical Oxidation (ISCO)	Effectiveness is uncertain and variable. May be effective for moderate to low COC concentrations in soil and groundwater. Limited effectiveness for highly impacted soils and NAPL (may provide an oxidized surface barrier to decrease partitioning of COC to groundwater and limit mobility).	Technology is in the demonstration phase. Moderate implementability. Corrosive oxidants are not compatible with underground utilities.	Moderate to High	Limited applicability due to corrosion of underground IAWWTF utilities. Limited effectiveness for DNAPL. Not retained for alternative development.
	Enhanced In-situ Groundwater Bioremediation: Aerobic and Anaerobic biodegradation of PAHs and BTEX	Effectiveness dependent upon contact through the groundwater column and therefore is less effective in less porous soils such as clays and silts, and more effective in sandy soils and sand lenses within alluvium. Long-term management and monitoring may be required to achieve groundwater RAOs. May be effective for moderate to low COC concentrations in soil and groundwater. Less effective if ongoing sources of groundwater impacts cannot be fully addressed.	Readily implementable. Technology is proven and is being implemented at MGP sites in New York State.	Moderate	Not retained for alternative development.

Table 6-4 (Cont'd.)
Technology Evaluation for Groundwater
Ithaca First Street MGP

General Response Action	Technology	Effectiveness	Implementability	Relative Cost	Site-Specific Applicability and Screening Evaluation
Removal	**Excavation/Removal of Soil:** Conventional and long-stick excavators/ Shored excavation Slurry trench excavation	Effective at meeting soil RAOs and addressing groundwater RAOs.	Technology is proven and readily implemented for accessible soils. However, implementation will be limited by the presence of existing buildings, a high density of subsurface utilities and infrastructure. Excavations deeper than the typical reach of an excavator, approximately 20 feet, would require additional equipment and more extensive dewatering and earth support structures.	High	Retained for alternative development.
	Groundwater Extraction and Treatment	Effectiveness limited as a complete groundwater remedy, without complete removal of source materials that lie beneath buildings.	Technology proven and readily implemented. However, implementation will be limited by the presence of existing buildings. Dewatering near existing structures may cause subsidence and potential damage. Dewatering near Cascadilla Creek may cause inflow that may be prohibitive to manage.	High	Limited applicability due to buildings, subsurface utilities and infrastructure on site. Limited effectiveness and high cost. Not Retained.
	NAPL Recovery: Wells and trenches	Partially addresses source material and aids in meeting groundwater and soil-related RAOs. Effectiveness will be limited by continuing presence of NAPL source material that is likely to be present beneath the IAWWTF buildings.	Technology proven and readily implemented. However, implementation will be limited by the presence of existing buildings, subsurface utilities and infrastructure.	Moderate	Limited applicability due to buildings, subsurface utilities and infrastructure on site. NAPL recoverability is uncertain. Retained for alternative development and possible pilot testing.

Table 6-5
Technology Evaluation for Surface Soil
Ithaca First Street MGP

General Response Action	Technology	Effectiveness	Implementability	Relative Cost	Site-Specific Applicability and Screening Evaluation
No Action	**No Action**	Not effective for achieving RAOs for surface soil in an acceptable timeframe.	Readily implemented.	No Cost	No Action is included for comparison purposes in accordance with NYSDEC DER-10. Retained for Alternative Development.
Institutional Controls and Engineering Controls (IC/ECs)	**ICs** Site Management Plan	Effective in preventing exposures to construction/utility workers and residents.	Readily implemented.	Low	Retained for alternative development.
	ECs Fencing Signage	Effective in preventing exposures for construction/utility workers and residents.	Readily implemented.	Low	Retained for alternative development.
Containment	**Surface Cover Soil and Caps** Soil covers Low permeability surface caps	Effective in preventing exposures for construction/utility workers and residents.	Technology proven and readily implemented.	Low	Soil covers were retained as the representative process option for alternative development.
Removal	**Excavation/Replacement of Soil:** Conventional and excavators and graders	Effective at meeting surface soil RAOs.	Technology is proven and readily implemented for surface soils.	High	Retained for alternative development.

Table 6-6
Technology Evaluation for Subsurface Soil
Ithaca First Street MGP

General Response Action	Technology	Effectiveness	Implementability	Relative Cost	Site-Specific Applicability and Screening Evaluation
No Action	**No Action**	Not effective for achieving RAOs for subsurface soil in an acceptable timeframe.	Readily implemented.	No Cost	No Action is included for comparison purposes in accordance with NYSDEC DER-10. Retained for Alternative Development.
Institutional Controls and Engineering Controls (IC/ECs)	**ICs**	Effective in preventing exposures to construction/utility workers and residents. Not effective in limiting subsurface migration of contaminants, volume reduction, or treatment.	Readily implemented.	Low	Retained for alternative development.
	ECs	Effective in preventing exposures for construction/utility workers and residents. Not effective in limiting subsurface migration of contaminants, volume reduction, or treatment.	Readily implemented.	Low	Retained for alternative development.
In-Situ Treatment	**In-Situ Solidification (ISS):** Auger Mixing Excavator Bucket Mixing Pressure/Jet Grouting	The ISS monolith physically prevents exposures to impacted subsurface soils. Physically binds or encloses a COC mass and/or induces a chemical reaction between the stabilizing agent and the COCs to reduce their mobility within the subsurface and to decrease permeability of the mass so that groundwater does not contact the COCs.	Technology proven and implementable under some conditions. Limited by existing buildings, subsurface utilities or subsurface infrastructure such as pilings.	High mobilization costs. Costs of ISS for saturated soils can be less than excavation/off-site disposal.	Not retained due to site-specific limitations..
	In-Situ Chemical Oxidation (ISCO)	Effectiveness is uncertain and variable. May be effective for moderate to low COC concentrations in soil and groundwater.	Technology is in the demonstration phase. Moderate implementability.	Moderate to High	Limited applicability due to corrosion of underground IAWWTF utilities. Limited effectiveness for DNAPL. Not retained for alternative development.
	Enhanced In-situ Bioremediation: Aerobic and Anaerobic biodegradation of PAHs and BTEX	Effectiveness dependent upon contact through the groundwater column and therefore is less effective in less porous soils such as clays and silts, and more effective in sandy soils and sand lenses within alluvium. Long-term management and monitoring may be required to achieve groundwater RAOs. May be effective for moderate to low COC concentrations in soil and groundwater. Less effective if ongoing sources of groundwater impacts cannot be fully addressed.	Readily implementable. Technology is proven and is being implemented at MGP sites in New York State.	Moderate	Not retained for alternative development.
Removal	**Excavation/Removal of Soil:** Conventional and long-stick excavators Shored excavation Slurry trench excavation	Effective at meeting soil RAOs and addressing groundwater RAOs.	Technology is proven and readily implemented for accessible soils. However, implementation will be limited by the presence of existing buildings, a high density of subsurface utilities and infrastructure. Excavations deeper than the typical reach of an excavator, approximately 20 feet, would require additional equipment and more extensive dewatering and earth support structures.	High	Retained for alternative development.
Treatment and Disposal	**Off-site Treatment and Disposal:** Landfill Low-Temperature Thermal Desorption Waste-To-Energy	Effective and widely used technologies	Readily implemented.	Moderate	All Retained for alternative development.

Table 7-1
RAOs Addressed by Alternatives
Ithaca First Street MGP

Applicable Medium	RAOs	Remedial Alternative					
		Alternative 1 **No Action**	**Alternative 2** **IC/ECs**	**Alternative 3** **IC/ECs, Soil Cover, Monitoring**	**Alternative 4** **IC/ECs, Soil Cover, Monitoring, NAPL Recovery**	**Alternative 5** **IC/ECs, Soil Cover, Monitoring, NAPL Recovery, Excavation to Industrial SCOs**	**Alternative 6** **Demolition of IAWWTF and Excavation to Unrestricted SCOs**
Surface Soil	Prevent ingestion/direct contact with soil with contaminant levels exceeding the applicable SCOs. Prevent inhalation of or exposure to contaminants in surface soil. Prevent migration of contaminants that would result in groundwater, surface water, or sediment contamination. Prevent impacts to biota from ingestion/direct contact with soil causing toxicity.	Outside of fenceline, addressed by previous actions of soil cover and asphalt pavement of Cayuga Waterfront Trail. Not addressed inside of fenceline.	Outside of fenceline, addressed by previous actions and SMP. Inside fenceline, addressed by SMP. One exceedance area not addressed.	Outside of fenceline, addressed by previous actions and SMP. Inside fenceline, addressed by SMP. One exceedance area addressed by additional soil cover.	Outside of fenceline, addressed by previous actions and SMP. Inside fenceline, addressed by SMP. One exceedance area addressed by additional soil cover.	Outside of fenceline, addressed by previous actions and SMP. Inside fenceline, addressed by SMP. One exceedance area addressed by additional soil cover.	Addressed by complete removal.
Subsurface Soil	Prevent ingestion/direct contact with soil with contaminant levels exceeding the applicable SCOs. Prevent inhalation of or exposure to contaminants in surface soil. Prevent migration of contaminants that would result in groundwater, surface water, or sediment contamination. Prevent impacts to biota from ingestion/direct contact with soil causing toxicity.	Partially addressed by previous soil excavation and removal actions of 1998 IRM.	Addressed by SMP and partially addressed by previous soil excavation and removal actions of 1998 IRM.	Addressed by SMP and partially addressed by previous soil excavation and removal actions of 1998 IRM.	Addressed by SMP and partially addressed by previous soil excavation and removal actions of 1998 IRM. Prevention of migration of NAPL partially addressed by NAPL recovery.	Addressed by SMP and excavation to Industrial SCOs, and previous soil excavation and removal actions of 1998 IRM. Prevention of migration of NAPL partially addressed by NAPL recovery.	Addressed by complete removal.
Groundwater	Prevent ingestion of groundwater with contaminant levels exceeding drinking water standards. Prevent contact with, or inhalation of, volatiles from contaminated groundwater. Prevent the discharge of contaminants to surface water or sediment. Remove the source of ground or surface water contamination, to the extent practicable. Restore groundwater aquifer to ambient groundwater quality criteria, to the extent practicable.	Not Addressed	Addressed by SMP with groundwater use restrictions.	Addressed by SMP with groundwater use restrictions.	Addressed by SMP with groundwater use restrictions. Removal of source of groundwater contamination partially addressed by NAPL recovery.	Addressed by SMP with groundwater use restrictions. Removal of source of groundwater contamination partially addressed by NAPL recovery.	Addressed by complete removal.

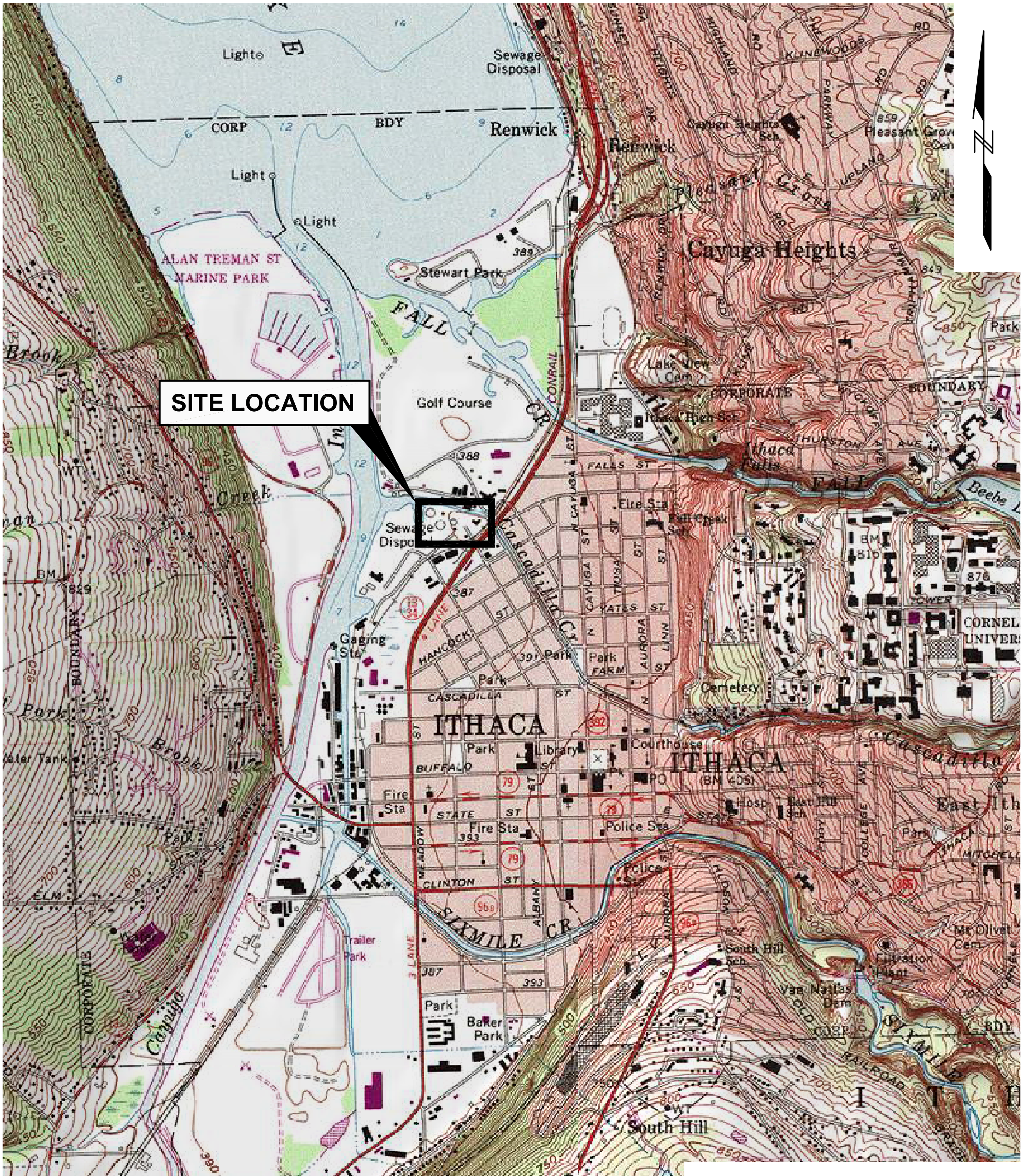
Table 7-2
Comparative Ranking of Alternatives
Ithaca First Street MGP

Alternative	Description	Threshold Criteria		Balancing Criteria						
		Overall Protection of Human Health and the Environment	Compliance with SCGs	Long-Term Effectiveness and Permanence	Reduction of Toxicity, Mobility, & Volume	Short-Term Effectiveness	Implementability	Total Cost (FS accuracy +50%/ - 30%)	Cost Effectiveness	Land Use
1	No Action	Not protective	Not Compliant	4th	5th	1st	1st	No Cost	No Cost	4th
2	Institutional Controls/ Engineering Controls as provided in a Site Management Plan (IC/ECs)	4th	2nd	3rd	4th	1st	1st	$350,000	2nd	2nd
3	IC/ECs, Additional soil cover and groundwater monitoring	3rd	2nd	3rd	4th	2nd	1st	$1,200,000	2nd	1st
4	IC/ECs, Additional soil cover groundwater monitoring, and NAPL recovery	3rd	2nd	2nd	3rd	3rd	2nd	$2,100,000	1st	1st
5	IC/ECs, Additional soil cover groundwater monitoring, excavation of soil to Industrial SCO levels, and NAPL recovery	2nd	2nd	2nd	2nd	4th	3rd	$9,100,000	2nd	1st
6	Demolition of IAWWTF and excavation of soil to Unrestricted SCO levels	1st	1st	1st	1st	5th	4th Not Implementable	$165,000,000	3rd	3rd

Comparative Ranking:

1st - Ranked First, Best
2nd - Ranked Second
3rd - Ranked Third
4th - Ranked Fourth
5th - Ranked Fifth, Last
Duplicate ranks indicate equivalent ranking.

Figures



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SCALE, FEET

SOURCE:
U.S.G.S. TOPOGRAPHIC MAP, CREATED WITH TOPO! ® ©2001
NATIONAL GEOGRAPHIC (www.nationalgeographic.com/topo)

NYSEG ITHACA FIRST STREET MGP SITE FS ITHACA, NEW YORK	GEI Consultants	**SITE LOCATION MAP**
NYSEG BINGHAMTON, NEW YORK	Project 101850	December 2010 Figure 1

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LEGEND:

INVESTIGATION AREA

SOURCE:

1. SURVEY OF EXISTING SURFACE FEATURES AND SAMPLE LOCATIONS PERFORMED BY DELTA ENGINEERS, ARCHITECTS, & LAND SURVEYORS, NEW YORK STATE LICENSED LAND SURVEYOR #050195. HORIZONTAL LOCATIONS ARE REFERENCED TO THE NYS-CENTRAL ZONE (NAD83). VERTICAL ELEVATIONS ARE REFERENCED TO NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88).
2. AERIAL ORTHOPHOTO FROM WWW.NYSGIS.STATE.NY.US/GATEWAYC/MG/

0 100 200

SCALE, FEET

NYSEG
ITHACA FIRST STREET MGP SITE FS
ITHACA, NEW YORK

NYSEG
BINGHAMTON, NEW YORK

GEI Consultants

Project 101850

INVESTIGATION AREA
ITHACA FIRST STREET MGP
SITE REMEDIAL INVESTIGATION

December 2010

Figure 2

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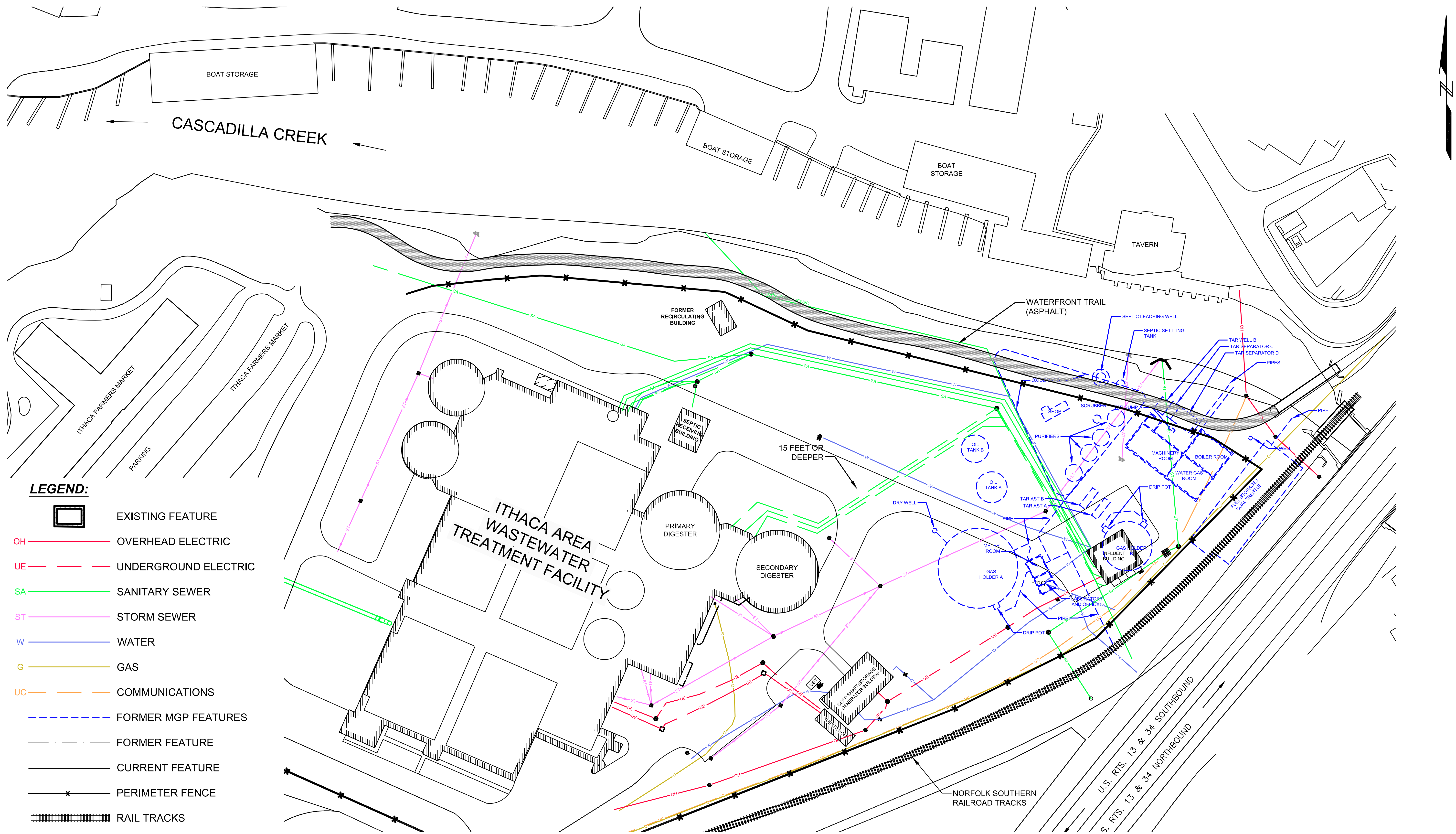

LEGEND:

	EXISTING FEATURE
OH	OVERHEAD ELECTRIC
UE	UNDERGROUND ELECTRIC
SA	SANITARY SEWER
ST	STORM SEWER
W	WATER
G	GAS
UC	COMMUNICATIONS
	FORMER MGP FEATURES
	FORMER FEATURE
	CURRENT FEATURE
	PERIMETER FENCE
	RAIL TRACKS

SOURCE:

1. SURVEY OF EXISTING CONDITIONS AND SAMPLE LOCATIONS PERFORMED BY DELTA SURVEYORS, INC., NEW YORK STATE LICENSED LAND SURVEYOR #050195. HORIZONTAL LOCATIONS ARE REFERENCED TO THE NYS-CENTRAL ZONE (NAD83). VERTICAL ELEVATIONS ARE REFERENCED TO NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88).

0 100 200

SCALE, FEET

NYSEG
ITHACA FIRST STREET MGP SITE FS
ITHACA, NEW YORK

NYSEG
BINGHAMTON, NEW YORK

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SITE LAYOUT AND FORMER MGP FEATURES

Project 101850 | December 2010 | Figure 3

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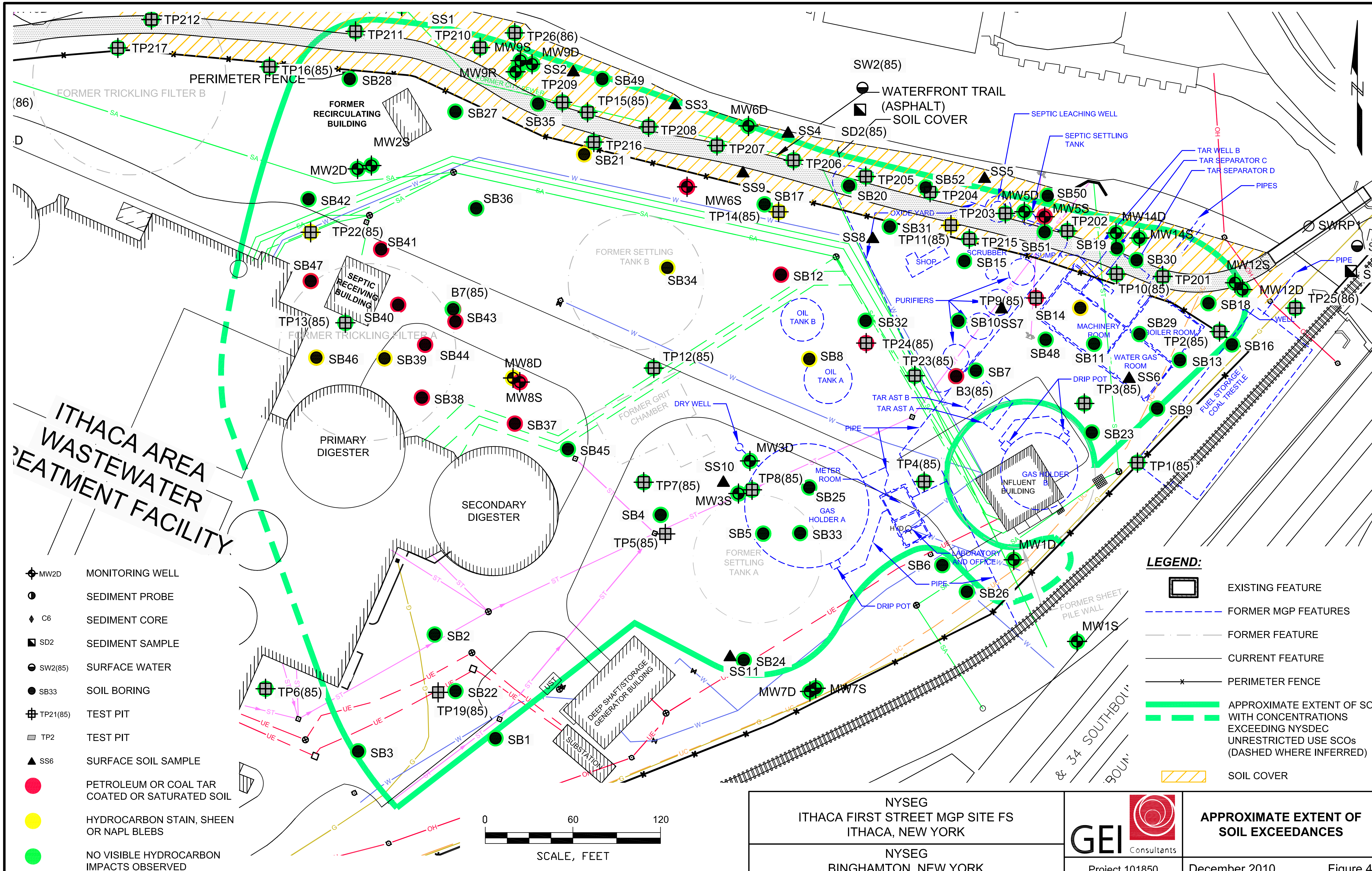

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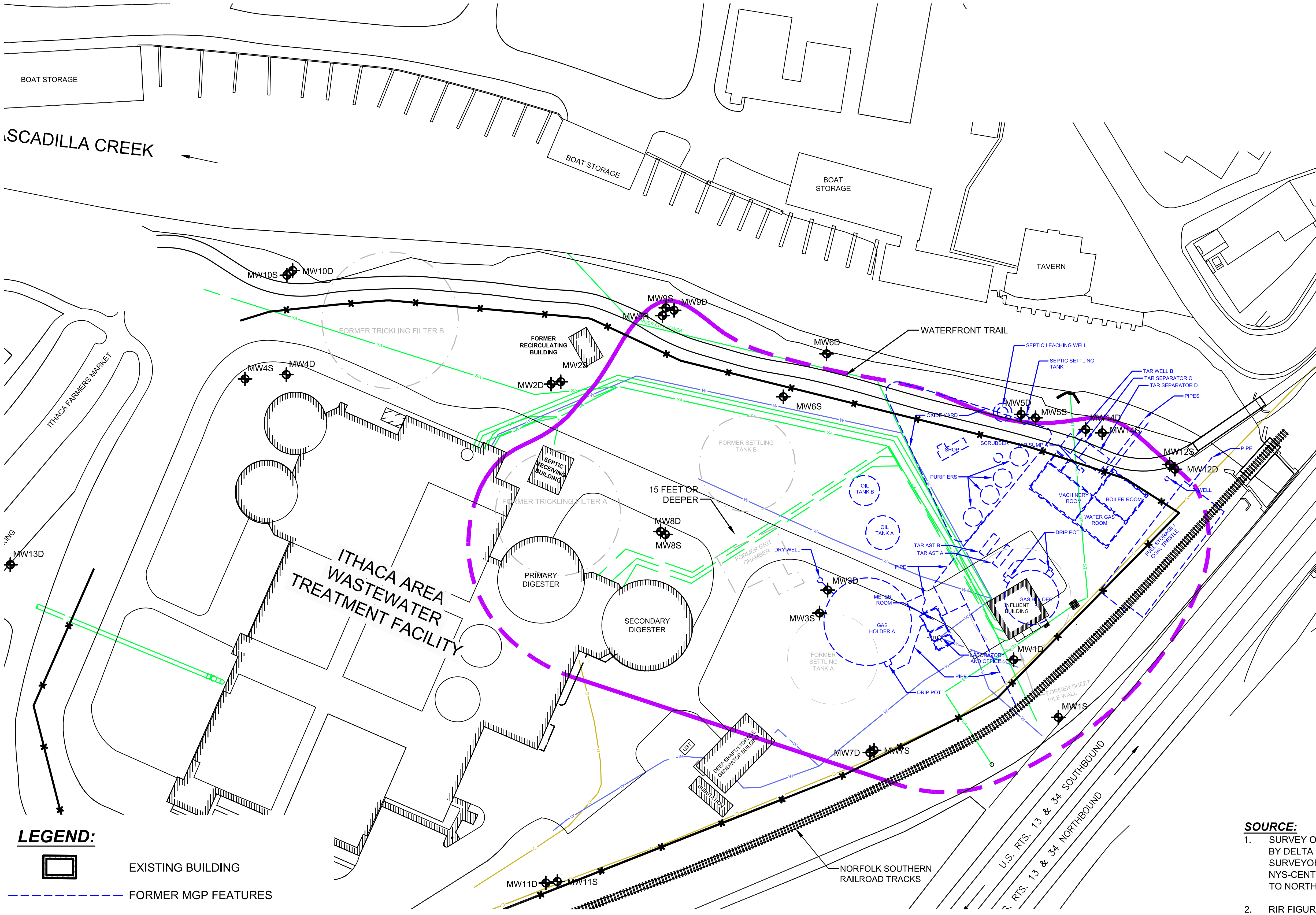

LEGEND:

- EXISTING BUILDING
- FORMER MGP FEATURES
- FORMER FEATURE
- CURRENT FEATURE
- RAILTRACK
- FENCE

LEGEND:

- MW2S — MONITORING WELL
- EXTENT OF EXCEEDANCES OF NYSDEC AMBIENT WATER QUALITY STANDARDS (DASHED WHERE INFERRED)

SOURCE:

1. SURVEY OF EXISTING CONDITIONS AND SAMPLE LOCATIONS PERFORMED BY DELTA SURVEYORS, INC., NEW YORK STATE LICENSED LAND SURVEYOR #050195. HORIZONTAL LOCATIONS ARE REFERENCED TO THE NYS-CENTRAL ZONE (NAD83). VERTICAL ELEVATIONS ARE REFERENCED TO NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88).
2. RIR FIGURES 21, 22, 23, & 24.

NYSEG ITHACA FIRST STREET MGP SITE FS ITHACA, NEW YORK	GEI Consultants	APPROXIMATE EXTENT OF GROUNDWATER EXCEEDANCES
NYSEG BINGHAMTON, NEW YORK	Project 101850	December 2010 Figure 5

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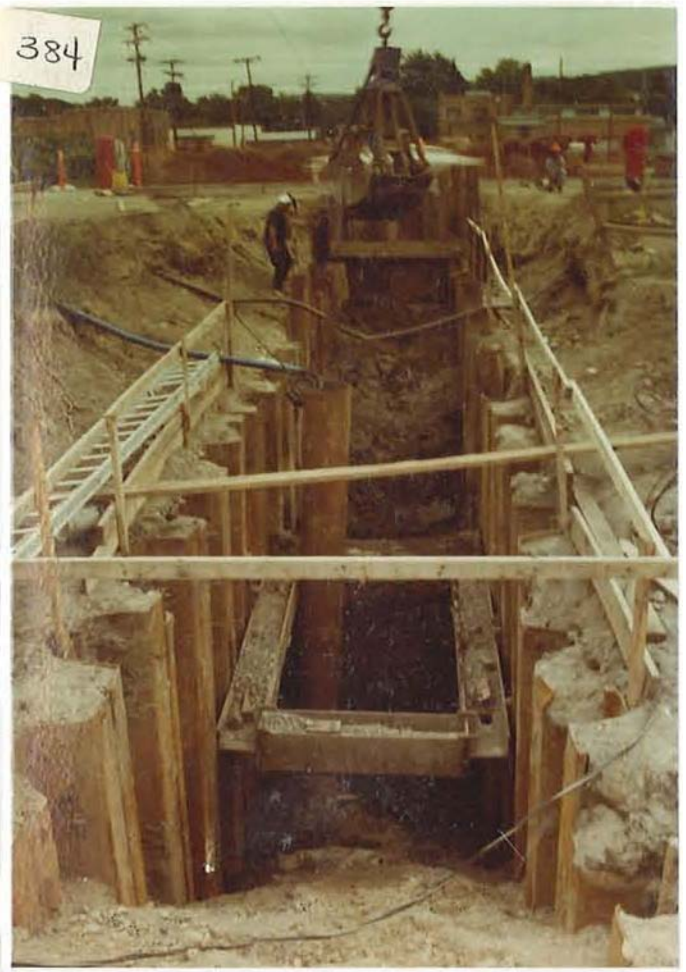
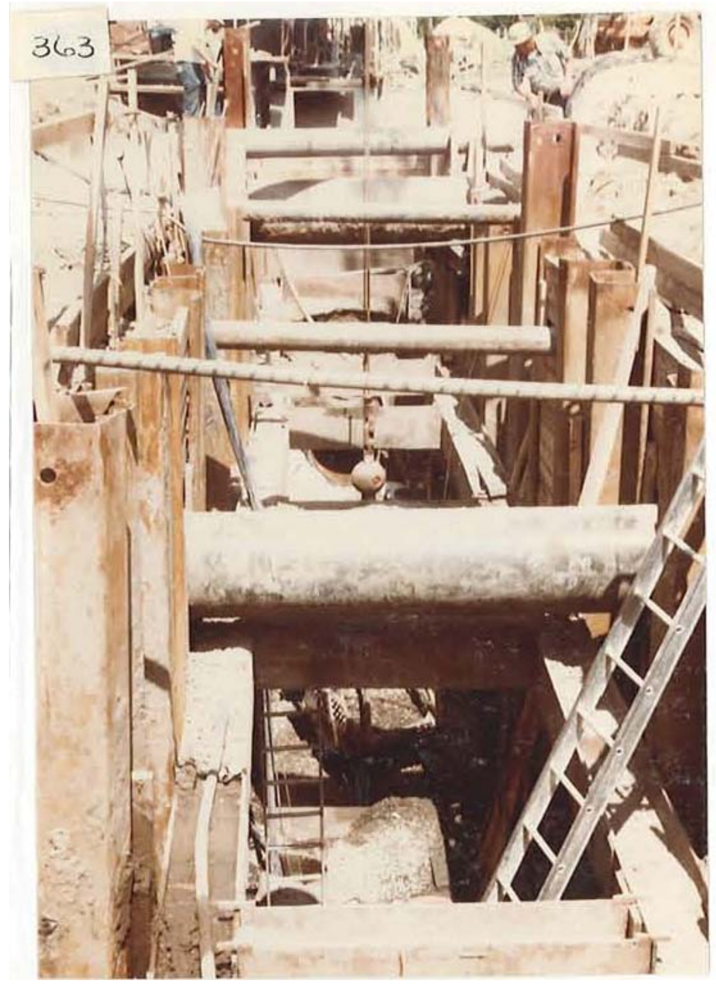
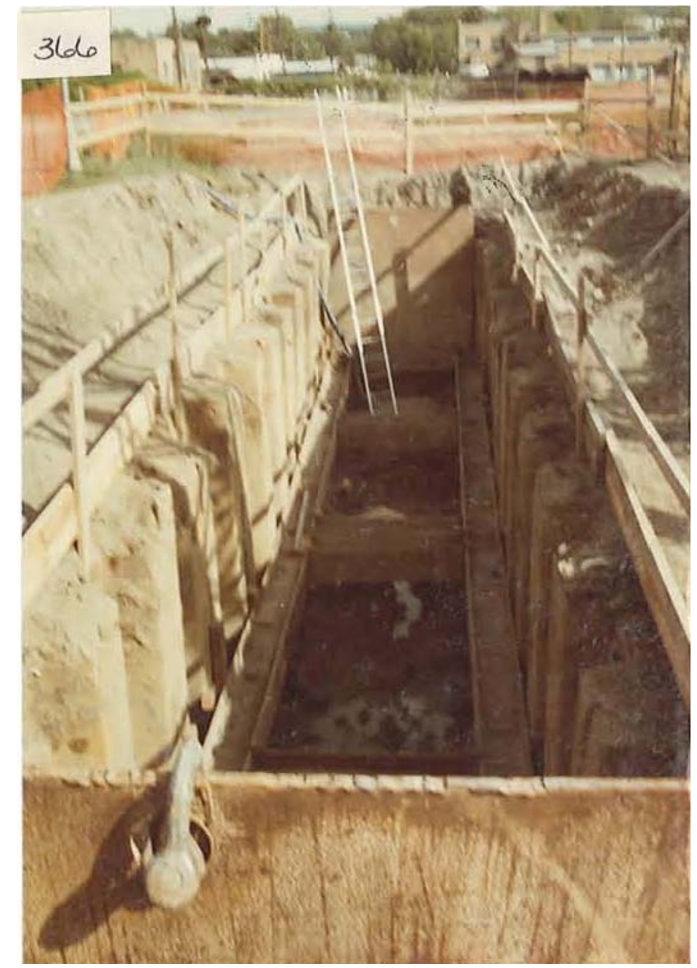
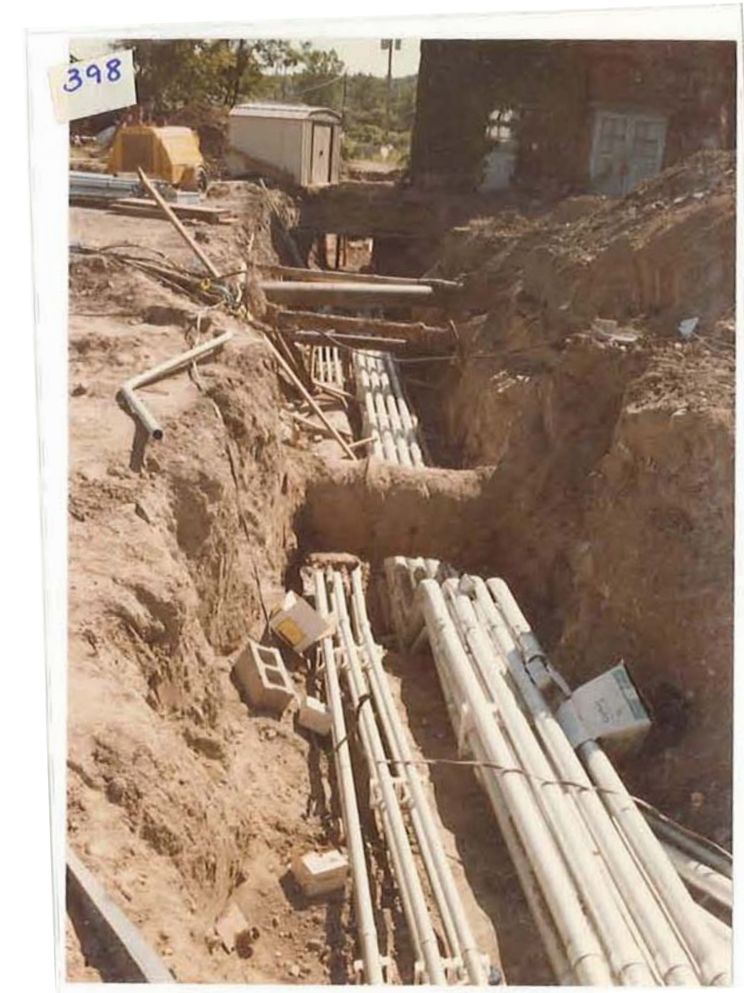
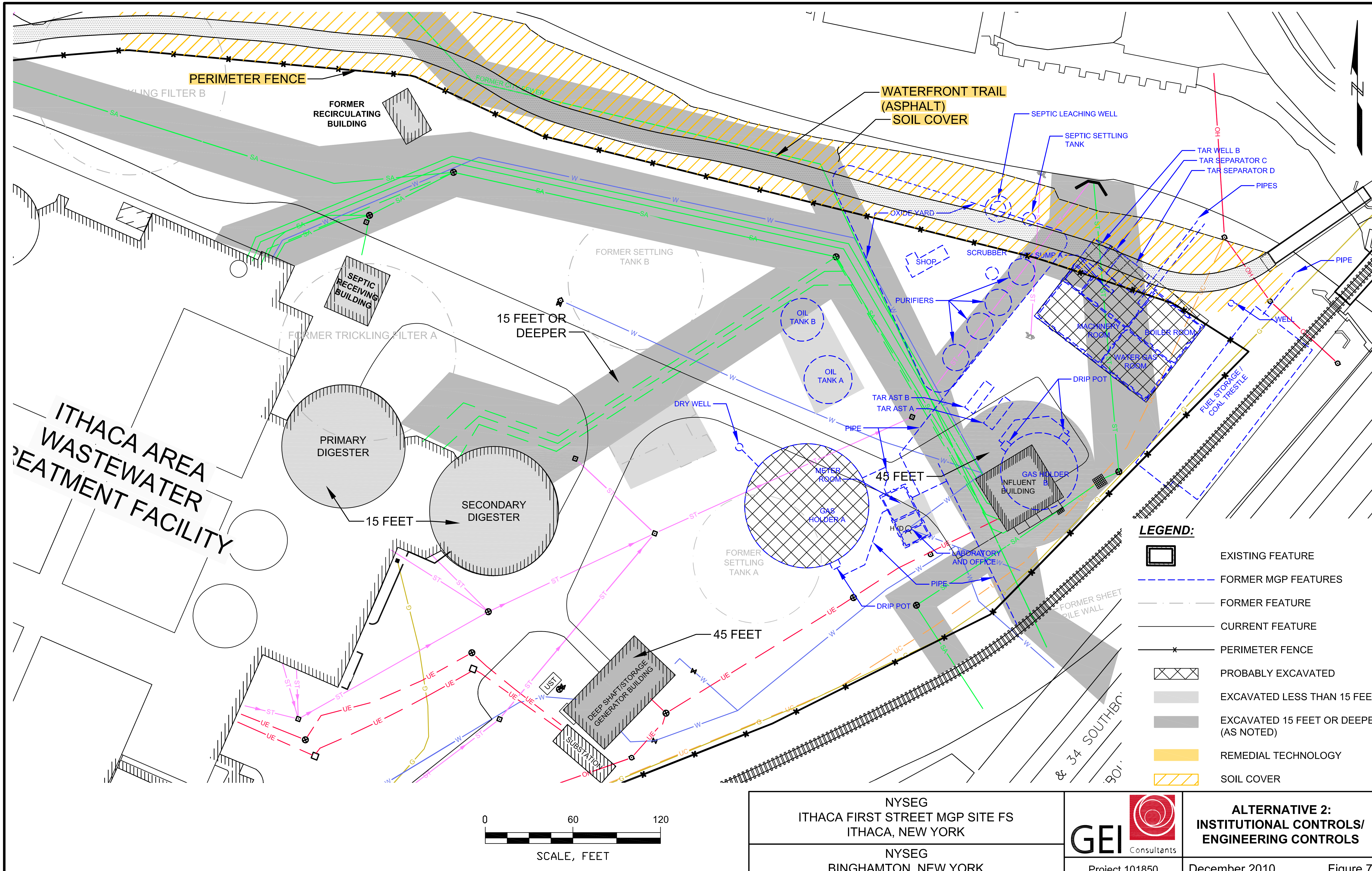








NYSEG ITHACA FIRST STREET MGP SITE FS ITHACA, NEW YORK NYSEG BINGHAMTON, NEW YORK	GEI Consultants Project 101850	**PHOTOGRAPHS OF IAWWTF CONSTRUCTION EXCAVATION ACTIVITIES** November 2010 Figure 6



NYSEG ITHACA FIRST STREET MGP SITE FS ITHACA, NEW YORK	GEI Consultants	ALTERNATIVE 2: INSTITUTIONAL CONTROLS/ ENGINEERING CONTROLS
NYSEG BINGHAMTON, NEW YORK	Project 101850	December 2010 Figure 7

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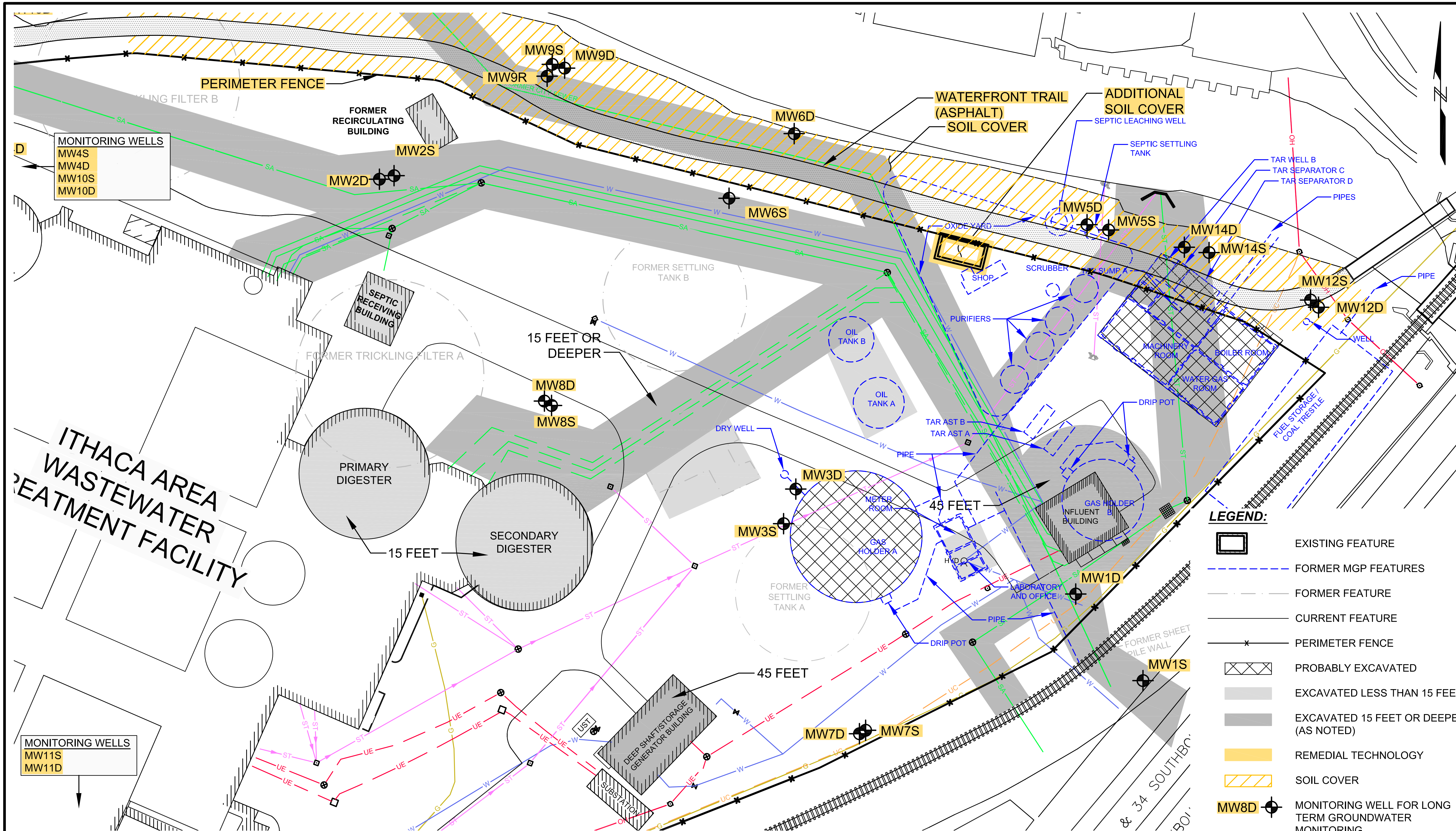

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ITHACA, NEW YORK

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BINGHAMTON, NEW YORK

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ALTERNATIVE 3: INSTITUTIONAL CONTROLS/ ENGINEERING CONTROLS, SOIL COVER, GROUNDWATER MONITORING

December 2010 | Figure 8

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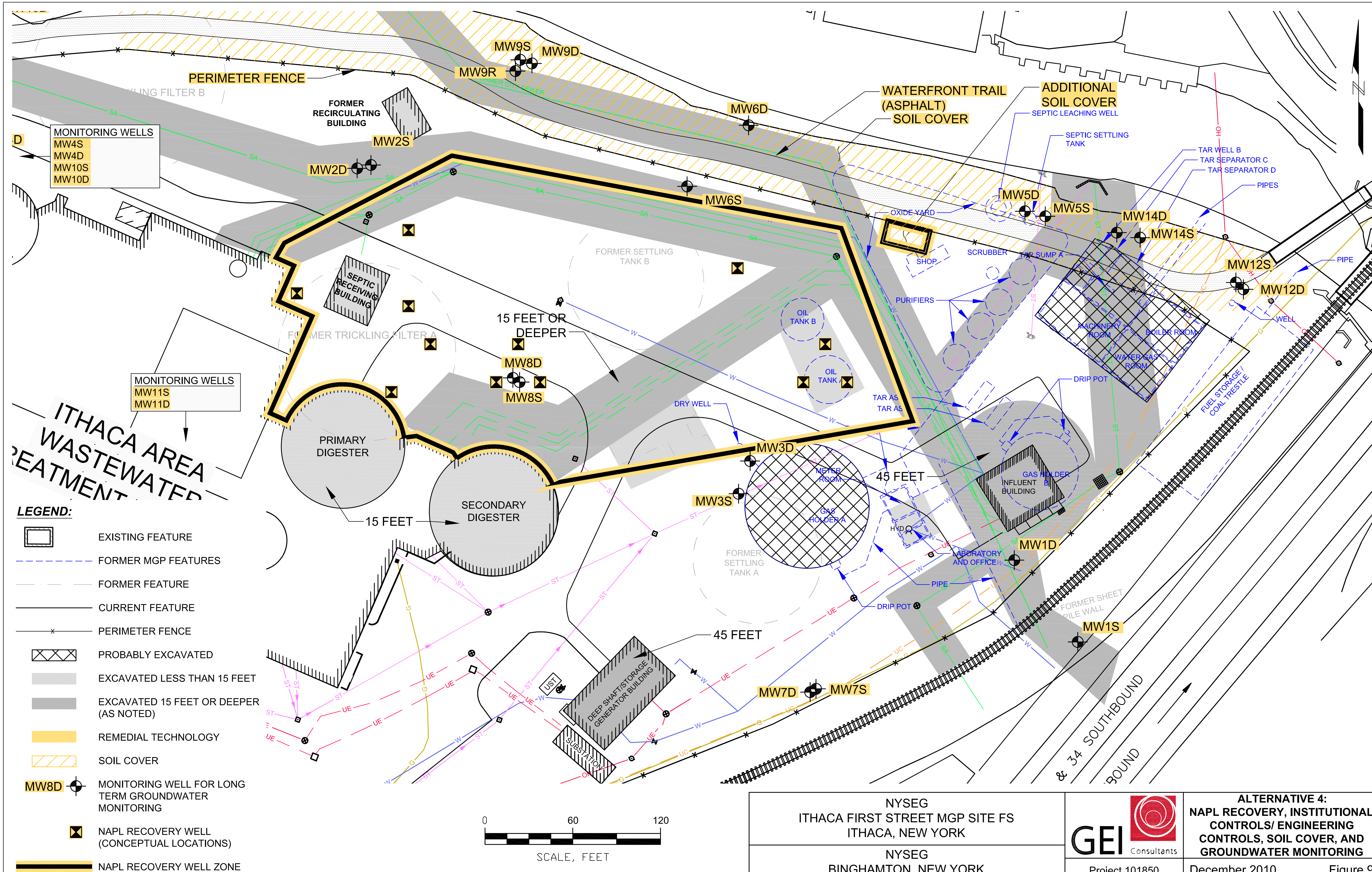

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ITHACA, NEW YORK

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ALTERNATIVE 4: NAPL RECOVERY, INSTITUTIONAL CONTROLS/ ENGINEERING CONTROLS, SOIL COVER, AND GROUNDWATER MONITORING

December 2010

Figure 9

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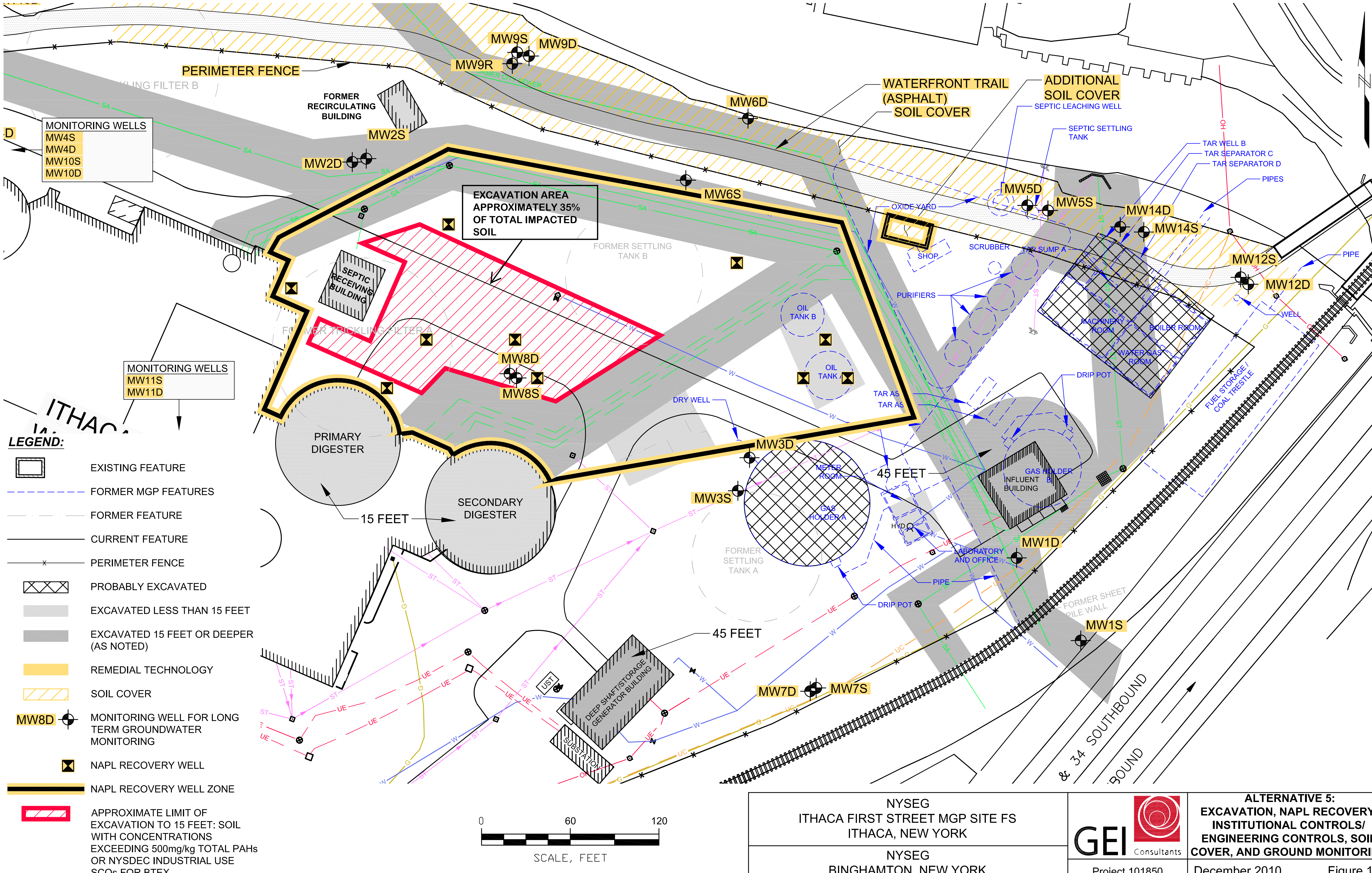

NYSEG ITHACA FIRST STREET MGP SITE FS ITHACA, NEW YORK	GEI Consultants	ALTERNATIVE 5: EXCAVATION, NAPL RECOVERY, INSTITUTIONAL CONTROLS/ ENGINEERING CONTROLS, SOIL COVER, AND GROUND MONITORING	
NYSEG BINGHAMTON, NEW YORK	Project 101850	December 2010	Figure 10

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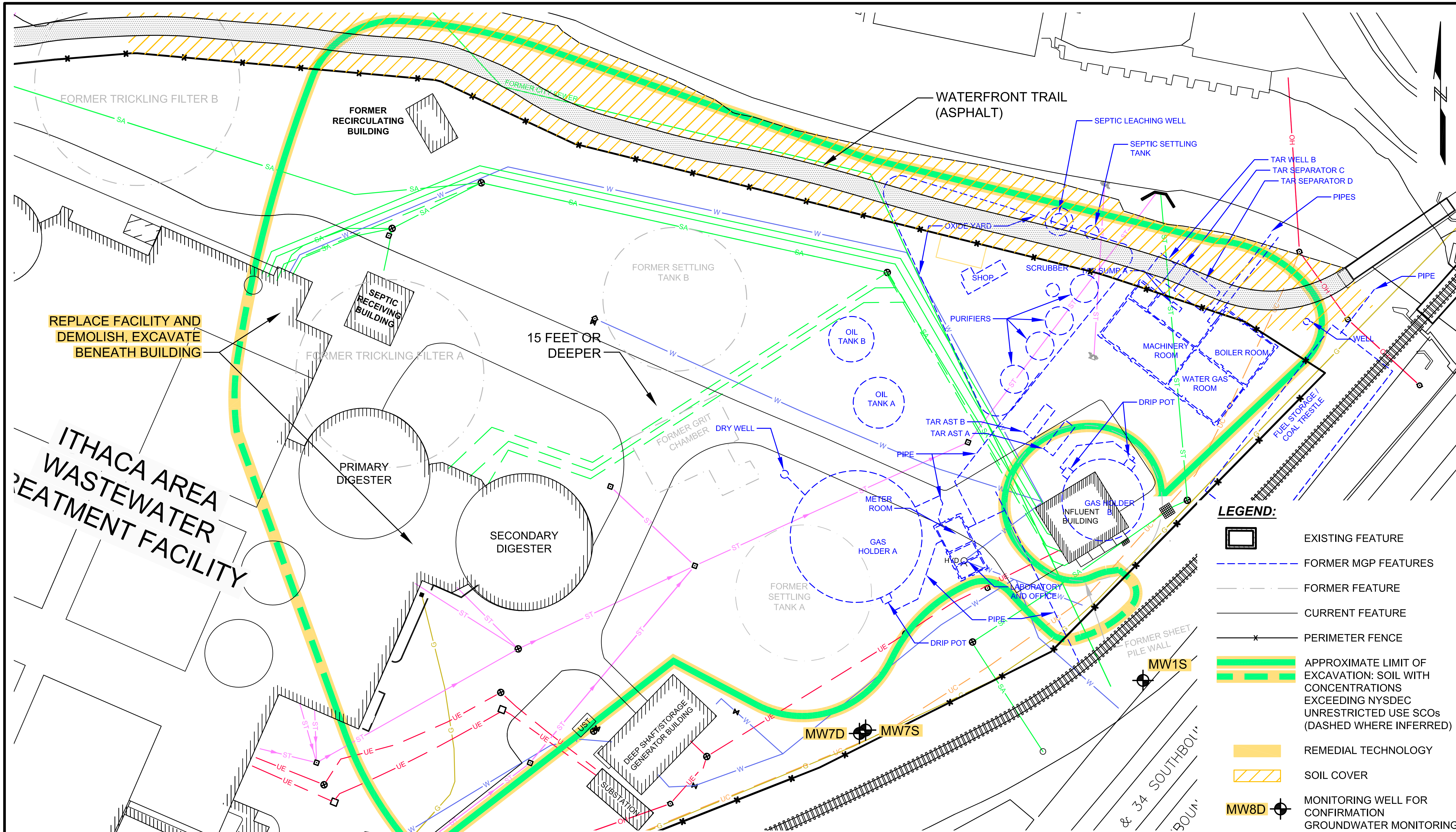

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ALTERNATIVE 6: EXCAVATION OF SOIL TO UNRESTRICTED SCO LEVELS

December 2010

Figure 11

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Appendix A

Cost Estimates

This appendix provides the cost estimates for the Alternatives Analysis. Table A-1 presents a summary of the estimates for all of the alternatives. A summary table is provided for each alternative, followed by a notes table which lists estimation sources and notes for each line item in the estimate.

The estimates were prepared using a tool specifically developed for remediation cost estimating. The Remedial Action Cost Engineering and Requirements (*RACER*) system is a cost-estimating tool that accurately estimates costs for all phases of remediation.   The system was originally developed under Air Force funding in 1991. Numerous revisions and updates have been made through several releases since then.

RACER 10.3, the latest release, was used. This version has been enhanced with updated data and features that reflect current remediation industry practice. The system has been peer reviewed by numerous organizations and industry professionals. *RACER* is a parametric cost modeling system that uses a patented methodology for estimating costs. The *RACER* cost technologies are based on generic engineering solutions for environmental projects, technologies, and processes. The generic engineering solutions were derived from historical project information, industry data, government laboratories, construction management agencies, vendors, contractors, and engineering analysis. *RACER* incorporates the most technologically up-to-date engineering practices and procedures to accurately reflect current remediation processes and pricing. *RACER* tailors the generic engineering solutions by adding site-specific parameters to reflect project-specific conditions and requirements. The tailored design is then translated into specific quantities of work. The quantities of work are then priced using current cost data.

The *RACER* cost database is based primarily on the Unit Price Book (UPB), which is developed by the Tri-Services Cost Engineering Group. The *RACER* database also includes a number of specialized assemblies that are not derived from the UPB.

Table A-1
Detailed Cost Estimate - Alternatives Summary
Ithaca First Street MGP Site
Ithaca, New York

Alternative	Description	Total Cost
Alternative 1	No Action	No Cost
Alternative 2	Utilization of Institutional and Engineering Controls (IC/ECs) only to prevent exposures and meet RAOs	$350,000
Alternative 3	IC/ECs, Additional Surface soil (1 foot clean soil cover), and Long term groundwater monitoring	$1,200,000
Alternative 4	IC/ECs, Additional Surface soil (1 foot clean soil cover), Long term groundwater monitoring, and installation of a series of NAPL Recovery wells	$2,100,000
Alternative 5	Excavation of Accessible Impacted Soils from 0 - 15 bgs which exceed 500ppm TPAH and BTEX industrial SCOs. Installation of a series of NAPL Recovery wells for deeper impacts and inaccessible areas.	$9,100,000
Alternative 6	Demolition of IAWWTF, total Removal of soils exceeding Part 375 Unrestricted SCOs, and replacement of IAWWTF.	$165,000,000

Table A-2
Detailed Cost Estimate - Alternative 2
Ithaca First Street MGP Site
Ithaca, New York

Remedial Component	Unit	Unit Price	Quantity	Total Cost
COMMON COST COMPONENTS				
100 ENGINEERING				
101 Engineering Design, Plans, Specs, Bid, Permitting, and Surveying	Lump Sum	$6,363	1	$6,363
			Subtotal	$6,363
			% Total Costs	2%
		TOTAL ENGINEERING COSTS		**$6,363**
200 CONSTRUCTION MANAGEMENT				
201 Construction Oversight	Day	$950	5	$4,750
203 Completion Report	Lump Sum	$2,500	1	$2,500
			Subtotal	$7,250
			% Total Costs	2%
300 REMEDIAL COMPONENTS				
Institutional Controls / Engineering Controls				
315 Groundwater Deed Restrictions	Lump Sum	$50,000	1	$50,000
316 Site Management Plan	Lump Sum	$50,000	1	$50,000
317 Fencing and Signage	Lump Sum	$20,000	1	$20,000
			Subtotal	$120,000
			% Total Costs	34%
		TOTAL CAPITAL COSTS		**$127,250**
400 OPERATION AND MAINTENANCE				
402 Annual Inspection and Reporting	Year	$10,000	30	$161,411
			Subtotal	$161,411
			% Total Costs	46%
		TOTAL O&M COSTS		**$161,411**
REMEDIAL COST SUMMARY				
Total Engineering Costs				$6,363
Total Capital Costs				$127,250
Total Operation and Maintenance Costs				$161,411
		Total Capital, O&M, and Engineering Costs		**$295,023**
500 CONTINGENCY				
501 Allowance for Undefined Costs Associated with Utilities, Subsurface Structures, and Extent of Impacts.			20%	$59,005
			% TOTAL COSTS	17%
			TOTAL COST	**$ 354,028**
		ROUNDED COST		**$350,000**

Table A-2
Detailed Cost Estimate Notes - Alternative 2
Ithaca First Street MGP Site
Ithaca, New York

100	**ENGINEERING**	
101	Engineering Design, Plans, Specs, Bid, Permitting, and Surveying	Percent of Total Capital Cost (5%)
200	**CONSTRUCTION MANAGEMENT**	
201	Construction Oversight	Assume 5 days - 1 Grade 3 Project Engineer
203	Completion Report	GEI Past Experience
300	**REMEDIAL COMPONENTS**	
	Institutional Controls / Engineering Controls	
315	Groundwater Deed Restrictions	GEI Past Experience
316	Site Management Plan	GEI Past Experience
317	Fencing and Signage	GEI Past Experience
400	**OPERATION AND MAINTENANCE**	
402	Annual Inspection and Reporting	$10K per year for 30 years at i=5% (per NYSDEC)
REMEDIAL COST SUMMARY		
	Total Capital Costs Without Contingency	Includes Sections 200 and 300
	Total Operation and Maintenance Costs	Includes Section 400
	Total Capital, O&M, and Engineering Costs Without Contingency	Includes Sections 100, 200, 300, and 400 without contingency
500 CONTINGENCY		
501	Allowance for Undefined Costs Associated with Utilities, Subsurface Structures, and Extent of Impacts.	Based on Total Capital Costs without Contingency

Table A-3
Detailed Cost Estimate - Alternative 3
Ithaca First Street MGP Site
Ithaca, New York

Remedial Component	Unit	Unit Price	Quantity	Total Cost
COMMON COST COMPONENTS				
100 ENGINEERING				
101 Engineering Design, Plans, Specs, Bid, Permitting, and Surveying	Lump Sum	$6,985	1	$6,985
			Subtotal	$6,985
			% Total Costs	1%
		TOTAL ENGINEERING COSTS		**$6,985**
200 CONSTRUCTION MANAGEMENT				
201 Construction Oversight	Day	$950	10	$9,500
203 Completion Report	Lump Sum	$5,000	1	$5,000
			Subtotal	$14,500
			% Total Costs	1%
300 REMEDIAL COMPONENTS				
Institutional Controls / Engineering Controls				
315 Groundwater Deed Restrictions	Lump Sum	$50,000	1	$50,000
316 Site Management Plan	Lump Sum	$50,000	1	$50,000
317 Fencing and Signage	Lump Sum	$20,000	1	$20,000
Soil Cover				
312 Topsoil placement, grading and seeding for 1-ft cover	Lump Sum	$5,200	1	$5,200
			Subtotal	$125,200
			% Total Costs	10%
		TOTAL CAPITAL COSTS		**$139,700**
400 OPERATION AND MAINTENANCE				
Groundwater Monitoring				
401 Post-remediation Confirmatory Monitoring	Year	$44,915	30	$724,976
402 Annual Inspection and Reporting	Year	$10,000	30	$161,411
			Subtotal	$886,387
			% Total Costs	86%
		TOTAL O&M COSTS		**$886,387**
REMEDIAL COST SUMMARY				
Total Engineering				$6,985
Total Capital Costs				$139,700
Total Operation and Maintenance Costs				$886,387
	Total Capital, O&M, and Engineering Costs			**$1,033,072**
500 CONTINGENCY				
501 Allowance for Undefined Costs Associated with Utilities, Subsurface Structures, and Extent of Impacts.			20%	$206,614
			% TOTAL COSTS	17%
			TOTAL COST	**$ 1,239,686**
		ROUNDED COST		**$1,200,000**

Table A-3 Detailed Cost Estimate Notes - Alternative 3 Ithaca First Street MGP Site Ithaca, New York		
100	**ENGINEERING**	
101	Engineering Design, Plans, Specs, Bid, Permitting, and Surveying	Percent of Total Capital Cost (5%)
200	**CONSTRUCTION MANAGEMENT**	
201	Construction Oversight	Assume 10 days - 1 Grade 3 Project Engineer
203	Completion Report	GEI Past Experience
300	**REMEDIAL COMPONENTS**	
	Institutional Controls / Engineering Controls	
315	Groundwater Deed Restrictions	GEI Past Experience
316	Site Management Plan	GEI Past Experience
317	Fencing and Signage	GEI Past Experience
	Soil Cover	
312	Topsoil placement and grading including 1-ft cover outside of excavation	1 load topsoil + Soil Testing
400	**OPERATION AND MAINTENANCE**	
	Groundwater Monitoring	
401	Post-remediation Confirmatory Monitoring	$44,915 per year (RACER) for 30 years at i=5%, Interest rate provided by NYSDEC
402	Annual Inspection and Reporting	$10K per year for 30 years at i=5% (per NYSDEC)
REMEDIAL COST SUMMARY		
	Total Capital Costs Without Contingency	Includes Sections 200 and 300
	Total Operation and Maintenance Costs	Includes Section 400
	Total Capital, O&M, and Engineering Costs Without Contingency	Includes Sections 100, 200, 300, and 400 without contingency
500 CONTINGENCY		
501	and Extent of Impacts.	Based on Total Capital Costs without Contingency

Table A-4
Detailed Cost Estimate - Alternative 4
Ithaca First Street MGP Site
Ithaca, New York

Remedial Component	Unit	Unit Price	Quantity	Total Cost
100 ENGINEERING				
101 Engineering Design, Plans, Specs, Bid, Permitting, and Surveying	Lump Sum	$34,881	1	$34,881
			Subtotal	$34,881
			% Total Costs	2%
		TOTAL ENGINEERING COSTS		**$34,881**
200 CONSTRUCTION MANAGEMENT				
201 Construction Oversight	Day	$950	80	$76,000
203 Completion Report	Lump Sum	$25,000	1	$25,000
			Subtotal	$101,000
			% Total Costs	5%
300 REMEDIAL COMPONENTS				
301 Mobilization / Demobilization	Lump Sum	$20,000	1	$20,000
Institutional Controls / Engineering Controls				
315 Groundwater Deed Restrictions	Lump Sum	$50,000	1	$50,000
316 Site Management Plan	Lump Sum	$50,000	1	$50,000
317 Fencing and Signage	Lump Sum	$20,000	1	$20,000
Soil Cover				
312 Topsoil placement, grading and seeding for 1-ft cover	Lump Sum	$5,200	1	$5,200
NAPL Recovery				
314 Installation of NAPL Recover Wells	Well	$18,869	12	$226,428
318 Installation of NAPL Recovery Controls System	Lump Sum	$225,000	1	$225,000
			Subtotal	$596,628
			% Total Costs	28%
		TOTAL CAPITAL COSTS		**$697,628**
400 OPERATION AND MAINTENANCE				
Groundwater Monitoring				
401 Post-remediation Confirmatory Monitoring	Year	$44,915	30	$724,976
402 Annual Inspection and Reporting	Year	$10,000	30	$161,411
403 NAPL Recovery	Year	$20,000	10	$162,156
			Subtotal	$1,048,543
			% Total Costs	59%
		TOTAL O&M COSTS		**$1,048,543**
REMEDIAL COST SUMMARY				
Total Engineering Costs				$34,881
Total Capital Costs				$697,628
Total Operation and Maintenance Costs				$1,048,543
		Total Capital, O&M, and Engineering Costs		$1,781,053
500 CONTINGENCY				
501 Allowance for Undefined Costs Associated with Utilities, Subsurface Structures, and Extent of Impacts.			20%	$356,211
			% TOTAL COSTS	17%
			TOTAL COST	**$ 2,137,263**
		ROUNDED COST		**$2,100,000**

Table A-4
Detailed Cost Estimate Notes - Alternative 4
Ithaca First Street MGP Site
Ithaca, New York

100 ENGINEERING	
101 Engineering Design, Plans, Specs, Bid, Permitting, and Surveying	Percent of Total Capital Cost (5%)
200 CONSTRUCTION MANAGEMENT	
201 Construction Oversight	Assume 4 months - 1 Grade 3 Project Engineer
203 Completion Report	GEI Past Experience
300 REMEDIAL COMPONENTS	
301 Mobilization / Demobilization	Lump Sum For Trailer, Utilities
Institutional Controls / Engineering Controls	
315 Groundwater Deed Restrictions	GEI Past Experience
316 Site Management Plan	GEI Past Experience
317 Fencing and Signage	GEI Past Experience
Soil Cover	
312 Topsoil placement and grading including 1-ft cover outside of excavation	1 load topsoil + Soil Testing
NAPL Recovery	
314 Installation of NAPL Recover Wells	RACER Estimate - 25 foot depth 6 inch stainless steel 12-inch Rotary Mud Drilled Annulus
318 Installation of NAPL Recover Controls System	Quote From Brownfield Associates: All hardware, Pumps, Controllers, Collection System, Containers, Installation and Start-up
400 OPERATION AND MAINTENANCE	
Groundwater Monitoring	
401 Post-remediation Confirmatory Monitoring	$44,915 per year (RACER) for 30 years at i=5%, Interest rate provided by NYSDEC
402 Annual Inspection and Reporting	$10K per year for 30 years at i=5% (per NYSDEC)
403 NAPL Recovery	$20K per year for 10 years at i=5%
REMEDIAL COST SUMMARY	
Total Capital Costs Without Contingency	Includes Sections 200 and 300
Total Operation and Maintenance Costs	Includes Section 400
Total Capital, O&M, and Engineering Costs Without Contingency	Includes Sections 100, 200, 300, and 400 without contingency
500 CONTINGENCY	
501 and Extent of Impacts.	Based on Total Capital Costs without Contingency

Table A-5
Detailed Cost Estimate - Alternative 5
Ithaca First Street MGP Site
Ithaca, New York

Remedial Component	Unit	Unit Price	Quantity	Total Cost
100 ENGINEERING				
101 Engineering Design, Plans, Specs, Bid, Permitting, and Surveying	Lump Sum	$298,961	1	$298,961
102 Pre Construction Sampling (design excavation limits and pre-characterization)	Lump Sum	$215,000	1	$215,000
103 Geotechnical and Structural Evaluation Survey	Lump Sum	$50,000	1	$50,000
			Subtotal	$563,961
			% Total Costs	6%
		TOTAL ENGINEERING COSTS		**$563,961**
200 CONSTRUCTION MANAGEMENT				
201 Construction Oversight	Day	$1,786	100	$178,600
202 Air Monitoring Program	Month	$52,300	5	$261,500
203 Completion Report	Lump Sum	$50,000	1	$50,000
			Subtotal	$490,100
			% Total Costs	5%
300 REMEDIAL COMPONENTS				
301 Mobilization / Demobilization	Lump Sum	$20,000	1	$20,000
302 Site Preparation (fence and shrub removal)	Lump Sum	$10,000	1	$10,000
Excavate and Backfill Materials				
303 Excavations to remove Soils (0-15 feet)	Cubic Yard	$62	8000	$492,000
304 IAWWTF building structural monitoring and reporting	Lump Sum	$100,000	1	$100,000
305 Excavation Wall Stabilization (Soldier piles, Sheet piling, etc.)	Square Feet	$190.00	9510	$1,806,900
306 Temporary Enclosure	Month	$39,080	3	$117,240
307 Dewatering Treatment System temporary installation and operations	Lump Sum	$84,400	1	$84,400
308 Water Disposal Costs	Gallon	$3	37335	$112,004
309 Special project insurance	Lump Sum	$100,000	1	$100,000
310 Disposal Costs Hauling and Thermal Treatment	CY	$249	8000	$1,992,000
311 Backfill excavations	Cubic Yard	$14.71	10,400	$152,984
Soil Cover				
312 Topsoil placement, grading and seeding for 1-ft cover	Lump Sum	$5,200	1	$5,200
313 Seeding	Lump Sum	$200	1	$200
NAPL Recovery				
314 Installation of NAPL Recover Wells	Well	$18,869	10	$188,690
318 Installation of NAPL Recovery Controls System	Lump Sum	$187,500	1	$187,500
Institutional Controls / Engineering Controls				
315 Groundwater Deed Restrictions	Lump Sum	$50,000	1	$50,000
316 Site Management Plan	Lump Sum	$50,000	1	$50,000
317 Fencing and Signage	Lump Sum	$20,000	1	$20,000
			Subtotal	$5,489,118
			% Total Costs	60%
		TOTAL CAPITAL COSTS		**$5,979,218**
400 OPERATION AND MAINTENANCE				
Groundwater Monitoring				
401 Post-remediation Confirmatory Monitoring	Year	$44,915	30	$724,976
402 Annual Inspection and Reporting	Year	$10,000	30	$161,411
403 NAPL Recovery	Year	$20,000	10	$162,156
			Subtotal	$1,048,543
			% Total Costs	12%
		TOTAL O&M COSTS		**$1,048,543**
REMEDIAL COST SUMMARY				
Total Engineering Costs				$563,961
Total Capital Costs				$5,979,218
Total Operation and Maintenance Costs				$1,048,543
		Total Capital, O&M, and Engineering Costs		**$7,591,722**
500 CONTINGENCY				
501 Allowance for Undefined Costs Associated with Utilities, Subsurface Structures, and Extent of Impacts.			20%	$1,518,344
			% TOTAL COSTS	17%
			TOTAL COST	**$ 9,110,066**
		ROUNDED COST		**$9,100,000**

Table A-5
Detailed Cost Estimate Notes - Alternative 5
Ithaca First Street MGP Site
Ithaca, New York

100	**ENGINEERING**	
101	Engineering Design, Plans, Specs, Bid, Permitting, and Surveying	Percent of Total Capital Cost (5%)
102	Pre Construction Analytical Sampling (design excavation limits and pre-characterization)	Racer
103	Geotechnical and Structural Evaluation Survey	GEI Past Experience
200	**CONSTRUCTION MANAGEMENT**	
201	Construction Oversight	Assume 5 months - 1 Grade 3 Project Engineer, 1-Grade 2 Geologist no per diem
202	Air Monitoring Program	Per Brian Skelly - GEI Quote
203	Completion Report	GEI Past Experience
300	**REMEDIAL COMPONENTS**	
301	Mobilization / Demobilization	Lump Sum For Trailer, Utilities
302	Site Preparation (fence and shrub removal)	GEI Past Experience
	Excavate and Backfill Materials	
303	Excavations to remove Soils (0-15 feet)	RACER Estimate with 50% additional for small cell excavation
		for groundwater and disturbance control, removal of existing pilings
304	IAWWTF building structural monitoring and reporting	GEI Past Experience
305	Excavation Wall Stabilization (Secant piles, Soldier piles, Sheet piling, etc.)	Cost Estimate from Mike Walker, GEI Geostructural Engineer
		based on actual site costs at a similar site. Based on exposed sq ft.
306	Temporary Enclosure	RACER Estimate - 40'x150' , 3 month rental, set-up / take-down 4 times
307	Dewatering Treatment System	GEI Experience (Chris Daily), Assumed 12 weeks of operations
308	Water Disposal Costs	Assumes 25% porosity, 2.5 times the volume of excavation
310	Disposal Costs Hauling and Thermal Treatment	RACER Estimate - To Fort Edward for Thermal Desorption
311	Backfill Excavations	Racer Estimate - 15 mile 1 way trip, 9 inch lifts
	Soil Cover	
312	Topsoil placement and grading including 1-ft cover outside of excavation	1 load topsoil + Soil Testing
	NAPL Recovery	
314	Installation of NAPL Recover Wells	RACER Estimate - 25 foot depth 6 inch stainless steel 12-inch Rotary Mud Drilled Annulus
318	Installation of NAPL Recover Controls System	Quote From Brownfield Associates: All hardware, Pumps, Controllers, Collection System, Containers, Installation and Start-up
	Institutional Controls / Engineering Controls	
315	Groundwater Deed Restrictions	GEI Past Experience
316	Site Management Plan	GEI Past Experience
317	Fencing and Signage	GEI Past Experience
400	**OPERATION AND MAINTENANCE**	
	Groundwater Monitoring	
401	Post-remediation Confirmatory Monitoring	$44,915 per year (RACER) for 30 years at i=5%, Interest rate provided by NYSDEC
402	Annual Inspection and Reporting	$10K per year for 30 years at i=5% (per NYSDEC)
403	NAPL Recovery	$20K per year for 10 years at i=5%
REMEDIAL COST SUMMARY		
	Total Capital Costs Without Contingency	Includes Sections 200 and 300
	Total Operation and Maintenance Costs	Includes Section 400
	Total Capital, O&M, and Engineering Costs Without Contingency	Includes Sections 100, 200, 300, and 400 without contingency
500 CONTINGENCY		
501	Allowance for Undefined Costs Associated with Utilities, Subsurface Structures, and Extent of Impacts.	Based on Total Capital Costs without Contingency

Table A-6
Detailed Cost Estimate - Alternative 6
Ithaca First Street MGP Site
Ithaca, New York

Remedial Component	Unit	Unit Price	Quantity	Total Cost
100 ENGINEERING				
101 Engineering Design, Plans, Specs, Bid, Permitting, and Surveying	Lump Sum	$6,525,466	1	$6,525,466
102 Pre Construction Sampling (design excavation limits and pre-characterization)	Lump Sum	$430,000	1	$430,000
			Subtotal	$6,955,466
			% Total Costs	4%
		TOTAL ENGINEERING COSTS		**$6,955,466**
200 CONSTRUCTION MANAGEMENT				
201 Construction Oversight	Day	$1,786	260	$464,360
202 Air Monitoring Program	Month	$52,300	12	$627,600
203 Completion Report	Lump Sum	$75,000	1	$75,000
			Subtotal	$1,166,960
			% Total Costs	1%
300 REMEDIAL COMPONENTS				
301 Mobilization / Demobilization	Lump Sum	$40,000	1	$40,000
302 Site Preparation (fence and shrub removal)	Lump Sum	$10,000	1	$10,000
Excavate and Backfill Materials				
303 Excavations to remove Soils to 36 feet	Cubic Yard	$41	292428	$11,989,548
306 Temporary Enclosure	Month	$39,080	12	$468,960
307 Dewatering Treatment System	Lump Sum	$151,200	1	$151,200
308 Water Disposal Costs	Gallon	$3	1025326	$3,075,977
310 Disposal Costs Hauling and Thermal Treatment	CY	$249	292428	$72,814,572
311 Backfill excavations	Cubic Yard	$14.71	380,156	$5,592,101
398 Demolition of Wastewater Treatment Plant	Lump Sum	$200,000	1	$200,000
399 Re-Construction of Wastewater Treatment Plant	Lump Sum	$35,000,000	1	$35,000,000
			Subtotal	$129,342,358
			% Total Costs	78%
		TOTAL CAPITAL COSTS		**$130,509,318**
400 OPERATION AND MAINTENANCE				
Groundwater Monitoring				
401 Post-remediation Confirmatory Monitoring	Year	$44,915	3	$128,430
			Subtotal	$128,430
			% Total Costs	0%
		TOTAL O&M COSTS		**$128,430**
REMEDIAL COST SUMMARY				
Total Engineering Costs				$6,955,466
Total Capital Costs				$130,509,318
Total Operation and Maintenance Costs				$128,430
		Total Capital, O&M, and Engineering Costs		**$137,593,214**
500 CONTINGENCY				
501 Allowance for Undefined Costs Associated with Utilities, Subsurface Structures, and Extent of Impacts.			20%	$27,518,643
			% TOTAL COSTS	17%
			TOTAL COST	**$ 165,111,857**
		ROUNDED COST		**$165,000,000**

Table A-6
Detailed Cost Estimate Notes - Alternative 6
Ithaca First Street MGP Site
Ithaca, New York

100	**ENGINEERING**	
101	Engineering Design, Plans, Specs, Bid, Permitting, and Surveying	Percent of Total Capital Cost (5%)
102	Pre Construction Analytical Sampling (design excavation limits and pre-characterization)	Racer
103	Geotechnical and Structural Evaluation Survey	GEI Past Experience
104	Demolition of Wastewater Treatment Plant	Based off of average similar wastewater treatment facilities costs (Source: http://www.dep.state.pa.us/dep/deputate/watermgt/wsm/wsm_tao/InnovTech/CostDB.htm#Wastewater)
105	Re-Construction of Wastewater Treatment Plant	Based off of average similar wastewater treatment facilities costs: Source: http://www.dep.state.pa.us/dep/deputate/watermgt/wsm/wsm_tao/InnovTech/CostDB.htm#Wastewater)
200	**CONSTRUCTION MANAGEMENT**	
201	Construction Oversight	Assume 12 months - 1 Grade 3 Project Engineer, 1-Grade 2 Geologist no perdiem
202	Air Monitoring Program	Per Brian Skelly - GEI Quote
203	Completion Report	GEI Past Experience
300	**REMEDIAL COMPONENTS**	
301	Mobilization / Demobilization	Lump Sum For Trailer, Utilities
302	Site Preparation (fence and shrub removal)	GEI Past Experience
	Excavate and Backfill Materials	
303	Excavations to remove Soils to 36 feet	RACER Estimate
306	Temporary Enclosure	RACER Estimate - 40'x150' , 12 mo rental, set-up / take-down 48 times
307	Dewatering Treatment System	GEI Experience (Chris Daily), Assumed 9 months of operations
308	Water Disposal Costs	Assumes 25% porosity, 2.5 times the volume of excavation
310	Disposal Costs Hauling and Thermal Treatment	RACER Estimate - To Fort Edward for Thermal Desorption
311	Backfill excavations	Racer Estimate - 15 mile 1 way trip, 9 inch lifts
400	**OPERATION AND MAINTENANCE**	
	Groundwater Monitoring	
401	Post-remediation Confirmatory Monitoring	$44915 per year (RACER) for 3 years at i=5%, Interest rate provided by NYSDEC
REMEDIAL COST SUMMARY		
	Total Capital Costs Without Contingency	Includes Sections 200 and 300
	Total Operation and Maintenance Costs	Includes Section 400
	Total Capital, O&M, and Engineering Costs Without Contingency	Includes Sections 100, 200, 300, and 400 without contingency
500 CONTINGENCY		
501	Allowance for Undefined Costs Associated with Utilities, Subsurface Structures, and Extent of Impacts.	Based on Total Capital Costs without Contingency

Appendix B

Volume Estimates

Table B-1
Total Volume of Impacted Soil

Unrestricted SCOs (total, without regard to buildings or pipelines)		**Rounded Values**
Area (square feet)	219,321.00	
Zone Thickness (feet)	36.00	
Total Volume (cubic feet)	7,895,556.00	
Conversion Factor (cubic feet to cubic yards)	0.037	
Total Volume (cubic yards)	**292,428.00**	292000

Industrial SCOs (0-15 feet, total without regard to buildings or pipelines)		
Area (square feet)	19,683.00	
Zone Thickness (feet)	15.00	
Total Volume (cubic feet)	295,245.00	
Conversion Factor (cubic feet to cubic yards)	0.037	
Total Volume (cubic yards)	**10,935.00**	11000

Industrial SCOs (0-15 feet, not beneath or near buildings or pipelines)		
Area (square feet)	14,116.90	
Zone Thickness (feet)	15.00	
Total Volume (cubic feet)	211,753.50	
Conversion Factor (cubic feet to cubic yards)	0.037	
Total Volume (cubic yards)	**7,842.72**	8000

Deeper Source material (15 feet and deeper, without regard to buildings or pipelines)		
Area (square feet)	31,625.00	
Zone Thickness (feet)	10.00	
Total Volume (cubic feet)	316,250.00	
Conversion Factor (cubic feet to cubic yards)	0.037	
Total Volume (cubic yards)	**11,712.96**	12000

Deeper Source material (15 feet and deeper, not beneath buildings or pipelines)		
Area (square feet)	30,007.00	
Zone Thickness (feet)	10.00	
Total Volume (cubic feet)	300,070.00	
Conversion Factor (cubic feet to cubic yards)	0.037	
Total Volume (cubic yards)	**11,113.70**	11000

1 $ft.^3$ = 0.037037037 cubic yards

Deeper Source Material in Footprint of Alt 5 Excavation (15-25 feet, not beneath buildings or pipelines)		
Area (square feet)	15,780.00	
Zone Thickness (feet)	10.00	
Total Volume (cubic feet)	157,800.00	
Conversion Factor (cubic feet to cubic yards)	0.037	
Total Volume (cubic yards)	**5,844.44**	6000

Total in Footprint of Alt 5 Excavation (0-25 feet, not beneath buildings or pipelines)		
Area (square feet)	15,780.00	
Zone Thickness (feet)	25.00	
Total Volume (cubic feet)	394,500.00	
Conversion Factor (cubic feet to cubic yards)	0.037	
Total Volume (cubic yards)	**14,611.11**	15000

Table B-2
Total Volume of Impacted Groundwater

Shallow Zone	
Area (square feet)	192,757.00
Average Thickness of Saturated Zone (feet)	12.00
Porosity	25%
Total Volume (cubic feet)	578,271.00
Conversion Factor (cubic feet to gallons)	7.48
Total Volume (gallons)	**4,325,767.48**

Deep Zone	
Area (square feet)	164,358.00
Average Thickness of Saturated Zone (feet)	25.00
Porosity	25%
Total Volume (cubic feet)	1,027,237.50
Conversion Factor (cubic feet to gallons)	7.48
Total Volume (gallons)	**7,684,270.13**

Average Porosity = 25%

1 $ft.^3$ = 7.48051948 gallons

Shallow and Deep Zones	
Total Volume (gallons)	12,010,037.61
Rounded Total Volume (gallons)	**12,000,000.00**