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GEI Consultants

LETTER OF TRANSMITTAL

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To: Mr. William T. Ports, P.E.
NYSDEC
625 Broadway
Albany, NY 12233-7014

Date: September 15, 2010
Project No. 091950-1-1102
Re: Clove and Maple Avenues Former MGP

We are sending you the following enclosures:

No.	Type	Description
1	Hard-copy	Feasibility Study Report – Clove and Maple Avenues Former MGP, Haverstraw, NY, dated 9/14/10
1	CD-ROM copy	Feasibility Study Report – Clove and Maple Avenues Former MGP, Haverstraw, NY, dated 9/14/10

These are transmitted as checked below:

☐ For Approval ☒ For Your Use ☐ For Review/Comment ☐ As Requested ☐ Other

Message:

Copy to:

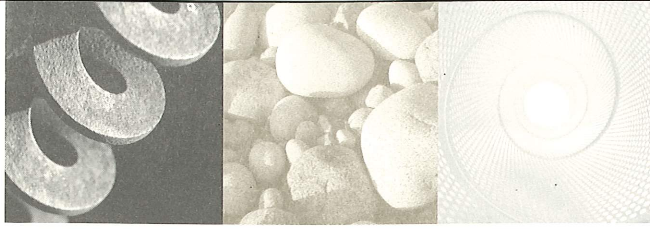
Ms. Maribeth McCormick – O&R (3 hard copies/CD-ROM copies)
Mr. Anthony Perretta – NYSDOH (1 hard copy/CD-ROM)
Document Repository – King's Daughters Library (1 hard copy/CD-ROM)
Document Repository – NYSDEC Region 3 Office (1 hard copy/CD-ROM)

Signed:

John T. Finn

John T. Finn, P.E.

If enclosures are not as noted, kindly notify us at once.



GEI Consultants

Geotechnical
Environmental
Water Resources
Ecological

Feasibility Study

Clove and Maple Avenues Former Manufactured Gas Plant

Haverstraw, Rockland County, New York
Order on Consent Index No. D3-0001-98-03
Site No. 3-44-049

Submitted to:
Orange and Rockland Utilities, Inc.
3 Old Chester Road
Goshen, NY 10924

Submitted by:
GEI Consultants, Inc.
1301 Trumansburg Road
Ithaca, NY 14850
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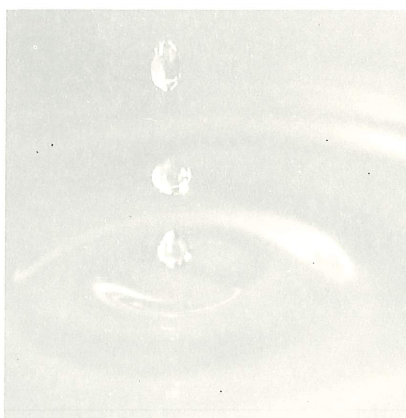
September 14, 2010
091950-1-1102

John T. Finn, P.E.
Project Manager

Reviewed by:

Bruce D. Coulombe, P.G.



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Abbreviations and Acronyms

AOC	Administrative Order on Consent
AWQS	Ambient Water Quality Standards, Guidance Values, and Groundwater Effluent Limitations
bgs	Below Ground Surface
BTEX	Benzene, Toluene, Ethylbenzene, and Xylene
CERCLA	Comprehensive Environmental Response Compensation and Liability Act of 1980. Amended in the Superfund Amendments and Reauthorization Act (SARA) of 1986
CMX	CMX Corporation
COCs	Constituents of Concern
CY Cubic	Yard
DEC Soil Cleanup Guidance	Draft Soil Cleanup Guidance DEC Policy, November 4, 2009
DER-10	DEC Draft DER-10 Technical Guidance for Site Investigation and Remediation, November 4, 2009
DNAPL	Dense Non-Aqueous Phase Liquid
FS	Feasibility Study
GEI	GEI Consultants, Inc.
GRA	General Response Action
HDPE	High-density Polyethylene
IRM	Interim Remedial Measure
IC/EC	Institutional Controls/Engineering Controls
ISCO	In-Situ Chemical Oxidation
ISS	In-Situ Solidification
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
NCP	National Contingency Plan. 40CFR1J Part 300 – National Oil and Hazardous Substances Pollution Contingency Plan
NGVD	National Geodetic Vertical Datum
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
O&R	Orange and Rockland Utilities, Inc.
ORC	Oxygen Releasing Compounds
O&M	Operation and Maintenance
OSHA	Occupational Safety & Health Administration
OU	Operable Unit
PAHs	Polycyclic Aromatic Hydrocarbons
POTW	Publicly Owned Treatment Works
ppb	Parts Per Billion
PPE	Personal Protective Equipment
ppm	Parts Per Million (equivalent to mg/kg)

PRAP	Proposed Remedial Action Plan
RAO	Remedial Action Objective
RCRA	Resource Conservation and Recovery Act
RD	Remedial Design
RETEC	The RETEC Group, Inc.
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
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
UWNY	United Water New York, Inc., West Nyack, New York
VOCs	Volatile Organic Compounds

Engineer's Certification

I certify that this Feasibility Study was prepared in accordance with the Order on Consent between New York State and Orange and Rockland Utilities, Inc., Index # D3-0001-98-03, and was prepared in substantial conformance with the DER Technical Guidance for Site Investigation and Remediation (DER10) of the New York State Department of Environmental Conservation.

Work for this project was performed, and this report prepared, in accordance with generally accepted professional practices for the nature and condition of work completed in the same or similar localities, at the time the work was performed. It is intended for the exclusive use of Orange and Rockland Utilities, Inc. for specific application to the Clove and Maple Avenues former manufactured gas plant site in Haverstraw, New York. No other warranty, express or implied, is made.

Engineer's Seal
GEI Consultants, Inc.

September 14, 2010
Date

Executive Summary

Introduction and Purpose

This report describes the Feasibility Study (FS) undertaken for the former manufactured gas plant (MGP) site located between Clove and Maple Avenues, and adjacent impacted parcels, in Haverstraw, New York. The purpose of the FS was to identify and evaluate a range of remedial alternatives and then recommend a remedy for the site and the adjacent impacted parcels.
The FS was based on a series of environmental studies performed by O&R, beginning with an initial assessment in 1996 and culminating in the DEC-approved Remedial Investigation Report (RIR) dated May 2009.

Properties Included in this FS

To facilitate the development of the remedial alternatives and address existing land use issues, three Operable Units (OUs) have been designated. The three OUs are defined as follows:

- **OU-1:** The MGP parcel owned by O&R, a vacant property approximately 1 acre in size.
- **OU-2:** Off-site properties including several private residences, an apartment complex and a portion of Maple Avenue that is assumed to be impacted. OU-2 is approximately 3 acres in size. Details regarding these properties are as follows:
  - The Apartment Complex property includes four apartment buildings on Maple Avenue and one apartment building on West Street;
  - A row house on Maple Avenue with four single-family residential properties, consisting of the adjacent properties at 111, 113, 115, and 117 Maple Avenue;
  - Single-family residential properties on West Street, consisting of six properties at 96, 100, 102, 104, 108, and 116 West Street;
  - A portion of the Alleyway between Maple Avenue and West Street; and
  - A section of Maple Avenue between 103 Maple Avenue and 131 Maple Avenue.
- **OU-3:** Sediments in the nearby Hudson River embayment, located about 80 feet from OU-2.

This FS addresses OU-1 and OU-2. OU-3 will be addressed in a separate FS.

Site Description, History, and Conceptual Site Model

The Clove and Maple Avenues MGP parcel, approximately one acre in size, is owned by O&R. The MGP began operations in the late 1800s and produced gas using the carbureted water gas method until approximately 1935 when natural gas began to be distributed. Former MGP structures were demolished in the 1960s and a retired gas regulator station is the only remaining structure on the fenced property. The gas regulator station was decommissioned by O&R in 2007. Adjacent properties affected by the MGP are owned by third parties.

Geology

The four geologic units at the site, in general order from the shallowest to deepest, are fill, alluvium (mixed lenses of sand, gravel, silt, and peat), clay, and till. The till layer is a dense clay unit that is acting as a barrier that limits downward migration of MGP-related residuals.

Hydrology and Hydrogeology

The hydrology and hydrogeology of OU-1 and OU-2 is dominated by the steep ridge above the site, and by the Hudson River. Surface water flows toward Maple Avenue and/or the drainage swale near the western property line. Surface water is discharged via the storm drain system to the Hudson River. At the time of the operation of the MGP, a former pond extended over much of OU-2. This pond, now filled, is the central feature of the OU-2 site geology. Groundwater depths are typically 8 feet below ground surface (bgs) in the central portion of OU-1, and 5 feet bgs at OU-2. This first water-bearing zone is a shallow zone present within the alluvium. The shallow aquifer at OU-2 is effectively confined by the clay unit. Groundwater from the ridge above the site results in artesian conditions at several monitoring wells along Maple Avenue. Artesian conditions have also been encountered in excavations immediately west of OU-2. At OU-1, groundwater flow appears to follow the topography, flowing from the southwest, to the northeast. At OU-2, groundwater flow appears to be controlled by topography and follows the former pond, from the west to east, towards the Hudson River embayment.

Nature and Extent of Impacts

The primary constituents of concern (COCs) at the site are benzene, toluene, ethylbenzene, and xylene (BTEX) and polycyclic aromatic hydrocarbons (PAHs). These are present in subsurface soil and groundwater, but were not prevalent in surface soil or in soil vapor or indoor air in buildings tested on OU-2. Dense, non-aqueous-phase liquid (DNAPL) was observed in discontinuous subsurface soil lenses in several areas on OU-1 and OU-2, and has accumulated in one monitoring well on OU-1 and two monitoring wells on OU-2. The COCs in surface soils identified on OU-1 were primarily PAHs and lead, and were present over most of the OU-1 area. The COCs in subsurface soils identified on OU-1 are limited to the northern half of the site where the former MGP operations were located, and are present in soils at depths ranging from 8 to 32 feet bgs. The COCs identified on OU-2 are bounded by the location of the former pond, and are present in soils at depths ranging from 7 to 22 feet bgs.

Exposure Assessment and Remedial Action Objectives

Complete exposure pathways at OU-1 and OU-2 exist, but only if invasive excavation, construction, or utility maintenance were to occur. No ongoing, current exposure pathways or threats are active for the site. Therefore, only potential exposure pathways exist.

The Remedial Action Objectives (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 Standards, Criteria and Guidance (SCGs) and the intended land use. The RAOs are site-specific goals that address the media of concern, specific contaminants, and the exposure pathways at the each operable unit of the site. These RAOs are goals to be achieved to the extent practicable:

OU-1 and OU-2

Groundwater

- Prevent ingestion of groundwater with contaminant levels exceeding drinking water standards.
- Prevent contact with, or inhalation of, volatiles from contaminated groundwater.
- Prevent discharge of contaminated groundwater to surface water.
- Restore the groundwater aquifer to meet ambient groundwater quality criteria to the extent practicable.
- Remove the source of groundwater contamination.

Soil

- Prevent ingestion/direct contact with soil exceeding applicable Soil Cleanup Objectives (SCOs).
- Prevent inhalation of contaminants, including dust, from the soil.
- Prevent migration of contaminants that would result in groundwater or surface water contamination.

Soil Vapor

- Prevent inhalation of soil vapor contaminants due to soil vapor intrusion into future buildings.

General Response Actions and Technologies

General response actions are categories or approaches which may be combined and further defined to create remedial alternatives. They do not represent a specific technology, rather they represent a conceptual approach which may be achieved by several different technologies. The general response actions considered for this site are:

1. No Action.

2. Administrative Actions Pertaining to Soil or Groundwater.
3. Containment of Soil and Groundwater.
4. On-site Treatment of Soil and Groundwater.
5. Removal and Off-site Treatment/Disposal of Soil and DNAPL/Groundwater.

The following technology categories were used in the development of the remedial alternatives:

1. Institutional Controls and Engineering Controls (IC/EC) – ICs include DEC Environmental Easements, Site Management Plans and land use restriction agreements with third party owners. ECs include activities such as fencing, signage, and maintenance of physical barriers such as pavement.
2. Containment Technologies – Containment technologies include surface caps such as pavement, and vertical barriers to reduce recontamination of remediated areas.
3. In-situ groundwater treatment and monitored natural attenuation (MNA) – In-situ groundwater treatment and MNA relies upon the natural degradation and mitigation processes which occur in the subsurface to remedy groundwater impacts over time. Natural processes can be enhanced by modifying the subsurface conditions either biologically, chemically, or physically, to provide active in-situ groundwater management.
4. Excavation Technologies – Conventional trackhoe and extended arm trackhoe technologies would be utilized for excavations. Control of odors and emissions can be accomplished using odor-controlling foam and temporary plastic covering for small excavation areas. At larger excavation areas, temporary fabric structures may be used to control odors, with vapor-phase carbon treatment of the ventilated air.
5. Side Wall Support – Due to the depth of the excavations, the groundwater flows and artesian conditions, and the constrained areas at the site, simple sloping and benching of the excavations will not be feasible and engineered sidewall support systems will be required.
6. Excavation Water Management – Because of the hydrogeologic conditions, excavation water management will be a critically important aspect of excavations performed at this site. Specific techniques for groundwater management will be selected during the design and construction phase of the remedy.
7. DNAPL Recovery Systems – DNAPL recovery can reduce the mass of DNAPL in the subsurface and can reduce the mobility of residual DNAPL by recovering the flowable fraction. Typical recovery systems include specially constructed wells and recovery trenches.

Several technologies were considered, but were screened out after further evaluation. In-situ solidification/stabilization, which involves the mixing of soil with stabilizing agents such as Portland cement, would not be readily implementable or effective in the NAPL-impacted, clay and peat soils at the site, and was therefore not retained for development of remedial alternatives. In-situ chemical oxidation, in which oxidizing agents are brought into contact with impacted groundwater and soil, was also screened out because of concerns regarding its effectiveness in the clay and peat soils found at this site.

OU-1 Recommended Remedial Alternative

Five alternatives were evaluated to address the impacts on OU-1:

1. No Action;
2. Institutional Controls and Engineering Controls (ICs/ECs);
3. Soil removal to Part 375 Commercial levels with in-situ groundwater treatment and MNA;
4. Soil removal to Part 375 Residential levels with groundwater treatment and MNA; and
5. Soil Removal to Part 375 Unrestricted Levels.

Upon consideration of the alternatives and their respective attributes and limitations, Alternative 4, Removal of Soil to Residential Levels, emerged as the recommended remedy in the FS for OU-1. This alternative provides a balanced emphasis on effectiveness and cost, is implementable with moderate short-term impacts, and meets the RAOs for the site. Alternative 4 will achieve an advantageous land use value and reduction in impacts, with more certainty in its implementation and less cost than Alternative 5, Removal of Soil to Unrestricted levels, and more effectiveness and permanence than Alternative 2, Institutional and Engineering Controls.

The recommended remedy would involve excavation of an estimated 15,100 CY followed by in-situ groundwater treatment and MNA of groundwater, for an estimated total cost of $8.0 million. This cost estimate includes capital costs, operations and maintenance costs, and a 25% contingency.

This remedial alternative includes the following sequential actions:

- Demolition and removal of the existing concrete holder pad.
- Delineation and excavation of approximately 15,000 CY of MGP-impacted soil exceeding the Residential SCOs and MGP source material.
- Removal of approximately 3,700 CY of MGP-impacted additional surface soil exceeding the Residential SCOs and placement of 2 feet of clean surface soil.
- Post-remedial in-situ treatment and MNA to address groundwater impacts.
- A Site Management Plan providing for IC/ECs.

OU-2 Recommended Remedial Alternative

Five alternatives were evaluated to address the impacts on OU-2:

1. No Action
2. NAPL Recovery
3. NAPL recovery and phased soil removal to Part 375 Residential levels with in-situ groundwater treatment and MNA

4. NAPL recovery and phased soil removal to Part 375 Residential levels with the additional removal of soils in the MW-32S Area in Phase 1 and in-situ groundwater treatment and MNA
5. Soil removal to Part 375 Unrestricted levels following purchase and demolition of the apartment buildings.

Upon consideration of the alternatives and their respective attributes and limitations, Alternative 4, Phased Soil Removal to Residential Levels including the MW-32S area, emerged as the recommended remedy in the FS for OU-2. This alternative would address most of the single family residences and a large portion of the source material in the near term, and provide conformance with SCGs in the long term. It provides a balanced emphasis on effectiveness and cost. It is implementable with some short-term impacts, but would not greatly disrupt the apartment complex property and residents, or the adjacent property owners on OU-2.

The recommended remedy would involve excavation of an estimated 12,000 CY of soil in Phase 1, which would begin after completion of the design and execution of property access agreements. An estimated 47,800 CY of soil would be excavated in Phase 2, which would be conducted when one or more of the parcels was the subject of future property development that included the demolition of one or more of the buildings. It is recognized that these opportunities may or may not occur simultaneously. The estimated cost of Phase 1 is $9.3 million, and the estimated total cost of Phase 2 is $22.2 million. This cost estimate includes capital costs, operations and maintenance costs, and a 25% contingency.

This remedial alternative includes the following sequential actions:

Phase 1: These actions would occur in the short term, following the preparation of the remedial design:

- NAPL recovery on the Apartment Complex property – This would be a temporary, phased action until the eventual demolition of the apartment complex and subsequent excavation to take place in Phase 2.
- Single Family Residences – Excavation of the West Street Properties to Part 375 Residential SCOs.
- Apartment Complex and Alleyway – Excavate the source material in the MW32S area adjacent to the West Street properties, north of the drain pipe in that area. This will mitigate recontamination of the West Street properties and provide a staging area for Phase 2.
- Groundwater monitoring to document conditions.
- Establish ECs and ICs to provide for land use restrictions.

Phase 2: These actions would occur in the future, when the opportunities present themselves to complete the excavation actions at 111-117 Maple Avenue and the Apartment Complex parcels:

- Apartment Complex – Excavate soil exceeding Part 375 Residential SCOs.

- 111-117 Maple Avenue properties – Excavate the soil exceeding Part 375 Residential SCOs.
- Develop a Site Management Plan for the area under Maple Avenue that may be impacted and establish a land use restriction that prohibits groundwater use for all properties on OU-2.
- Conduct post-remedial in-situ groundwater treatment and MNA groundwater monitoring.

Conclusions

The recommended remedy for OU-1 and OU-2 is for removal of soil to Part 375 Residential cleanup levels followed by in-situ groundwater treatment and MNA to address groundwater RAOs. Taken together, the remedy for OU-1 and OU-2 will address the terrestrial portion of the site. OU-3, a small area of impacted sediment in the Hudson River embayment near the site, will be addressed in a separate FS. The recommended remedy for OU-1 and OU-2 represents a consistent approach appropriate for residential and recreational land use and fitting with the local community. The OU-1 and OU-2 excavation work will be designed and implemented in concert 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 synergy and least short-term impacts, to the ultimate benefit of property owners and the surrounding Haverstraw community.

1. Introduction and Scope

This report describes the Feasibility Study (FS) undertaken for the former manufactured gas plant (MGP) site located between Clove and Maple Avenues and adjacent parcels in Haverstraw, New York. The site location is shown in Figure 1. The purpose of the FS was to identify and evaluate a range of remedial action alternatives to aid in the selection of the final remedy for the terrestrial portion of the site. The FS was conducted in a manner consistent with the Administrative Order on Consent (AOC), dated September 1998, Index number D3-0001-98-03 and number 0001-99-01 dated March 1999, between Orange and Rockland Utilities, Inc. (O&R) and the New York State Department of Environmental Conservation (DEC), Title 6 of the New York Code of Rules and Regulations Part 375 for remedial action selection, the DEC *Draft DER-10 Technical Guidance for Site Investigation and Remediation*, dated November 4, 2009 (DER-10), and the "*Draft Soil Cleanup Guidance DEC Policy*" dated November 4, 2009, (DEC Soil Cleanup Guidance).

The Clove and Maple Avenues MGP parcel, approximately one acre in size, is owned by O&R. The MGP began operations in the late 1800s and produced gas using the carbureted water gas method until approximately 1935 when natural gas began to be distributed. Former MGP structures were demolished in the 1960s and a retired gas regulator station is the only remaining structure on the fenced property. The gas regulator station was decommissioned by O&R in 2007. Adjacent properties affected by the MGP are owned by third parties.

O&R performed a series of environmental studies at the site and nearby properties, beginning with an initial assessment in 1996 and a Preliminary Site Assessment in 1997. The Remedial Investigation (RI) was initiated in 1998, with multiple phases of field work, analysis, and review. This investigation resulted in a series of reports, culminating in the DEC-approved Remedial Investigation Report (RIR) dated May 2009 (CMX, 2009). To facilitate the development of the remedial alternatives and address existing land use issues, three Operable Units (OUs) have been designated. The locations of the three OUs are shown on Figure 2, and they are described as follows:

- **OU-1:** The MGP parcel owned by O&R, and the drainage swale located between the O&R property and 104 Maple Avenue.

- **OU-2:** The off-site properties including: The Apartment Complex property comprising four apartment buildings on Maple Avenue and one apartment building on West Street; single-family residential properties on Maple Avenue, consisting of four adjacent properties at 111, 113, 115, and 117 Maple Avenue; single-family residential properties on West Street, consisting of six properties at 96, 100, 102,104, 108, and 116 West Street; a portion of the Alleyway between Maple Avenue and West Street; and a portion of Maple Avenue between 103 and 131 Maple Avenue.

- **OU-3:** Sediments in the nearby Hudson River embayment.

The triangular parcel at the intersection of Maple Avenue and West Street, owned by the Village of Haverstraw, and the parcel at 146 Maple Avenue, which houses the Head Start facility, were included in the RIR study area but were substantially unaffected by the MGP, and so were not included in OU-2.

This FS addresses OU-1 and OU-2. OU-3 will be addressed in a separate FS.

This FS document 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); develops and evaluates remedial options for OU-1 and OU-2; and presents a recommended remedy for OU-1 and OU-2. The balance of the document is divided into the following sections:

2.0 Site Description, History, and Conceptual Site Model

3.0 Exposure Assessment and Remedial Action Objectives

4.0 General Response Actions

5.0 Identification and Screening of Technologies

6.0 Development and Analysis of Alternatives for OU-1

7.0 Development and Analysis of Alternatives for OU-2

8.0 Conclusions

9.0 References

The appendices to the report provide the basis for volume and cost estimates.

2. Site History, Description, and Conceptual Site Model

The section provides a summary of the site history and description based on information presented in the RIR. A site plan providing the locations of additional details are available in the RIR document (CMX, 2009).

2.1 Physical Setting and Local Land and Water Use

The climate in Haverstraw is temperate, with winter and summer monthly average temperatures ranging from 25 to 75 degrees Fahrenheit. The average annual precipitation is 51 inches.

The site lies at the base of High Tor Mountain, which is 600 vertical feet above the site and less than one mile to the south. The topography of OU-1 is varied. The topography slopes from Clove Avenue to a terrace in the center of the site, and then steeply slopes to Maple Avenue. There is a 25-foot elevation difference from Clove Avenue down to Maple Avenue. The topography of OU-2 is relatively flat, with a slight slope from Maple Avenue to the center of OU-2, which forms a shallow basin. OU-2 slopes slightly to the east, toward the embayment of the Hudson River, which is located 80 feet from the northeastern border of OU-2 along West Street.

The site is located in the Village of Haverstraw, with a population of 10,117 (year 2000). Land use in the vicinity of the site is generally residential and commercial. The zoning in the area of the site is residential, residential townhouse, planned industrial district, and light industrial. OU-1 is zoned light industrial and OU-2 is zoned residential. Both OU-1 and OU-2 are characterized as landscaped and developed areas.

Public water in the area is supplied by United Water New York, Inc. of West Nyack, New York (UWNY). Groundwater is not used for drinking water or other purposes within one mile of the site.

There are no surface water bodies on OU-1 or OU-2. The nearest surface water body is the Hudson River, which lies 600 feet to the northeast of OU-2, with the small embayment lying approximately 80 feet to the northeast of OU-2. A detailed discussion of the area surface water bodies, their intended uses, and their water quality designations is found in the *Fish and Wildlife Impact Assessment - Former Manufactured Gas Plants, Haverstraw, New York*, prepared by NEA and submitted to the DEC in February 2000 (NEA, 2000). The potential impacts to the surface water and sediment in the Hudson River embayment will be addressed as OU-3, separately from this FS.

2.2 OU-1 MGP Parcel History and Description

A property index map, Plate 1, identifies the MGP parcel as Tax Map Section 27.62, Block 1, Lot 9. (Plate 1 includes a true north designation and a "site north" designation used in the RIR and in this FS to indicate site north as perpendicular to Maple Avenue.) The MGP parcel is a rectangular-shaped parcel, approximately 1-acre in size. According to historic records it appears that the MGP operated for approximately 48 years between 1887 and 1935. At that time, natural gas was introduced into the area, and the MGP operation was closed. The general configuration of the MGP did not substantially change over the operating period. The historical records indicate that MGP structures included an above-grade gas holder, an above-grade high pressure holder, an above-grade iron oil tank (30,000 gallons), a coke shed, a tar well, and gas generator and purifier rooms. A specific type of carbureted water gas process, known as the Boecklin process, was used, with both coal and crude oil as feedstocks in the production of the gas. Additional details regarding the MGP history are provided in the RIR (CMX, 2009).

The MGP parcel is currently owned by O&R and has decommissioned natural gas lines and a regulator station on the property. The on-grade holder foundation, approximately 65 feet in diameter, exists in the northwest corner of the site. The property is currently unoccupied and consists mostly of a landscaped, mowed grassy area, three large trees, and a hedgerow of trees along Maple Avenue. It is fenced with a locked gate located on Clove Avenue. The topography slopes down from Clove Avenue to the midpoint of the property, with a 75-foot wide, flat terrace over the northern half of the site, closest to Maple Avenue. The hedgerow of trees is on a sloped bank down to Maple Avenue. Along the western boundary, there exists a drainage swale that intermittently directs stormwater runoff to a storm culvert beneath Maple Avenue. The ownership of the drainage swale will be confirmed in conjunction with a review of historical records.

Prior to the MGP operations at the Clove and Maple site, a gas plant was in operation at 93B Maple Avenue. The 93B site is located northwest of the Clove and Maple site on the opposite side of Maple Avenue. The 93B MGP site and nearby properties were previously investigated and were remediated by a series of Interim Remedial Measures (IRMs) from 2003 through 2005. The remediation included excavations on properties immediately adjacent to the area now identified as OU-2 of the Clove and Maple MGP site. An IRM excavation was also conducted in 2005 at 104 Maple Avenue, adjacent to OU-1 of the Clove and Maple site. Additional detailed information regarding these IRMs is provided in the IRM Certification Report (GEI, 2006). The locations of the 93B site and the IRM areas are shown in Figure 2.

2.3 OU-2 History and Description

OU-2 consists of several residential parcels, as shown in Plate 2 and the aerial photograph provided as Figure 2. This section first describes the history and location of the former pond area which underlies a large portion of OU-2 and is the most important historical feature of OU-2. This section also designates the three groups of residential parcels which lie within OU-2: the Apartment Complex parcel, the group of single family parcels on Maple Avenue, and the group of single family residential parcels on West Street.

2.3.1 Former Pond Area

Historical mapping indicates that a stream previously flowed past the 93B MGP site and through the OU-2 area, roughly parallel with Maple Avenue. The stream appeared to have been dammed near the intersection of West Street and Maple Avenue, forming a pond area that covered a large portion of OU-2. The historic mapping of the pond and stream area is shown in Figure 3. A photograph of the area from approximately 1890, showing the pond and residences along West Street, is provided in Figure 4. The stream was subsequently relocated to the existing 54-inch culvert that is located beneath the Alleyway and traverses the Apartment Complex property on OU-2.

2.3.2 Apartment Complex Parcel

The Apartment Complex parcel is an approximately 2.5-acre irregularly shaped property identified as Tax Map Section 27.62, Lot 17. The apartment buildings contain 56 apartments housing a total of over 200 residents. The property includes four 2-story apartment buildings, located on the north side of Maple Avenue across from the MGP and Head Start properties, and a 2-story apartment building on West Street. All buildings in the apartment complex are built on concrete slabs with no basements or crawl spaces. Small grassed areas and laundry facility outbuildings are located behind the apartment buildings. Paved parking and driveway areas comprise the remainder of the property between the apartment buildings and the neighboring lots. Emergency vehicle access to the rear of the buildings is from West Street and Tor Avenue via the Alleyway. Numerous electrical power poles and overhead building service lines are located behind the buildings. The 54-inch storm drain and three lateral storm drain pipes are located on the property.

2.3.3 Single-Family Residences on Maple Avenue

A row house building and associated properties are located west of the Apartment Complex on Maple Avenue. The properties are identified as Tax Map Section 27.62, Lots 18, 19, 20, and 21. These single-family residences are identified as 111, 113, 115, and 117 Maple Avenue. The row house is built on slabs without basements or crawl spaces. Vehicle parking is located in front of the building on Maple Avenue, and fenced yard areas with decks, sheds, and additional parking are located behind the building.

2.3.4 Single-Family Residences on West Street

Six properties are located on West Street immediately north of the Apartment Complex parcel. These are identified as Section 27.62, Lots 1, 2, 3, 4, 5, and 6. Each of these properties include a single-family residence at 96 through 116 West Street. Most of the houses abut close to West Street, with grassed and paved backyard areas. Vehicle access for some of these properties is from the rear of the lots, via the Alleyway and the Apartment Complex driveway to West Street.

2.3.5 Maple Avenue

Maple Avenue is a narrow, two-way, paved street with a concrete sidewalk on the north side. Utility poles and overhead electrical and telephone lines are located on the south side of the street. The utilities located beneath the street and sidewalk include water, sanitary sewer, storm drains, and natural gas.

2.3.6 The Alleyway

The Alleyway is an unpaved single lane connecting Tor Avenue with the parking area behind the Apartment Complex. Several of the West Street residents access their driveways via the alley, and it also provides emergency vehicle access to the rear of the apartment buildings.

2.4 Site Geology

The Clove and Maple site (OU-1 and OU-2) is located at the base of High Tor Mountain (elevation 600 feet) and South Mountain, which is a steep northeast-facing ridge. Maple Avenue (elevation 20 feet), runs along the toe of this ridge. As described previously in Section 2.1, OU-1 is characterized by moderate relief (approximately 25 feet) with the ground surface sloping predominantly to the north. OU-2 is relatively flat, with a shallow basin in the center of the site (low elevation 14 feet and also to the east, toward the embayment of the Hudson River.

The following four geologic units were identified in the RI:

- **Fill.** Miscellaneous soil and demolition debris forms the uppermost stratigraphic unit at the site. The fill at this site is primarily made up of loamy soil with some cobbles, gravel, brick fragments, cinders, coal, and glass shards. Thickness of the fill unit ranges from approximately 15 feet near Clove Avenue, to approximately 5 feet and less along Maple Avenue and along the northeast side of the Apartment Complex. The 54-inch storm sewer primarily passes through fill.

- **Alluvium.** This unit underlies the fill at most boring locations. It is a heterogeneous mixture of alluvial deposits comprised of discontinuous beds of coarse-grained sands, gravel, fine-grained sands, silts, some clays, and in some locations, organic peat. Thickness and composition of the alluvial deposits vary widely throughout the site, but can be generalized into five subunits:

1. Coarse-grained sand and gravel with some fine-grained material and cobbles, varying in thickness from 7 to 20 feet. This subunit either thins to the east or grades into fine-grained sand, silt, and clay.
2. Fine sand, found primarily at the former MGP property. The thickness ranges from less than 1 foot to approximately 25 feet thick.
3. Silt and fine to coarse-grained sand. This subunit is found primarily on the northeast side of the Apartment Complex. The thickness of this unit does not exceed about 4 feet.
4. Clay and fine sand/silt mixture. It is the only soil that is ubiquitous at the site, on both sides of Maple Avenue. Its thickness ranges from less than 0.5 feet (at MW-28S) to approximately 15 feet (at MW-11).
5. Organic peat. It is found between the first and second units at the Apartment Complex and West Street properties as a layer of organic clay/ silt and peat. The material appeared to be friable and slightly cohesive, and appeared to be deposited at the former pond bottom.

- **Glacial Lacustrine Clay.** This third unit is comprised of gray and brown clay. It can be massive or can contain thin lenses of fine-grained sand, and it is nearly ubiquitous in its presence. The clay is thickest near Maple Avenue and thins to the southwest and west. The thickness varies from 2 feet to approximately 18 feet on the MGP parcel. The clay was observed at the Apartment Complex. Where clay is present, it is underlain by coarse-grained sand and gravel or interbedded with fine sand/silt and clay.

- **Till.** This fourth unit consists of a dense silty clay to a dense sandy clay. The till behaves as a basal confining unit for dense, non-aqueous-phase liquid (DNAPL), although DNAPL appears to have been confined by the upper stratigraphic units and rarely migrated to the depth of till. Information from a deep boring (SB/MW-07) indicates that the till unit is at least 22 feet thick. At OU-1 the till was encountered at depths ranging from about 17 feet deep (SB/MW-6) to 36 feet deep (SB/MW-10). At OU-2, the till was encountered between 22 feet deep (SB/MW-21) and 30.5 feet deep (SB/MW-28D).

2.5 Surface Water Hydrology

At OU-1, overland flow is from the south (highest site elevation) to the north. Because OU-1 is sloped, surface drainage is good, with minor puddling in the terrace area in the vicinity of wells MW-02 and MW-03. Most overland surface water flows toward Maple Avenue and/or the drainage swale near the western property line. Ultimately, surface water that does not evaporate or infiltrate soils is discharged via the storm drain system to the Hudson River.

At OU-2, surface water generally flows west to east, following the topography of the parking lot behind the apartment buildings. From the surveyed base map provided in the RIR, it appears that storm water is collected in five catch basins along Maple Avenue and in three catch basins located in the parking lot area and is discharged via the 54-inch storm drain to the Hudson River.

2.6 Site Hydrogeology

Hydrogeology in the region is dominated by the steep ridge above the site, and by the Hudson River. Groundwater is expected to discharge to surface water bodies such as ponds, streams, and rivers in the Hudson River watershed. All these regional watershed features eventually discharge to the Hudson River.

The depth to groundwater varies throughout the site, with typical depths of 8 feet below ground surface (bgs) in the central portion of OU-1, and 5 feet bgs at OU-2. This first water-bearing zone is a shallow zone present within the alluvium. The shallow aquifer at OU-2 is effectively confined by clay, resulting in artesian conditions being observed at several monitoring well locations along Maple Avenue at the border of OU-1. Artesian conditions were also observed in portions of the 93B IRM excavations that were completed near the western border of OU-2.

At OU-1, groundwater flow appears to follow the topography, flowing from uphill, southwest, to downhill, northeast. At OU-2, groundwater flow appears to be controlled by topography and following the former pond, from the west to east towards the Hudson River embayment.

Groundwater levels in OU-2 were tested for tidal fluctuations and found not to be tidally influenced.

Estimates of the average horizontal linear flow velocity appear to range widely at the site, depending on the hydraulic conductivity of the geologic units in the tested wells. Data from tests performed at MW-01 and MW-03 at OU-1 used to estimate velocities of 12.6 feet/year and 993 feet/year in the northeastern direction.

2.7 Extent of Impacts and Conceptual Site Model

This section is a summary of the analysis and discussion presented in the RIR of the historic site activities, the nature and extent of impacts, fate and transport of MGP residuals, and other RI information, together with additional insights gained through the review of 93B IRM information, to present a conceptual model of the present site conditions.

The Clove and Maple MGP site operated from approximately 1887 until 1935, at which time natural gas was introduced into the area and the MGP operation was terminated. After gas production ceased, circa 1935, the gas plant structures remained on site until demolition of the plant in the 1960s. The RIR established that the primary constituents of concern (COCs) at the site are benzene, toluene, ethylbenzene, and xylene (BTEX) and polycyclic aromatic hydrocarbons (PAHs). The areal extent of surface soil and subsurface soil impacts, defined as exceedances of Part 375 Unrestricted SCOs, and groundwater impacts, defined as exceedances of NYSDEC Ambient Water Quality Standards, are shown in Figure 10.

2.7.1 Nature and Extent of Contamination at OU-1

The RIR identified the presence of DNAPL, BTEX, PAHs as COCs at the MGP parcel, OU-1. Total cyanide (i.e. complexed cyanide) and Target Analyte List (TAL) metals (a list of 23 metals) were also detected, but not found to be a significant concern. The nature and extent of these impacts in surface soils, subsurface soils, DNAPL source materials, and groundwater are described below. Impacts to indoor air quality are not discussed as no buildings exist on OU-1. Impacts to surface water are not discussed as there are no surface water bodies on OU-1.

- **Surface Soils.** PAHs and metals exceeded the Soil Cleanup Objectives (SCOs) in surface soils in multiple locations at the site. However, local soil background metals concentrations were demonstrated to also exceed the SCOs. The highest concentration of PAHs was found at sample SS5 (6,821 mg/kg total PAHs) collected near the gas regulator station. This prompted an IRM by O&R. O&R placed a gravel cover on the soils south of the regulator station covering surface-soil samples SS5, SS35A, and SS35B. This cover assists in minimizing potential direct contact with the surface soils (RETEC, 1997).

- **Subsurface Soils.** In addition to the DNAPL source material described below, MGP-related soil contamination, above DEC Part 375 SCOs was identified throughout the northern half of OU-1, extending to depths ranging from 8 to 32 feet bgs. Soil impacts were not identified beyond the MGP parcel boundaries to the southwest (Clove Avenue) or southeast (146 Maple Avenue property).

- **DNAPL.** The RIR reported DNAPL impacts in soil at OU-1 which were described as tar-like and oil-like materials. The RIR grouped these impacts into the following categories according to the amount of DNAPL impacts present:

  - MGP and hydrocarbon-like odors only
  - Sheens or staining only
  - Blebs and thin lenses
  - DNAPL-impacted intervals

  The DNAPL on OU-1 was characterized as flowable, low-viscosity material.

  For this FS, the RIR borelog observations were used to develop a 3-dimensional model to illustrate the extent, thickness, and depths of soil with substantial DNAPL contamination in layers thicker than 0.2 feet. These layers are defined as source materials for this FS. Figures 5, 6, and 7 depict the location of these source materials. Source material and soil impacts on OU-1 are shown in more detail in Figures 11, 12, 13, and 14, and are further discussed in the remedial alternatives evaluation for OU-1 in Section 6.

At OU-1, the DNAPL source materials were observed to occur within the alluvium and did not extend down to the till layer, as shown in Figure 6. One well on OU-1, MW-02, was observed to have accumulated 5 feet of DNAPL. A thin layer (less than 1 foot thick) of DNAPL-impacted soil may extend to the northwest beneath the drainage swale area adjacent to the MGP parcel. This layer, which is on top of the clay at a depth of approximately 11 feet bgs, was encountered during the IRM excavation on the adjacent property at 104 Maple Avenue. Thin layers of DNAPL-impacted soil also extend above the clay layer from OU-1 to the northeast beyond Maple Avenue to the southernmost portion of the OU-2 properties along Maple Avenue.

- **Groundwater.** Groundwater contamination at OU-1 was detected in a zone similar to that of the subsurface soils. Groundwater impacts did not extend below the till layer and were limited to the northern half of OU-1.

2.7.2 Nature and Extent of Contamination at OU-2

The RIR identified the presence of DNAPL, and exceedances of BTEX, and PAHs in soil and groundwater at OU-2. The nature and extent of these impacts, if any, in surface soils, subsurface soils, DNAPL source materials, groundwater, stormwater drainage, and indoor air quality are described below. The impacts identified in OU-2 appear to be limited to the location of the former pond. Impacts to surface water are not discussed as there are no surface water bodies on OU-2.

- **Surface Soils**. Surface soil samples were not collected on OU-2. However, most of the site is covered with buildings, sidewalks and pavement. Also, the expected transport pathway of contaminants from the OU-1 toward OU-2 is through subsurface soils and groundwater. Additionally, the Apartment Complex and other properties are separated from the former MGP Site by Maple Avenue.

- **Subsurface Soils.** MGP-related soil contamination, above DEC Part 375 SCOs was identified throughout most of the Apartment Complex property and the Maple Avenue Individual Residences, and in the southern portions of the West Street Individual Residences. Soil contamination extends horizontally to the north in the Alleyway behind 88 West Street and 90 West Street. The soil impacts on OU-2 extended to depths ranging from 7 to 25 feet bgs. Soil contamination was not identified beyond the West Street property boundaries to the north or the Apartment Complex property boundary to the north and east.

- **DNAPL.** The RIR reported DNAPL impacts on soil at OU-2 of tar-like and oil-like materials. The DNAPL impacts were characterized in the following categories:

  - MGP and hydrocarbon-like odors only
  - Sheens or staining only

- Blebs and thin lenses
- DNAPL-impacted intervals

The DNAPL on OU-2 was characterized as varying from low-viscosity, light colored NAPL in the western portion of OU-2 (MW-32S and MW-31S) to more viscous, dark colored material in the eastern portion of OU-2 (SB-86 and eastward). A further discussion of DNAPL transport is provided in Section 2.7.3, below.

At OU-2, DNAPL source material impacts occur predominantly in the former pond area, which is now the backyard and parking lot area for the residences and Apartment Complex. Two wells in this area, MW-31S and MW-32S, were observed to accumulate DNAPL. Most of the source material impacts on OU-2 appear to follow the pattern observed during the 93B IRM excavation immediately to the west, with impacts found within the alluvium, including sand, clayey silt and peat subunits, and not extending down to the till layer, as shown in Figure 6. The darker colored, more viscous tarry DNAPL was observed in subsurface soils at SB-86 and eastward, north of the apartment buildings. The presence or absence of source material impacts beneath the Apartment Complex buildings has not been determined, and is indicated by dashed lines in the FS figures (e.g. Figure 6). Source material and soil impacts on OU-2 are shown in more detail in Figures 19 and 20, and are further discussed in the remedial alternatives evaluation for OU-2 in Section 7.

- **Groundwater.** The volatile organic compounds (VOC) and PAH groundwater impacts extend horizontally to the northwest to the Apartment Complex property boundary (MW-61), to the north beneath the parking lot at the rear of the Apartment Complex property (MW-63, MW-28S), and to the east beneath the parking lot behind 139 Maple Avenue (MW-60).

  Storm water drainage. Storm water and sediments in the storm drainage system located on OU-2 have been impacted by VOCs and PAHs at low concentrations. The drainage system receives urban runoff and the detected contaminants may not be solely related to the MGP parcel. The VOCs and PAHs detected in the storm sewer system are also present in urban storm sewer runoff.

- **Soil Vapor and Indoor Air Quality.** Several investigations of soil vapor and indoor air quality were conducted on the properties comprising OU-2. It was concluded that there was no evidence indicating intrusion of MGP-related vapors into the Apartment Complex buildings or the nearby residences on Maple Avenue or West Street. Soil vapor investigations performed along the east property line of OU-1 and off site at the Head Start property at 146 Maple Avenue, and at representative locations around the perimeter of the Head Start building footprint, confirmed that no MGP-related vapor impact has been identified extending onto the Head Start property.

In conclusion, the vertical extent of impacts at OU-1 and OU-2 has been limited by the presence of alluvial materials including clay layers and peat deposits. The underlying compacted till provides a final confining layer which appears to mitigate the potential vertical migration of contaminants at the site based on the available data. The previous geomorphic (stream and pond) features have prevented the northward migration of contaminants beyond the West Street properties.

2.7.3 Fate and Transport Mechanisms at OU-1 and OU-2

The downward migration of DNAPL from MGP operations at OU-1 appears to have been limited by the clay layer and fine-grained layers within the alluvium. Downward migration of the DNAPL at OU-1 could also have been limited if the density of the material were relatively low, that is, only slightly more dense than that of water.

Several transport mechanisms could account for the presence of DNAPL at OU-2. DNAPL could have migrated from OU-1 to OU-2 by lateral movement along the surface of the clay layer and/or in sand lenses in the clay. However, the wells and borings located along Maple Avenue at the border of OU-1 and OU-2 did not indicate a significant DNAPL transport pathway. Figure 8 shows the estimated extent of MGP source material on OU-2 and the location of cross section A-A'. Figure 9 shows cross section A-A'. This cross section originates at MW-08 and MW-02 on OU-1, and extends north across Maple Avenue to SB-49 and then east to SB-86. The surface of the clay layer slopes downward from OU-1 to OU-2, indicating that the surface of the clay layer, and sand lenses within the clay layer, were possible migration pathways from OU-1 to OU-2. Impacts at MW-02 are at a slightly higher elevation than SB-46. However, the impacts are discontinuous: SG-11, SG-12, and SB/MW-21, which are located adjacent to Maple Avenue, did not have gross impacts. It is possible that some DNAPL migration could have occurred in more permeable discrete sand lenses that could be present between the borings along Maple Avenue. Surface water flows or pipe flows could also have occurred from OU-1 to OU-2, but there has been no documentation or direct observations of such occurrences. Transport of DNAPL originating at the 93B MGP to the back yard areas along the former streambed west of OU-2 was documented in the IRM activities conducted in 2005. It is possible that DNAPL could have continued to flow east into the former pond where it settled and was contained in the absorbent peat material where it was reported in the RIR to be present. It is not possible to determine how much of the DNAPL now present at OU-2 originated from the Clove and Maple MGP site and how much originated from the 93B MGP site. Gas was manufactured at the 93B Maple Avenue site from 1859 until approximately 1893 when the gas manufacturing process was moved to the Clove & Maple Avenue site in Haverstraw, which had begun operations in 1887. Manufactured gas at the 93B site was produced first by heating coal, and later by heating coal and petroleum products. The later process would have produced similar DNAPL characteristics to those from the Clove and Maple MGP.

At OU-2, downward migration of DNAPL appears to have been limited by the clay and peat layers, and by the relative low density, as at OU-1. It appears that DNAPL did not migrate laterally from

OU-2 to areas to the north or east because of the absorbent nature of the organic peat material in which it was contained, and the limits to lateral movement imposed by the banks of the former pond within OU-2. Slight DNAPL impacts were found in one sediment sample in OU-3, and appear to have been associated with transport from the 54-inch drain pipe, the pipe bedding, and the former stream channel which daylight in the embayment, the pipe bedding and former stream channel. General, widespread migration of DNAPL off site from OU-2 does not appear to be occurring.

The dissolved-phase groundwater contaminant concentrations within the area of NAPL impacts are likely in a steady-state condition, where the rate of dilution from inflowing clean water equals the rate of dissolution of contaminants from the MGP-impacted materials. Changes in groundwater concentrations result from the chemical diffusion of contaminants adsorbed to the soil into the dissolved groundwater phase in response to changes in equilibrium. This is based upon historical monitoring well results, which show the groundwater concentrations are stable, and the likely age of the release (on the order of 70 years).

In addition to groundwater flow conditions, the potential exists that the storm sewer system beneath the parking area in the north section of the Apartment Complex, which channels a former stream and pond, is intercepting the low concentration groundwater contaminants, providing a preferential pathway and discharge to downstream locations. However, MW-107, located at the east end of the Apartment Complex, had no groundwater exceedances of BTEX, PAH, or cyanide during the 2008 RI, which mitigates this concern.

3. Exposure Assessment and Remedial Action Objectives

This section presents the RAOs that apply to this site, based on an understanding of the exposure pathways provided in the RIR and the applicable SCGs values for the site.

3.1 Exposure Pathways

Complete exposure pathways at OU-1 or OU-2 exist, but only if invasive excavation, construction, or sewer drain maintenance were to occur. No ongoing, current exposure pathways or threats are actively occurring at the site. Therefore, only potential exposure pathways exist. Section 9 of the RIR presents an assessment of the exposure pathways at the various properties that comprise the site study area. The following summary is provided to form the basis for the site RAOs.

3.1.1 Exposure Pathways at OU-1

- **OU-1 Surface Soil:** The site is fenced and cover material has been placed, therefore only potential exposure of O&R maintenance workers and trespassers exists for the current use of the property. A potential exposure pathway would exist if the property were to be developed in the future and construction workers and residents were to come in contact with soil below the soil cover.

- **OU-1 Subsurface Soil:** A potential exposure pathway would exist if the property were to be developed in the future, and if subsurface soils were disturbed by construction workers or residents.

- **OU-1 Groundwater:** A potential exposure pathway would exist if the property were to be developed in the future, and if subsurface soils were disturbed below the water table (approximately 8 feet bgs) by construction workers or residents, or if the groundwater were to be used by residents.

- **OU-1 Soil Vapor:** A potential exposure pathway would exist for residents if the property were to be developed in the future.

3.1.2 Exposure Pathways at OU-2

- **OU-2 Surface Soil:** Surface soil was not identified as a medium of concern at OU-2.

- **OU-2 Subsurface Soil:** A potential exposure pathway exists for construction workers or residents disturbing subsurface soils.

- **OU-2 Groundwater:** A potential exposure pathway exists for construction workers or residents disturbing subsurface soils below the water table (approximately 5 feet bgs) or using groundwater.

- **OU-2 Stormwater Sediments:** A potential exposure pathway exists for construction workers or residents disturbing stormwater sediments.

- **OU-2 Soil Vapor and Indoor Air Quality:** At the Apartment Complex buildings and the rowhouse at 111-117 Maple Avenue, the subslab soil vapor, indoor air, and ambient air were sampled in 2004 and again in 2005. It was determined that subslab soil vapor concentrations were consistently low and did not represent a potential exposure pathway (RETEC, 2005). As reported in the RIR, soil vapor outside of the buildings at other properties on OU-2 was sampled and it was determined that the soil vapor was not a medium of concern for the other buildings on OU-2.

3.2 Standards, Criteria, and Guidance (SCGs)

SCGs are defined in the DER-10. Standards and Criteria are New York State regulations or statutes which dictate th e clean up standard s, standards of control and ot her substantive environm ental protection requirements, criteria, or lim itations which are generally app licable, 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;*
- *Draft NYSDEC Policy Memorandum on Soil Cleanup Guidance (Soil Cleanup Memo), November 4, 2009;*
- *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; and*
- *TAGM 4030-Selection of Remedial Actions at Inactive Hazardous Waste Sites.*

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

3.2.1 Soil Cleanup Levels for OU-1 and OU-2

As stated in the DEC Soil Cleanup Memo, 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*:

1. *The applicable regulatory program*, which for the Clove and Maple MGP parcel 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 the Clove and Maple MGP parcel is confirmed by the RIR;
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;* and
4. *Other impacted environmental media such as surface water, sediment, and soil vapor*. These considerations are not applicable for OU-1 and OU-2 of the Clove and Maple MGP parcel, as described in Section 2, above.

After evaluating the nature and extent of the soil contamination associated with OU-1 and OU-2 of the Clove and Maple MGP parcel, this FS presents alternatives based on Approach 1: Unrestricted Use SCOs and Approach 2: Restricted Use SCOs, as described in the DEC Soil Cleanup Memo.

Protection of Groundwater. Protection of Groundwater SCOs (which are the Unrestricted SCOs for the PAHs and BTEX compounds at this site) may be deemed not applicable by the DEC, allowing a Restricted Use approach, if the following conditions are met, as described in the DEC Policy Memo, Section V, Paragraph D2:

- *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 materials.

- *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 either:*

  a) *Is not migrating or likely to migrate off site*. Impacted groundwater is migrating or likely to migrate off of OU-1, but only onto OU-2, which is part of the site. General, widespread migration of MGP-contaminated groundwater off site from OU-2 does not appear to be occurring. Migration of some MGP-contaminated groundwater from OU-2

to the Hudson River is potentially occurring through the pipe and pipe bedding of the storm sewer system and the former stream channel. However, the PAHs detected in the storm sewer system are also present in urban storm sewer runoff.
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).

Land Uses and SCOs. The various present and possible future land uses applicable to the parcels comprising OU-1 and OU-2, and the associated minimum Part 375 SCOs are presented below in Table 3-1. The minimum SCOs indicated in Table 3-1 assume that groundwater use is addressed by institutional and engineering controls.

Table 3-1. OU-1 and OU-2 Land Uses and SCO Categories

Parcel	Current Land Use	Future Possible Land Use	Minimum Applicable Part 375 SCO Category
OU-1	Light Industrial	Commercial/Passive Recreation Multi-family Residential or Active Recreation Single Family Residential or Active Recreation	Commercial SCOs Restricted Residential SCOs Residential SCOs
OU-2 Apartment Complex and Alleyway	Multi-family Residential	Multi-family Residential or Active Recreation Single Family Residential or Active Recreation	Restricted Residential SCOs Residential SCOs
OU-2 111-117 Maple Avenue	Single Family Residential	Single Family Residential or Active Recreation	Residential SCOs
OU-2 West Street Single Family Residential Parcels	Single Family Residential	Single Family Residential or Active Recreation	Residential SCOs
OU-2 Maple Avenue	Municipal Roadway	Municipal Roadway	Commercial SCOs

The applicability and specific COCs for the use levels used in this FS are summarized as follows:

For OU-1:

- **Unrestricted Use.** Part 375 Unrestricted SCOs for individual PAH and BTEX compounds, applicable down to bedrock;
- **Residential Use**. Part 375 Residential SCOs for individual PAH and BTEX compounds, applicable to 15 feet bgs after source removal;
- **Restricted Residential Use**. Part 375 Restricted Residential SCOs for individual PAH and BTEX compounds, applicable to 15 feet bgs after source removal; and
- **Commercial Use**. For surface soils: Part 375 Commercial SCOs for individual PAH and BTEX compounds. For subsurface soils: 500 mg/kg Total PAHs and Part 375 Commercial SCOs for individual BTEX compounds, applicable to 15 feet bgs after source removal.

For OU-2:

- **Unrestricted Use.** Part 375 Unrestricted SCOs for individual PAH and BTEX compounds, applicable down to bedrock;
- **Residential Use** Applicable for the single-family parcels on Maple Avenue and West Street. Part 375 Residential SCOs for individual PAH and BTEX compounds, applicable to 15 feet bgs after source removal;
- **Restricted Residential Use** Applicable for the current use of the Apartment Complex parcel. The Alleyway was included in the Apartment Complex because it represents a small volume which would be addressed along with the adjacent areas of the Apartment Complex. Part 375 Restricted Residential SCOs for individual PAH and BTEX compounds, applicable to 15 feet bgs after source removal; and
- **Commercial Use** (for the affected area of Maple Avenue). For subsurface soils: 500 mg/kg Total PAHs (DEC Cleanup Policy, V, paragraph H.) and Part 375 Commercial SCOs for individual BTEX compounds, applicable to 15 feet bgs after source removal. Surface soil objectives are not applicable for this paved street.

3.2.2 Groundwater Cleanup Levels for OU-1 and OU-2

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).

3.3 Remedial Action Objectives

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 intended land use. The RAOs are site-specific goals that address the media of concern, specific contaminants, and the exposure pathways at the each operable unit of the site.

Upon consideration of the SCGs, and the nature and extent of MGP impacts, as described in the RI, the following are the RAOs for OU-1 and OU-2 of the Clove and Maple MGP parcel. These RAOs are goals to be achieved to the extent practicable:

OU-1:

Groundwater

- Prevent ingestion of groundwater with contaminant levels exceeding drinking water standards.
- Prevent contact with, or inhalation of, volatiles from contaminated groundwater.
- Prevent discharge of contaminated groundwater to surface water.
- Restore the groundwater aquifer to meet ambient groundwater quality criteria to the extent practicable.
- Remove the source of groundwater contamination.

Soil

- Prevent ingestion/direct contact with soil exceeding applicable SCOs.
- Prevent inhalation of contaminants, including dust, from the soil.
- Prevent migration of contaminants that would result in groundwater or surface water contamination.

Soil Vapor

- Prevent inhalation of soil vapor contaminants due to soil vapor intrusion into future buildings.

OU-2:

Groundwater

- Prevent ingestion of groundwater with contaminant levels exceeding drinking water standards.
- Prevent contact with, or inhalation of, volatiles from contaminated groundwater.
- Prevent discharge of contaminated groundwater to surface water.
- Restore the groundwater aquifer to meet ambient groundwater quality criteria to the extent practicable.
- Remove the source of groundwater contamination.

Soil

- Prevent ingestion/direct contact with soil exceeding applicable SCOs.
- Prevent inhalation of contaminants, including dust, from the soil.

- Prevent migration of contaminants that would result in groundwater or surface water contamination.

Soil Vapor

- Prevent inhalation of soil vapor contaminants due to soil vapor intrusion into existing or future buildings.

4. General Response Actions

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 3.

4.1 Range of General Response Actions

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 FS guidance, but would not result in meeting the RAOs and is not contemplated for this site.
2. **Administrative Actions Pertaining to Soil or Groundwater.** These actions involve restrictions of legal access to soil or groundwater. They are combined with other actions in the development of alternatives.
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 caps.
4. **On-site Treatment of Soil and Groundwater.** These actions include on-site or off-site reduction in the volume, toxicity, and/or mobility of the contaminants. Technologies include in-situ solidification/stabilization 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 DNAPL/Groundwater**. These actions include excavation of impacted soil and extraction of DNAPL, and off-site treatment/disposal of these in properly permitted facilities.

4.2 General Extent of Impacts

The nature and extent of impacts on OU-1 and OU-2 in surface soil, subsurface soil, DNAPL, and groundwater were described in Sections 2.7.1 and 2.7.2, respectively. In accordance with the guidance provided in DER-10, this section presents the maximum extent of impacts in soil and groundwater. The extent of impacts in OU-1 and OU-2 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. A summary of groundwater results was provided in Table 5-5 of the RIR. A delineation summary providing exceedance depths for soil analytical results was provided in Table 7-1 of the RIR. A summary of NAPL impacts was provided in Table 7-2 of the RIR.

The areal extent of surface soil and subsurface soil impacts, defined as exceedances of Part 375 Unrestricted SCOs, and groundwater impacts, defined as exceedances of NYSDEC Ambient Water Quality Standards, are shown in Figure 10. These impacts in soil and groundwater are present on the northern half of OU-1 and most of OU-2. The dashed lines shown on Maple Avenue and some of the properties on West Street indicate areas where the extent of soil impacts was less certain because few borings were advanced in these areas.

4.3 Volume Estimates

The volumes of impacted soil, DNAPL and groundwater present at OU-1 and OU-2 were estimated for the purpose of providing a basis for the development and evaluation of remedial alternatives. Tables 4-1 and 4-2 provide a summary of the volumes for each medium and operable unit.

Table 4-1 Estimated Volumes of Impacted Media for OU-1

Medium	Volume
Surface Soil, 1 ft depth	1,700 CY
Surface Soil, 2 ft depth	3,400 CY
Subsurface Soil:	
Source Material	7,400 CY
Source Material and Commercial SCOs	11,800 CY
Source Material and Restricted Residential SCOs	14,700 CY
Source Material and Residential SCOs	15,000 CY
Source Material and Unrestricted SCOs	21,000 CY
DNAPL	Range of 70 to 1,600 gallons
Groundwater 0.75	million gallons

Table 4-2 Estimated Volumes of Impacted Media for OU-2

Medium	Volume
Apartment Complex and Alleyway Subsurface Soil:	
Source Material and Restricted Residential SCOs	42,300 CY
Source Material and Residential SCOs	44,800 CY
Source Material and Unrestricted SCOs	60,300 CY
West Street Single Family Residential Parcels Subsurface Soil:	
Source Material and Residential SCOs	9,000 CY
Source Material and Unrestricted SCOs	12,800 CY
Maple Avenue Single Family Residential Parcels Subsurface Soil:	
Source Material and Residential SCOs	6,000 CY
Source Material and Unrestricted SCOs	9,300 CY
Maple Avenue	
Source Material and Commercial SCOs	4,600 CY
Source Material and Unrestricted SCOs	7,200 CY
Total OU-2 Subsurface Soil	
Source Material and Residential SCOs	59,800 CY
Source Material and Unrestricted SCOs	89,600 CY
DNAPL	Range of 200 to 4,500 gallons
Groundwater 5.6	million gallons

4.2.1 Surface Soils

OU-1. Impacted surface soils at OU-1 are present on much of the site, over an estimated area of 1.03 acres (45,000 square feet). The surface soil impacts were primarily due to PAHs and lead. Numerous PAHs contributed to the exceedances, with naphthalene and pyrene predominating. The volume of surface soil represented by this area depends upon the associated land use. In accordance with DER-10, for a commercial use, a 1-foot depth corresponds to a volume of 1,700 cubic yards (CY), with approximately 870 CY extending beyond the footprint of the subsurface soil excavation area. For residential use, a 2-foot depth corresponds to a volume of 3,400 CY, with approximately 1,300 CY extending beyond the footprint of the subsurface soil excavation area.

OU-2. As discussed previously in Section 2.7.2, surface soils in OU-2 are not of concern and were not included in the volume estimates for this FS.

4.2.2 Subsurface Soils

Impacted soil volumes were estimated as the product of the impacted area and applicable impacted depths. Although non-impacted soils may be present in the upper 4 to 6 feet of soil, these soils were included in the volume estimates because they would need to be excavated to gain access to the impacted soils in most remedial scenarios. Segregation and re-use of soils on site will be considered in the design phase for the larger soil volumes in the OU-2 remedy, as further discussed in Section 7. Volume calculation sheets and associated figures are provided in Appendix B. All soil volumes were rounded to the nearest 100 CY.

OU-1. As discussed in Section 3, there are four possible land use approaches applicable to OU-1: Commercial (no residences, passive recreational use), Restricted Residential (multi-family use, active recreational use), Residential (single-family use, active recreational use) and Unrestricted (no restrictions on use), in accordance with NYS Part 375 and the NYS Soil Cleanup Policy Memorandum.

In accordance with the NYS Soil Cleanup Guidance Memo, source material is to be addressed in all four approaches. For the purposes of this FS, source material was defined as NAPL-saturated material with lenses of greater than 0.2 feet thickness. Soil with thinner lenses, blebs, and sheens was not considered grossly impacted source material. The volume of source material was estimated by referring to the summary of TarGOST™ responses and NAPL observations discussed in Section 6 of the RIR, and the NAPL observations listed on Table 7-2 of the RIR. The thickness of NAPL-impacted soils were estimated from these RIR data and are shown in Figure 11. The lateral and vertical extent of source material was further estimated by the 3D EVS model, which was based on the observations listed in Table 7-2. The estimated extent and depths of source material are shown in Figure 11. The volume was estimated to be 7,400 CY.

The soil volume corresponding to the Commercial use approach was estimated by referring to the data tables from the RIR for soils less than 15 feet in depth bgs and exceeding the Commercial SCOs of 500 mg/kg TPAH and the individual BTEX compounds. In determining this volume, the presence of source material was a significant factor, as was the exceedance of the 500 mg/kg TPAH SCO. Numerous PAHs contributed to the 500 mg/kg TPAH exceedances, with naphthalene and pyrene predominating. The total volume, including the requisite source material volume, was estimated to be 11,800 CY.

Soil volume estimates were developed for the Restricted Residential SCOs (14,700 CY, appropriate for multi-family property use, with a 15-foot bgs limit), the Residential SCOs (15,000 CY appropriate for single-family property use, with a 15-foot bgs limit), and the Unrestricted SCOs (21,000 CY appropriate for all uses). All of these estimates include the volume of source material. The Unrestricted approach includes all impacted soils, regardless of depth. The maximum depth of exceedances or bore log observations of impacts was 32 feet bgs. The approximate lateral limits of corresponding to these SCOs are shown in Figures 12 and 15. Volume calculation sheets and figures are provided in Appendix B. In determining these volumes, the presence of source material was a significant factor, as were the exceedances of benzene and of numerous PAHs. Naphthalene and pyrene were the predominant PAH compounds found to exceed the SCOs.

OU-2. The soil volume estimates for OU-2 were based on the practical considerations of the buildings and land uses on the parcels which make up OU-2. The parcels are zoned for residential use, and therefore, unlike OU-1, a future commercial use approach was not included in the volume estimates. Separate soil volume estimates for the Apartment Complex parcel and the Single Family Residences were prepared to allow for the development of remedial alternatives addressing the Apartment Complex separately from the Single Family Residences. Volume estimates to meet Restricted Residential, Residential and Unrestricted SCOs were prepared. Commercial SCOs are not applicable to these residential properties and therefore volume estimates to meet Commercial SCOs were not presented. The greater volumes for the Unrestricted SCOs were primarily due to the increased depth of Unrestricted volumes, as the Restricted volumes were generally limited to a maximum depth of 15 feet bgs. In determining these volumes, the presence of source material was a significant factor, as were the exceedances of numerous PAHs. Naphthalene and pyrene were the predominant PAH compounds found to exceed the SCOs.

The Apartment Complex soil volumes consist of source material at depths as great as 17 feet bgs, and soils that exceed SCOs. A substantial amount of the soil on the Apartment Complex parcel is near and/or beneath the apartments buildings, so that it is either inaccessible or may be subject to recontamination by inaccessible source material that is presumed to be present beneath some of the buildings. The volume of soil exceeding the Restricted Residential SCOs and Residential SCOs, including the source material, was estimated to be 42,300 CY and 44,800 CY, respectively. The small difference between these volume estimates is due to the slightly less depth and slightly smaller extent of impacts in some areas. These volumes include the relatively small area of impacted soils in the Alleyway. The volume of soil exceeding the Unrestricted SCOs, including the source material, was estimated to be 60,300 CY.

The parcels which comprise Single Family Residences along West Street were grouped together for the purposes of this FS. Unlike the impacts in the Apartment Complex parcel, there is less source material on these parcels, thinner NAPL-impacted lenses, and soil exceeding SCOs is not likely to be present beneath the buildings. Two parcels, 86 West Street and 102 West Street were not sampled during the RI. Portions of these parcels are adjacent to parcels with impacted soils. Therefore, for the purpose of the FS volume estimates, these portions were assumed to be impacted similarly to neighboring parcels. The volume of soil exceeding Residential SCOs, including source material, for the group of West Street parcels was estimated to be 9,000 CY. The volume of soil exceeding the Unrestricted SCOs, including the source material, was estimated to be 12,800 CY.

The four parcels which comprise Single Family Residences along Maple Avenue consist of a single row house building and four separately owned parcels, 111-117 Maple Avenue. These were grouped together for the purposes of this FS. The back yards of these parcels were not sampled and so there is limited information with regard to the impacts on these parcels. For the purposes of this FS, these parcels were assumed to not contain source material, but to have soil exceeding Residential SCOs, including the soil beneath the building. The volume of soil exceeding Residential SCOs, including source material, for these parcels was estimated to be 6,000 CY. The volume of soil exceeding the Unrestricted SCOs was estimated to be 9,300 CY.

The volume of impacted soil beneath Maple Avenue was estimated for the purposes of an alternative which would include total removal to pre-release conditions. The volumes of soil exceeding the Commercial SCOs and Unrestricted SCOs were estimated to be 4,600 CY and 7,200 CY.

The total volume of soil exceeding Unrestricted SCOs, inclusive of the Apartment Complex (with buildings removed), the Alleyway, the Single Family Residences, and the impacted soil beneath Maple Avenue, was estimated to be 89,600 CY.

Some of the volume estimates for subsurface soil in certain areas of OU-2 were further refined in the development of remedial alternatives, as described in Section 7.

4.2.3 DNAPL

The potentially recoverable volumes of DNAPL in OU-1 and OU-2 were estimated from the data and observations of DNAPL indicated in the RIR. The actual recoverable volumes of DNAPL depend upon characteristics of the DNAPL and the soil in which it is present, and the forces which act upon the DNAPL to cause its movement. A portion of the DNAPL is present below residual saturation, with the volume of DNAPL less than the volume of voids and causing the DNAPL to become discontinuous and immobilized by capillary forces. These factors have not been quantified for this site, and therefore there is significant uncertainty in the DNAPL volume estimates, as indicated by the large ranges in volumes provided in this section (Pankow and Cherry, 1996; ITRC 2004).

OU-1. DNAPL was observed to have accumulated in MW-02. The borelog from this location indicated that the DNAPL-impacted sand lenses were present intermittently from 14 to 18 feet. MW-02 is in the center of a source material area estimated to be 60 feet by 40 feet. The upper end of the volume range was calculated by assuming 25% of the 4-foot sand interval contained DNAPL, a DNAPL saturation of 30%, and a sandy soil porosity of 30%. Using these assumptions the DNAPL volume was estimated to be 216 cubic feet, or approximately 1,600 gallons. The lower end of the volume range was calculated assuming 10% of the 4-foot sand interval contained DNAPL, a DNAPL saturation of 5%, and a sandy soil porosity of 20%. Using these assumptions, the DNAPL volume was estimated to be 9.5 cubic feet, or approximately 70 gallons.

OU-2. DNAPL was observed to have accumulated in MW-31S and MW-32S, located in the paved driveway in the northwest portion of OU-2. The borelogs from these locations indicated that the DNAPL-impacted silt and sand lenses extended from 8 to 8.8 feet bgs, and 10.5 to 12 feet bgs in MW-31S and MW-32S, respectively. MW-31S is in the center of a source material area estimated to be 60 feet by 60 feet. MW-32S is in the center of a source material area estimated to be 30 feet by

50 feet. A third area containing potentially recoverable DNAPL was identified in the RIR located in the rear of the apartment buildings on Maple Avenue. No DNAPL accumulation was measured in this area because no monitoring wells were installed there. Borelogs from borings SB-86 and SB-94 indicated an average of 1.8 feet of DNAPL-saturated thickness, in lenses ranging from 8 to 10.5 feet bgs. The extent of the area was estimated to be 200 feet by 60 feet. Using the same assumptions as the range of DNAPL estimates for OU-1, the upper end of the DNAPL volume in these areas was estimated to be 600 cubic feet, or approximately 4,500 gallons, and the lower end of the DNAPL volume range was estimated to be 26 cubic feet, or approximately 200 gallons.

4.2.4 Groundwater

OU-1. The area of impacted groundwater at OU-1 is approximately 20,000 square feet. The total volume of impacted water, assuming a 25% soil porosity and an average impacted thickness of 20 feet, is approximately 0.75 million gallons.

OU-2. The area of impacted groundwater at OU-2 is approximately 100,000 square feet. The total volume of impacted water, assuming a 25% soil porosity and an average impacted thickness of 30 feet, is approximately 5.6 million gallons.

5. Identification and Screening of Technologies

An initial screening process was 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). Technologies corresponding to the General Response Actions of Administrative and Engineering Site Controls, On-site Treatment, and Removal and Off-site Treatment/Disposal were further refined and developed for this site, as discussed below. Table 5-1 provides a summary of the retained technologies and those that were not retained.

5.1 Institutional and Engineering Site Controls

Site controls can effectively prevent exposures for potential receptors. They do not involve direct management of the impacted media, and therefore they are not effective in limiting subsurface migration of contaminants, or in volume reduction, or treatment. They consist of institutional controls and engineering controls. Site controls are included in an alternative if the remedy does not immediately achieve RAOs, and use restrictions need to be applied.

The institutional controls that may be applicable to alternatives for OU-1 include a deed restriction for groundwater use and site use, and a site management plan providing procedures to be implemented prior to disturbance of impacted soils. The engineering controls that may be applicable to OU-1 include site fencing and signage.

The institutional controls that may be applicable to alternatives for OU-2 include agreements with private property owners for groundwater use and site use, and a site management plan providing procedures to be implemented prior to disturbance of impacted soils. Engineering controls at OU-2 consist of the pavement and structures covering most of the area which decreases access to surface and subsurface soils.

5.2 Containment Technologies

Containment technologies include surface caps, vertical barriers, and soil containment by in-situ solidification/stabilization (ISS).

Caps include surface cover soil and impervious caps. These are effective for controlling exposure from surface soils.

Low permeability barriers minimize infiltration of precipitation to source areas, reducing migration of dissolved contaminants. These technologies are proven and readily implemented, and are retained for development of alternatives.

The purpose of vertical barrier containment technologies would be to reduce migration of impacted groundwater and NAPL by containment of these impacted media. There are four technologies commonly used to construct physical barriers for containment: 1) plastic liners used to minimize recontamination from adjacent impacted soils, 2) slurry walls, 3) grout curtains, and 4) sheet piling. All four technologies involve the construction of an impermeable wall capable of blocking groundwater and NAPL migration. For permanent barriers as a primary component of a site-wide remedy, the limitations of future site use and continuing operation and maintenance of groundwater control or treatment systems are primary concerns. For the Clove and Maple site, these concerns eliminate containment technologies from further consideration as the primary component of remedial alternatives. However, this technology is retained for use in detailed design of excavation alternatives to minimize recontamination from adjacent areas.

ISS technologies are discussed in Section 5.4.9, below.

5.3 Monitored Natural Attenuation and In-situ Groundwater Treatment Technologies

MNA relies upon the natural degradation and mitigation processes which occur in the subsurface to remedy groundwater impacts over time. 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).

Natural processes can be enhanced by modifying the subsurface conditions to provide active in-situ groundwater management. In-situ groundwater remediation can be accomplished biologically, chemically, or physically. For example, biological treatment enhances the natural degradation of contaminants. Long-term in-situ groundwater treatment of BTEX and PAH compounds is typically an aerobic biodegradation process, but can also occur by anaerobic processes. Engineered saturated zone bioremediation processes are designed to treat the dissolved constituents of the groundwater plume by insuring the existence of a bioactive zone which is sufficient to degrade the constituents before they reach an environmental receptor. Enhancements such as increasing the dissolved oxygen content in the subsurface have been shown to be effective at MGP Sites (Levinson, 2009).

MNA and in-situ groundwater treatment technologies were retained for development of alternatives at this site.

5.4 Excavation Technologies

5.4.1 Overview of Excavation and Related Technologies

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 the Clove and Maple site, excavation for removal of impacted soils could extend to depths of approximately 30 feet or less. A combination of conventional trackhoe and extended arm trackhoe technologies would be used to accomplish the excavation work at and are therefore carried forward into the detailed description of excavation alternatives.

Control of odors and VOC emissions will be a critical aspect of all excavation scenarios at the site. Excavation and loading activities would be conducted using odor-controlling foam and temporary plastic covering, as was effectively done for odor control during the 93B IRM activities in which excavation occurred in residential back yards. At larger excavation areas, temporary fabric structures have been used to control odors, with vapor-phase carbon treatment of the ventilated air.

Materials handling and treatment/disposal of soils, rock, holder pad demolition debris, and debris encountered in subsurface fill material will be an important aspect of excavation. On-site treatment or disposal of impacted solids will not be feasible at this site due to the lack of space and the inappropriate location for such activities and was not carried forward into the alternatives. Off-site transportation and treatment/ disposal of solids is the technology carried forward for excavated materials. Prior to transport, wet soils excavated from below the water table will first require stabilization. Transportation of solids would be done by appropriately permitted trucks, rather than by rail, since no rail siding exists at the site. Off-site disposal options include commercial thermal desorption and landfill disposal. While both of these disposal options were carried forward into the detailed description of excavation alternatives, thermal desorption will be given preference where it is technically feasible, such as for impacted soils. Large rock and demolition debris would constitute materials that would not be acceptable, or would be cost prohibitive, for commercial thermal desorption facilities, and therefore would require landfilling.

The two remaining major challenges for excavation at the site are sidewall support and water management. The screening of technologies to address these aspects is discussed below.

5.4.2 Sidewall Support

Due to the depth of the excavations, the groundwater flows and artesian conditions, and the constrained areas at the site, simple sloping and benching of the excavations will not be feasible and engineered sidewall support systems will be required. Six technologies have been widely used for sidewall support of excavations: 1) Pre-engineered shoring systems, 2) soldier beam and lagging walls, 3) sheet piling, 4) slurry walls, 5) grout curtains, and 6) slurry-supported wet excavation. One or more may be applicable to the excavations at OU-1 and OU-2, and selection of specific shoring techniques will be conducted in the design and construction phase of the remedy. For areas of OU-1 and OU-2 containing DNAPL, the design of the shoring support structures should avoid creating vertical migration pathways through the peat and clay layers which appear to be confining the DNAPL in many areas. The following selection criteria will be important in the consideration of these technologies for use at the Clove and Maple site:

- Safety during installation;
- Confidence in the success of implementation;
- Protection against sidewall failure;
- Protection against creating vertical migration pathways;
- Protection of the structural integrity of all buildings on and near the site;
- Minimization of groundwater seepage into the excavation; and
- Minimization of water content of excavated soils.

5.4.3 Pre-engineered Shoring Systems

These “trench box” and other modular systems include slide rails, trench shields and hydraulic shoring (American Shoring Inc, 2007). Rail systems that have steel posts and sidewall panels (slide rails) that are assembled on site. The panels are advanced into the excavation as the work proceeds. They are appropriate for shallow to moderate depths. Advantages include low design costs, rapid installation and re-use. Pre-engineered shoring systems were used successfully at the 93B IRM excavations in the residential back yards in 2005 (GEI, 2006) and would be applicable to similar excavations at the Clove and Maple site. This technology is retained for alternative development and as a basis for cost estimation.

5.4.4 Soldier Beam and Lagging Walls

This is the most commonly used shoring technology for deep excavations. Soldier beams (vertical steel pilings) are first driven or drilled in from the ground surface to the final design depth, which is a specified depth below the final depth of the wall. They are placed at regular spacings of approximately 5 to 10 feet. After installation of the soldier beams, the soil in front of the wall is excavated in lifts, followed by installation of the first course of lagging. The lagging (usually wood beams) is placed horizontally between the flanges of the beam. Ground anchors (tie-backs) are then drilled through the side of the wall at a specified downward angle and length to support the wall. The top-down sequence of excavation followed by lagging placement and ground anchor installation continues until the design depth of the wall is reached (USDOT, 1999).

Safety and implementability of this technology are well established for a wide range of site conditions. Properly designed, the technology would provide adequate protection against sidewall failure and would be protective of nearby buildings. One drawback of these systems is the large flows of groundwater that would seep from between the lagging (even with lagging seals). This can be overcome by the appropriate design and implementation of construction dewatering system. One advantage of this type of shoring system is that the soldier beam pilings can also be utilized for support of a temporary fabric structure, such as at OU-1, where the slope of the site would require the downhill side of the structure to be elevated above ground level. This technology is retained for alternative development and as a basis for cost estimation.

5.4.5 Sheet Piling

Sheet piling, as applied in the environmental industry, typically involves driving lengths of inter-connectable steel sheeting into the ground to form an impermeable barrier. The same materials are used for construction of a temporary sheet pile wall for excavation shoring. The steel sheeting is available in a wide variety of configurations and strengths. The sidewall support is provided by driving the sheeting deeper than the excavation in a cantilevered application. Greater support for deep excavations are provided by ground anchors (tie-backs) which are drilled through the side of the wall at a specified downward angle and length to support the wall. Walers, rakers, and deadman anchors may be used to brace the sheetpile and performed in stages to achieve the required excavation depths. Dewatering outboard of the sheetpile may be required to minimize groundwater pressure, especially during rain events. Cross-lot bracing between walls or other internal bracing may be used (Ratay, 1996; Deep Excavation, 2005).

The safety and implementability of this technology are well established for a wide range of site conditions. Sheet piling could be advanced below the bottom of the excavation to allow for more effective dewatering than a soldier beam and lagging wall. One disadvantage of sheet piling is the potential for damage to nearby structures due to vibration. In addition, the installation of sheet piling can be difficult or ineffective in conditions where large rock or wood obstructions are present. Sheet piling was successfully implemented at 103 Maple Avenue during the 93B IRM in 2005. In addition, substantial subsurface obstructions were not observed during the test pit excavations on OU-1. These sheet piling experiences and excavation observations indicate that sheet piling is likely to be implementable at OU-1 and OU-2.

Considering these advantages and limitations, this technology may be applicable to portions of the excavation sidewall supports.

5.4.6 Slurry Walls and Grout Curtains

A slurry wall is a low-permeability subsurface vertical barrier constructed by excavating a trench which is then backfilled with selected low-permeability materials, such as bentonite. The sides of the trench are kept stable during excavation by a slurry (a suspension of bentonite clay in water). Grout curtain installation involves injecting a liquid, slurry, or emulsion under pressure into the soil matrix. The use of slurry walls and grout curtains as shoring for excavation has been made possible augmented by various steel reinforcing frames, pilings, and/or other materials. Greater support for deep excavations are provided by ground anchors (tie-backs) which are drilled through the side of the wall at a specified downward angle and length to support the wall (Ratay, 1996).

The safety and implementability of this technology are well established for a wide range of site conditions. They could be advanced below the bottom of the excavation to allow for more effective groundwater cutoff than a soldier beam and lagging wall. The main drawback of these technologies is their requirement for additional strengthening to provide adequate protection against sidewall failure at depths greater than 30 feet. Considering this limitation, these technologies may be applicable to a limited portion of relatively shallow excavation sidewall supports, and could also be applicable for most of the deeper site excavation work, with substantial design and construction efforts.

5.4.7 Slurry Supported Wet Excavation

Another approach to excavation sidewall support is to perform the excavation in a series of slurry-filled trenches. The bentonite clay slurry would act to support the sidewalls and to prevent groundwater infiltration. This process would alternate an excavated strip with an unexcavated strip, which allows for curing time for the slurry/clean fill mixture.

This is a relatively new application of slurry support technology and the safety and implementability of this technology are not well established. One of the main drawbacks of this technology is that some material could collapse from the sidewalls (Rumer and Ryan, 1995). This would threaten the sidewall stability and result in impacted material falling to the bottom and not being removed. The second main drawback is that this technology would result in unacceptably wet soil being removed, with no on-site area available to stabilize the wet soil prior to transportation off site. Considering these limitations, this technology was not carried forward into the alternatives involving excavation.

5.4.8 Excavation Water Management

Excavation below the water table will require management of the groundwater seepage into the excavated area. Because of the hydrogeologic conditions, excavation water management will be a critically important aspect of excavations performed at this site. Excavations below the water table will be especially vulnerable to seasonal high groundwater flows generated by the steep ridge above the site. Excavations below the water table in OU-2 will be especially vulnerable to upwelling of groundwater caused by artesian conditions of groundwater confined beneath the clay layer. Specific techniques for groundwater management will be selected during the design and construction phase of the remedy. The following general review was completed for the purposes of conceptual design and cost estimating for this FS.

Excavation dewatering technologies include area-wide dewatering or excavation pit dewatering. Area-wide dewatering involves depressing the water table over the entire site by pumping from a series of manifolded well points (Nichols and Day, 1999).

Dewatering of the excavation pits would involve a localized dewatering of a specific zone below an excavation. The localized dewatering would be made possible advancing wells outside the construction area, and augmented by sumps inside the construction area. Excavation pit dewatering would produce water that would need to be treated prior to discharge to the local Publicly Owned Treatment Works (POTW) These dewatering and water treatment and disposal methods were used successfully during the 93B IRM work adjacent to the OU-1 and OU-2 in 2005 (GEI, 2006) and are carried forward into the alternatives involving excavation.

5.4.9 In-situ Solidification Technologies

ISS of impacted soil involves the in-place mixing of cementitious reagents (such as Portland cement) with impacted soil to create a solid monolith that substantially decreases the ability of groundwater to come into contact with contaminants. An early use of the technology was for treatment of PCB-impacted soils (Stinson and Sawyer, 1988), metals-impacted soils, and oil-impacted soils (Conner, 1990). It is becoming an increasingly accepted means of remediation at MGP sites (EPA, 2000), including MGP sites in New York State (New York Construction, 2007). The ISS technology relies on the selection of the appropriate agents and proportions (the "mix design") as well as the successful delivery system to provide in-situ contact and encapsulation of the impacted soil. The three common delivery systems used for ISS are bucket mixing, auger mixing, and pressure/jet grouting.

The effectiveness of ISS technology is the primary concern with regard to application at OU-1 and OU-2, due primarily to the silty clay present at both OU-1 and OU-2. The ISS mix design and delivery system would need to be effective in the clay matrix, which is not well established for this technology. ISS does not have sufficient advantages over removal of soil, and has substantial uncertainty with regard to effectiveness, and was therefore not carried forward for development of alternatives at this site.

5.4.10 NAPL Recovery Technologies

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 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). Selection of specific NAPL recovery techniques, well and/or trench locations, and recovery pumping, control, and storage equipment, will be conducted during the design and construction phase of the remedy. As described in Section 2.7.2, the characteristics of NAPL appear to vary across OU-2. Recovery of viscous and weathered NAPL may be difficult. Pre-design NAPL recovery testing will be necessary to develop design information for NAPL recovery at this site.

This technology was carried forward for development of alternatives.

6. Development and Analysis of Alternatives for OU-1

In this section, the remedial alternatives for OU-1 are developed and evaluated. A recommended alternative is presented at the conclusion of this section. A summary and comparison of the remedial alternatives is provided in Table 6-1.

6.1 Development of Alternatives for OU-1

A range of alternatives were developed for OU-1, based on the land use approaches, RAOs and GRAs identified in Sections 3 and 4, and the applicable technologies identified in Section 5. A total of five alternatives were developed and retained for detailed analysis:

1. No Action
2. Institutional and Engineering Controls
3. Soil removal to Part 375 Commercial levels, with in-situ groundwater treatment and MNA
4. Soil removal to Part 375 Residential levels, and with in-situ groundwater treatment and MNA
5. Soil removal to Part 375 Unrestricted levels

An alternative featuring containment and NAPL recovery was considered, but after initial evaluation, was dropped from detailed development and evaluation. This alternative had the advantage of minimizing short-term disturbance, but was not substantially cost effective in comparison to the Institutional and Engineering Controls alternative.

An alternative featuring removal of soil to Part 375 Restricted Residential Levels was also considered, but after initial evaluation, was dropped from detailed development and evaluation. The Restricted Residential land use approach would limit the use of the site to multi-family residences, rather than allow for single family residences under the Residential land use approach. For a small additional quantity of soil removal, estimated to be less than 1,000 CY, the site could be cleaned up to Part 375 Residential Levels, and therefore the Residential use alternative was carried forward into the detailed evaluation.

6.2 Detailed Analysis of Alternatives

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

1. Overall protection of human health and the environment
2. Conformance with SCGs
3. Long-term effectiveness and permanence

4. Reduction of toxicity, mobility, or volume of contamination through treatment
5. Short-term impacts and effectiveness of controls
6. Im plementability
7. Cost effectiveness
8. Land Use

6.2.1 Alternative 1 No Action

The No Action alternative is used as a baseline condition for comparison to other alternatives. It involves no Institutional Controls and Engineering controls, monitoring, or active remediation. There is no cost associated with this baseline alternative.

6.2.2 Alternative 2 Institutional and Engineering Controls, and Monitoring

Description

This alternative provides for protection of human health and the environment while having low short-term impacts and low remedial action cost. However, the RAOs would not be met. The land use would be restricted to the current state of a fenced lot.

This alternative includes the following institutional and engineering controls (IC/ECs):

- A NYSDEC Environmental Easement for future uses of the site, limiting the use of the site to its current state as a fenced, unused parcel, and specific protocols to manage future ground-intrusive work. The protocol would be included in a NYSDEC-approved Site Management Plan (SMP) to manage ground-intrusive work, which will require that such work be done under a work plan approved by NYSDEC and NYSDOH. The Easement will prohibit use of groundwater on OU-1. In accordance with 6 NYCRR Part 375, the Environmental Easement will be an interest in the real property of OU-1, owned by O&R, created under and subject to the provisions of ECL article 71, title 36, and held by the property owner, which is currently O&R.

- Engineering Controls. The SMP will require that a chain-link fence, with a minimum height of 6 feet, be maintained on the perimeter of the former MGP parcel at OU-1. The drainage ditch adjacent to this parcel to the west would not be included in the perimeter fencing. A locked gate would be maintained, and a sign would be maintained on each of the four sides of the perimeter fence stating the following: "No Trespassing Without Permission. Private Property. Trespassers Will Be Prosecuted". The existing gravel cover material present over the impacted surface soil would be maintained.

- The SMP will include a provision for an annual certification that these engineering controls are in place.

Groundwater monitoring would be a feature of this alternative, as groundwater quality does not currently meet NYSDEC SCGs, and would not be expected to in the near future under this remedy. The details of the groundwater monitoring program would be developed by O&R in a Groundwater Monitoring Work Plan, approved by the NYSDEC and NYSDOH. However, for the purposes of cost estimation, annual monitoring of one well on each side of the property was assumed, such as wells MW-01 (upgradient), MW-18 (on site, west), MW-05 (adjacent to Maple Avenue), and MW-09 (on site east, adjacent to 146 Maple Avenue). For the purposes of cost estimation, a 30-year groundwater monitoring program was assumed. However, the specific review period and total monitoring time period would be determined in coordination with NYSDEC and NYSDOH and included in the Groundwater Monitoring Work Plan.

Overall Protection of Human Health and the Environment

This remedial alternative is not fully protective of human health and the environment. The potential for contact with PAH compounds in surface soil at the site is low due to the engineering controls of site fencing and the previously placed cover material. The institutional controls of this alternatives would provide for protection from human health or environmental exposure to surface and subsurface soils, soil vapor (construction of buildings on the property would be precluded), groundwater, and soils and groundwater that contain NAPL. NAPL in subsurface soil and groundwater in OU-1 represents a continuing source of groundwater impacts and is potentially migrating onto OU-2. This remedy does not directly address this source material and is therefore not fully protective of human health and the environment.

Conformance with SCGs

This alternative will not be in conformance with SCGs because soil contamination would exceed 6 NYCRR Part 375 Soil Cleanup Objectives and groundwater contamination would exceed 6 NYCRR Part 703 Surface Water and Groundwater Quality Standards.

Long-term Effectiveness and Permanence

This alternative would have moderate long-term effectiveness and permanence. O&R’s financial resources and the legally binding easement provisions would provide for maintenance of the institutional and engineering controls, as well as the groundwater monitoring provisions, for the foreseeable future. While there is a low probability the institutional controls would be violated and thus rendered ineffective, the effectiveness of the engineering controls of fencing and the existing soil cover could be compromised by a breach in the fencing or the soil cover. This could occur either accidentally or intentionally by a trespasser. Because impacted materials would remain on site near the surface, the remedy would be not be permanent.

Reduction of Mobility, Toxicity, or Volume Through Treatment

This remedial alternative will result in no reduction of mobility, toxicity, and volume of COC.

Short-term Impacts and Effectiveness of Controls

The engineering controls of this alternative are in place currently and would cause no short-term impacts.

Implementability

Technical Feasibility. This alternative has very high technical feasibility. The engineering controls of this alternative are in place currently.
Administrative Feasibility. This alternative is administratively feasible because O&R owns the property and the provision of institutional controls is well established.
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 although the cost is low, the long-term liability of the site would remain as a potential future cost.

The projected cost for Alternative 2 is $530,000. This includes site maintenance and the present worth of groundwater monitoring of $30,000 for 30 years. It also includes the estimated cost of Easement and SMP preparation is $70,000. Details of the cost estimate are provided in Appendix A.

Land Use

The land use for this alternative would be limited to the current status of the property as a fenced lot. The property is currently zoned for light industrial use.

6.2.3 Alternative 3 Soil Removal to Commercial Levels and In-situ Groundwater Treatment / MNA

Description

This alternative provides for moderate protection of human health and the environment while having moderate short-term impacts and moderate remedial action cost. The land use would be restricted to commercial use, including passive recreational use, such as a park with benches or a paved basketball court where there would not be contact with site soil.

This remedial alternative includes the following sequential actions:

- Demolition and removal of concrete holder pad. The holder pad located at the surface in the northwest portion of OU-1 would be demolished and transported to an off-site, permitted landfill. The pad is approximately 65 feet in diameter.

- Delineation and excavation of approximately 11,800 CY of MGP-impacted subsurface soil exceeding the Commercial SCOs and MGP source material.

- Removal of approximately 870 CY of surface soil, to a depth of 1 foot. Placement of 1 foot of clean soil cover in areas outside of the excavation footprint to satisfy the SCOs for surface soil under the Commercial use approach. (The Commercial SCO for total PAHs in subsurface soil is 500 mg/kg, which is not appropriate for surface soil.)

- Placement of a demarcation layer in appropriate locations.

- Post-remedial in-situ groundwater treatment and MNA to address groundwater impacts. A contingency action of in-situ active groundwater management would be engaged if, upon review, downward concentration trends from MNA were not observed. Enhancement of subsurface groundwater conditions to provide active groundwater management is described in Section 5. The specific technology would be determined during the design phase for this remedy, after monitoring, if necessary. In-situ groundwater oxygenation technology was used as a basis for the FS cost estimate.

- An Environm ental Easem ent and SMP would be established as in Alterna tive 2, except fencing and signage would not be required.

Alternative 3 is presented conceptually in Figures 11 and 12. Figure 11 depicts the removal of source material, which would be followed by excavation of additional soil to the approximate limits of Commercial SCO exceedances, as shown in Figure 12. The excavation limits encompass the former gas holder, tar well, MW-02, and former valve area where tar had been observed at the surface. In accordance with NYSDEC's Soil Cleanup Memorandum of November 2009, removal of the source material would extend to depths greater than 15 feet; the source material excavation will extend to a depths of approximately 18 feet and 22 feet. After source removal, the excavation of soils to Commercial levels would extend to depths no greater than 15 feet. Actual limits of excavation will be established by verification sampling to be conducted during the design process. For the purposes of the cost estimate, the excavation volumes were estimated as described in Section 4.3 – Volume Estimates. Volume estimate details are provided in Appendix B.

The following considerations would apply to these excavation activities:

- The limits of excavation would first be delineated and the soil would be pre-characterized for disposal in accordance with the requirements for the proposed receiving facilities.

- Odor, vapor, and dust control would primarily be accomplished by conducting all excavation of NAPL-containing soil within a temporary fabric structure as further described in Section 5 – Excavation Technologies. In addition, a community air monitoring plan will be implemented.

- The excavation sidewalls would be stabilized by engineered shoring. The limits of excavation are very close to the neighboring properties of 104 Maple Avenue, the Maple Avenue right of way, and 146 Maple Avenue. A shoring system would be used to protect against sloughing of the sidewalls and damage to these properties. For the conceptual design used for the purposes of the cost estimate, the posts of the shoring system could also support the downhill side of the temporary fabric structure, as shown schematically in cross section Figure 14. The design of the shoring support structures should avoid creating vertical migration pathways through the clay layers which appear to be confining the DNAPL in many areas.

- Excavation of material in the drainage swale area would occur as depicted in plan view Figure 12 and cross section Figure 14.
- The water table is typically 7 to 8 feet below grade. Therefore, localized excavation dewatering would be performed. Dewatering is further discussed in Section 5 – Excavation Technologies.
- Pre-treatment of water would occur on site, prior to permitted discharge to the local POTW. This method of treatment and disposal was used successfully during the 93B IRM work.
- The NAPL accumulated in MW-2 would be removed and properly disposed of off-site prior to excavation in the MW-2 source material area.
- All excavated materials will be loaded into lined, covered trucks for transport to permitted off-site treatment/disposal facilities. The primary treatment/disposal facilities would be low-temperature thermal desorption facilities (LTTD). Debris or other material not acceptable to the LTTD would be disposed of at permitted landfill facilities.

The excavated areas would be backfilled with clean soil from an approved off-site source after placement of a demarcation layer. Approximately 11,800 CY of impacted subsurface soil and debris and 870 CY of impacted surface soil would be excavated and transported off site under this alternative. An equivalent quantity of clean soil would be imported as backfill.

Remaining areas exceeding surface soil SCOs would be excavated and then 1 foot of clean soil would be imported and placed over exposed soils, to meet the Commercial use requirements. Based on the previous surface sampling conducted at OU-1, this is anticipated to be a large portion of the site.

Following excavation and backfilling, the in-situ groundwater treatment/ MNA program will commence. Monitoring would occur at least twice per year and would include the MNA parameters and protocols described as best practices in the recent review article applicable to MNA at MGP sites (Neuhauser, et al, 2009). The details of the program will be described in a NYSDEC-approved Groundwater Management Work Plan prepared during remedial design. Active groundwater management would continue until RAOs for groundwater were met. The duration of the groundwater treatment and monitoring program was assumed to be 10 years.

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 soil and subsurface soils would be eliminated by the excavation and the placement of 1 foot of cover. Removal of source material and other impacted soil will reduce the potential for ongoing groundwater impacts.

Conformance with SCGs

This alternative will comply with the appropriate soil SCGs, but would not immediately comply with all SCGs because complete removal of SCG groundwater exceedances would not be achieved. Excavation of source materials and other impacted soil will be performed to meet the RAOs for the site. Since residual materials would remain, the RAOs would be met by the elimination of the potential migration and exposure pathways by the IC/ECs and implementation of in-situ groundwater treatment and MNA.

Long-term Effectiveness and Permanence

Removal of source material and soil to Commercial SCOs, in combination with the IC/ECs, would effectively eliminate the potential soil exposure pathways and would significantly decrease the leaching of soil-bound COCs into the dissolved phase groundwater impacts. The permanence of the remedy would be limited by the permanence of the IC/ECs imposed on the site.

Reduction of Mobility, Toxicity, or Volume Through Treatment

This remedial alternative will result in a substantial reduction of volume of COCs present at the site by removal of NAPL, source material and other impacted soil. In-situ treatment and MNA of groundwater will further decrease the mass and concentrations of COC.

Short-term Impacts and Effectiveness of Controls

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 by implementing a community air monitoring plan. Excavation of MGP source material would be performed inside the fenced O&R property under a temporary fabric structure. Noise from the operation of the air handling equipment would be mitigated by an enclosure. Truck traffic from the operations would be a significant impact, and would be necessary for the work. Truck traffic would include mobilization and demobilization of heavy construction equipment, trucking of impacted material from the site, and trucking of backfill material into 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 and O&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 environmental impacts from this alternative would be low. Impacts during the source removal will be addressed by use of spill prevention and control measures.

Time Until Response Objectives are Achieved. It is anticipated that removal of the concrete holder pad, erecting of the temporary fabric structure, and the excavation and site restoration work will take approximately four months to perform. This alternative provides for a significant reduction in the concentrations of COCs in groundwater, starting at least one year after the removal action. In-situ treatment and MNA will continue until RAOs are met, with monitoring periodically re-evaluated, for an assumed period of 10 years. The time until the RAOs are achieved is not possible to predict until the site-specific MNA trend is determined during the MNA monitoring.

Implementability

Technical Feasibility. Removal of NAPL and impacted soils and the placement of backfill and cover soils are technically feasible using conventional equipment and construction methods. Excavation, transportation, and disposal of impacted soils are conventional remedial techniques. Groundwater in-situ treatment and MNA has been demonstrated as a technically feasible approach at similar MGP sites.

Administrative Feasibility. This alternative is administratively feasible because O&R owns the property where the material would be excavated, and thus legal access would not be a problem. Approvals for discharge of water to the POTW and for transportation of materials on Village of Haverstraw streets have been obtained previously for the 93B IRM work.

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 cost is substantial, while the gain in land use value, restricted to commercial use, is minimal. However, the long-term liability of the site would be substantially reduced.

The projected costs for this alternative are as follows:

Capital Cost	$4.9 million	
O&M Cost	$0.5 million	(including present worth of groundwater management for 10 years)
Contingency	$1.3 million	(A 25% allowance for undefined costs and conditions)
Total	$6.7 million	

Details of the cost estimate are provided in Appendix A.

Land Use

The land use for this alternative would be restricted to commercial use and use as a passive recreational area, such as a park with benches.

6.2.4 Alternative 4 Soil Removal to Residential Levels and Groundwater In-situ treatment and MNA

Description

This alternative provides for additional protection of human health and the environment while having moderate short-term impacts and moderate remedial action cost. The land use value would substantially increase, allowing for single family residences or active recreational use, such as a park with swings where there would be contact with site soil.

This remedial alternative includes the following sequential actions:

- Demolition and removal of concrete holder pad. The holder pad located at the surface in the northwest portion of OU-1 would be demolished and transported to an off-site, permitted landfill. The pad is approximately 65 feet in diameter.
- Delineation and excavation of approximately 15,000 CY of MGP-impacted subsurface soil exceeding the Residential SCOs and MGP source material.
- Removal of approximately 1,300 CY of surface soil, to a depth of 2 feet. Placement of 2 feet of soil cover to satisfy SCOs for residential use in the area outside the footprint of the subsurface soil excavation.
- Post-remedial In-situ treatment and MNA to address groundwater impacts. A contingency action of in-situ active groundwater management would be engaged if, upon review, downward concentration trends from MNA were not observed. Enhancement of subsurface groundwater conditions to provide active groundwater management is described in Section 5. The specific technology would be determined during the design phase for this remedy, after monitoring, if necessary. In-situ groundwater oxygenation technology was used as a basis for the FS cost estimate.
- An SMP to restrict groundwater use on the property.

Alternative 4 is presented conceptually in Figures 11 and 12. Figure 11 depicts the removal of source material, which would be followed by excavation of additional soil to the approximate limits of Residential SCO exceedances, as shown in Figure 12. The excavation limits encompass the former gas holder, tar well, MW-02, and former valve area where tar had been observed at the surface. In accordance with NYSDEC's Soil Cleanup Memorandum of November 2009, removal of the source material would extend to depths greater than 15 feet; the source material excavation will extend to a depths of approximately 18 feet and 22 feet. After source removal, the excavation of soils to Residential levels would extend to depths no greater than 15 feet. Actual limits of excavation will be established by verification sampling to be conducted during the design process. For the purposes of the cost estimate, the excavation volumes were estimated as described in Section 4.3 – Volume Estimates. Volume estimate details are provided in Appendix B.

The following considerations would apply to these excavation activities:

- The limits of excavation would first be delineated and the soil would be pre-characterized for disposal in accordance with the requirements for the proposed receiving facilities.
- Odor, vapor, and dust control would primarily be accomplished by conducting all excavation of NAPL-containing soil within a temporary fabric structure as further described in Section 5 – Excavation Technologies. In addition a community air monitoring plan will be implemented.
- The excavation sidewalls would be stabilized by engineered shoring. The limits of excavation are very close to the neighboring properties of 104 Maple Avenue, the Maple Avenue right of way, and 146 Maple Avenue. A shoring system would be used to protect against sloughing of the sidewalls and damage to these properties. For the conceptual design used for the purposes of the cost estimate, the posts of the shoring system could also support the downhill side of the temporary fabric structure, as shown schematically in cross section Figure 13. The design of the shoring support structures should avoid creating vertical migration pathways through the peat and clay layers which appear to be confining the DNAPL in many areas.
- Excavation of material in the drainage swale area would occur as depicted in plan view Figure 12 and cross section Figure 14.
- The water table is typically 7 to 8 feet below grade, therefore localized excavation dewatering would be performed. Dewatering is further discussed in Section 5 – Excavation Technologies.
- Pre-treatment of water would occur on site, prior to permitted discharge to the local sewage treatment plant. This method of treatment and disposal was used successfully during the 93B IRM work.
- The NAPL accumulated in MW-2 would be removed and properly disposed of off-site prior to excavation in the MW-2 source material area.
- All excavated materials will be loaded into lined, covered trucks for transport to permitted off-site treatment/disposal facilities. For the purposes of this FS, the primary treatment/disposal facilities were assumed to be LTTD facilities. Debris or other material not acceptable to the LTTD would be disposed of at permitted landfill facilities.

The excavated areas would be backfilled with clean soil. Approximately 15,000 CY of impacted subsurface soil and debris and 1,300 CY of impacted surface soil would be excavated and transported off site under this alternative. An equivalent quantity of clean soil would be imported as backfill.

Remaining areas exceeding surface soil SCOs would be excavated and then 2 feet of clean soil would be imported and placed over exposed soils, to meet the Residential use requirements. Based on the previous surface sampling conducted at OU-1, this is anticipated to be a large portion of the site.

Following excavation and backfilling, the in-situ groundwater treatment and MNA program will commence. The details of the program will be described in a NYSDEC-approved Active Groundwater Management Work Plan prepared during remedial design. Groundwater monitoring would continue as described in Alternative 2.

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 soil and subsurface soils would be eliminated by the excavation and the placement of 2 feet of cover. Removal of source material and other impacted soil will reduce the potential for ongoing groundwater impacts.

Conformance with SCGs

This alternative will comply with the appropriate soil SCGs, but would not immediately comply with all SCGs because complete removal of SCG groundwater exceedances would not be achieved. Excavation of source materials and other impacted soil will be performed to meet the RAOs for the site. Since residual materials would remain, the RAOs would be met by the elimination of the potential migration and exposure pathways by the IC/ECs and implementation of in-situ groundwater treatment and MNA.

Long-term Effectiveness and Permanence

Removal of source material and soil to Residential SCOs, in combination with the IC/ECs, would effectively eliminate the potential soil exposure pathways and would significantly decrease the leaching of soil-bound COCs into the dissolved phase groundwater impacts. The permanence of the remedy would be limited by the permanence of the IC/ECs imposed on the site.

Reduction of Mobility, Toxicity, or Volume Through Treatment

This remedial alternative will result in a substantial reduction of volume of COCs present at the site by removal of NAPL, source material and other impacted soil. In-situ treatment and MNA of groundwater will further decrease the mass and concentrations of COC.

Short-term Impacts and Effectiveness of Controls

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 by implementing a community air monitoring plan. Excavation of MGP source material would be performed inside the fenced O&R property under a temporary fabric structure. Noise from the operation of the air handling equipment would be mitigated by an enclosure. Truck traffic from the operations would be a significant impact, and would be necessary for the work. Truck traffic would include mobilization and demobilization of heavy construction equipment, trucking of impacted material from the site; and trucking of backfill material into 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 and O&M activities will wear the appropriate PPE as required in a site-specific health and safety plan.

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

Time Until Response Objectives are Achieved. It is anticipated that removal of the concrete holder pad, erecting of the temporary fabric structure, and the excavation and site restoration work will take approximately five months to perform. This alternative provides for a significant reduction in the concentrations of COCs in groundwater, starting at least one year after the removal action. In-situ treatment and MNA will continue until RAOs are met, with monitoring periodically re-evaluated, for an assumed period of up to 10 years. The time until the response objectives are achieved is not possible to predict until the site-specific MNA trend is determined during the MNA monitoring.

Implementability

Technical Feasibility. Removal of NAPL and impacted soils and the placement of backfill and cover soils are technically feasible using conventional equipment and construction methods. Excavation, transportation, and disposal of impacted soils are conventional remedial techniques. Groundwater in-situ treatment and MNA has been demonstrated as a technically feasible approach at similar MGP sites.

Administrative Feasibility. This alternative is administratively feasible because O&R owns the property where the material would be excavated, and thus legal access would not be a problem. Approvals for discharge of water to the POTW and for transportation of materials on Village of Haverstraw streets have been obtained previously for the 93B IRM work.

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, while the cost is substantial, the gain in land use value, to residential use, is substantial. The long-term liability of the site would be substantially reduced.

The projected costs for this alternative are as follows:

Capital Cost	$5.9 million	
O&M Cost	$0.5 million	(including present worth of groundwater management for 10 years)
Contingency	$1.6 million	(A 25% allowance for undefined costs and conditions)

Total $8.0 million

Details of the cost estimate are provided in Appendix A.

Land Use

The land use for this alternative would allow for single family residences or active recreational use, such as a park with swings where there would be contact with site soil.

6.2.5 Alternative 5 Removal of Soil to Unrestricted Levels

Description

This alternative provides for protection of human health and the environment, with the highest short-term impacts and highest remedial action cost. The land use value would substantially increase, allowing for single family residences or active recreational use, such as a park with swings where there would be contact with site soil.

This remedial alternative includes the following sequential actions:

- Demolition and removal of concrete holder pad. The holder pad located at the surface in the northwest portion of OU-1 would be demolished and transported to an off-site, permitted landfill. The pad is approximately 65 feet in diameter.

- Delineation and excavation of approximately 21,000 CY of MGP-impacted soil exceeding the Unrestricted SCOs and MGP source material.

- Removal of approximately 1,300 CY of surface soil. Placement of soil cover to satisfy SCOs for unrestricted use in the area outside the footprint of the subsurface soil excavation.

- If the removal was demonstrated to be complete and effective for groundwater, then aside from this confirmatory monitoring, post-remedial MNA and long-term monitoring to address groundwater impacts would not be required, after a final attenuation period, assumed to be 3 years in duration. An SMP and other institutional controls as described in Alternative 2 would not be required.

Alternative 5 is presented conceptually in Figures 11 and 15. Figure 11 depicts the removal of source material, which would be followed by excavation of additional soil to the approximate limits of Unrestricted SCO exceedances, as shown in Figure 15. The excavation limits encompass the former gas holder, tar well, MW-02, and former valve area where tar had been observed at the surface. In accordance with NYSDEC's Soil Cleanup Memorandum of November 2009, removal of the source material, and soils exceeding Unrestricted SCOs, would extend to depths greater than 15 feet. The source material excavation will extend to depths of approximately 18 feet and 22 feet. After source removal, the excavation of soils to Unrestricted levels would extend to depths as great as 32 feet. Actual limits of excavation will be established by verification sampling to be conducted during the design process. For the purposes of the cost estimate, the excavation volumes were estimated as described in Section 4.3 – Volume Estimates. Volume estimate details are provided in Appendix B.

The following considerations would apply to these excavation activities:

- The limits of excavation would first be delineated and the soil would be pre-characterized for disposal in accordance with the requirements for the proposed receiving facilities.
- Odor, vapor, and dust control would primarily be accomplished by conducting all excavation of NAPL-containing soil within a temporary fabric structure as further described in Section 5 – Excavation Technologies. In addition, a community air monitoring plan will be implemented.
- The excavation sidewalls would be stabilized by engineered shoring. The limits of excavation are very close to the neighboring properties of 104 Maple Avenue, the Maple Avenue right of way, and 146 Maple Avenue. A shoring system would be used to protect against sloughing of the sidewalls and damage to these properties. For the conceptual design used for the purposes of the cost estimate, the posts of the shoring system could also support the downhill side of the temporary fabric structure, as in Alternatives 3 and 4. The design of the shoring support structures should avoid creating vertical migration pathways through the peat and clay layers which appear to be confining the DNAPL in many areas.
- Excavation of material in the drainage swale area would occur as in Alternatives 3 and 4.
- For the deep excavation involved in this alternative, to 32 feet bgs, specialized excavation techniques will be required. For example, benching down to allow reach by an extended excavator boom, or use of crane and clamshell, may be necessary.
- The water table is typically 7 to 8 feet below grade, therefore localized excavation dewatering would be performed. For the deep excavation involved in this alternative, to 32 feet bgs, shoring and groundwater control during excavation would be especially critical. Dewatering is further discussed in Section 5 – Excavation Technologies.
- Pre-treatment of water would occur on site, prior to permitted discharge to the local POTW. This method of treatment and disposal was used successfully during the 93B IRM work.
- The NAPL accumulated in MW-2 would be removed and properly disposed of off-site prior to excavation in the MW-2 source material area.
- All excavated materials will be loaded into lined, covered trucks for transport to permitted off-site treatment/disposal facilities. The primary treatment/disposal facilities would be LTTD. Debris or other material not acceptable to the LTTD would be disposed of at permitted landfill facilities.

The excavated areas would be backfilled with clean soil. Approximately 21,000 CY of impacted subsurface soil and debris and 1,300 CY of impacted surface soil would be excavated and transported off site under this alternative. An equivalent quantity of clean soil would be imported as backfill.

Remaining areas exceeding surface soil SCOs would be excavated and then clean soil would be imported, to meet the Unrestricted use requirements. Based on the previous surface sampling conducted at OU-1, this is anticipated to be a large portion of the site.

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 soil and subsurface soils would be eliminated by the removal action. Removal of source material and other impacted soil will eliminate the potential for ongoing groundwater impacts.

Conformance with SCGs

This alternative would rapidly comply with all soil SCGs because complete removal of soil to Unrestricted levels and the subsequent mitigation of groundwater exceedances to meet groundwater RAOs. Excavation of source materials and other impacted soil will be performed to meet the RAOs for the site. Groundwater objectives would be met after a final attenuation period, estimated to have a duration of three years.

Long-term Effectiveness and Permanence

The complete removal of impacted soils would effectively and permanently eliminate the potential soil exposure pathways and would eliminate leaching of soil-bound COCs into the dissolved phase groundwater impacts.

Reduction of Mobility, Toxicity, or Volume Through Treatment

This remedial alternative will result in a complete removal of the volume of COCs present at the site by removal of NAPL, source material, and other impacted soil.

Short-term Impacts and Effectiveness of Controls

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 by implementing a community air monitoring plan. Excavation of MGP source material would be performed inside the fenced O&R property under a temporary fabric structure. Noise from the operation of the air handling equipment would be mitigated by an enclosure. Truck traffic from the operations would be a significant impact, and would be necessary for the work. Truck traffic would include mobilization and demobilization of heavy construction equipment, trucking of impacted material from the site, and trucking of backfill material into 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 and O&M activities will wear the appropriate PPE as required in a site-specific health and safety plan.

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

Time Until Response Objectives are Achieved. It is anticipated that removal of the concrete holder pad, erecting of the temporary fabric structure, and the excavation and site restoration work will take approximately seven months to perform. This alternative provides for a significant reduction in the concentrations of COCs in groundwater, starting at least one year after the removal action, assuming complete effectiveness of the removal action. Groundwater objectives would be met after a final attenuation period, estimated to have a duration of three years.

Implementability

Technical Feasibility. Removal of NAPL and impacted soils and the placement of backfill soils are technically feasible using conventional equipment and construction methods. Excavation, transportation, and disposal of impacted soils are conventional remedial techniques. However, the deep excavation required to remove all soils to Unrestricted levels will require substantial shoring and dewatering efforts, with moderate implementability. The uncertainty inherent in achieving deep excavation goals in saturated soils makes this only moderately implementable.

Administrative Feasibility. This alternative is administratively feasible because O&R owns the property where the material would be excavated, and thus legal access would not be a problem. Approvals for discharge of water to the POTW and for transportation of materials on Village of Haverstraw streets have been obtained previously for the 93B IRM work.

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 the cost is very high and carries substantial uncertainty, while the gain in land use value to residential use is only moderate. The long-term liability of the site would be nearly eliminated.

The projected costs for this alternative are as follows:
Capital Cost $8.2 million
Confirmatory Monitoring Cost $0.2 million (including present worth of groundwater monitoring for 3 years)
Contingency $2.9 million (A 25% allowance for undefined costs and conditions)
Total $11.3 million

Details of the cost estimate are provided in Appendix A.

Land Use

The land use for this alternative would allow for single family residences or active recreational use, such as a park with swings where there would be contact with site soil. The Unrestricted land use would also allow for agricultural uses, which are not applicable to this site.

6.3 Comparison of Alternatives

A comparative analysis of the alternatives for OU-1 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 6-1. The following discussion provides a comparison of the four substantive alternatives, without the No Action alternative, which is not considered a viable alternative.

Overall Protection of Human Health and the Environment

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

All three removal action alternatives would meet the RAOs for groundwater, with the removals to Commercial and Residential levels meeting the groundwater objectives over time.

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

1. Alternative 5 would be the most protective, because it would involve the most complete removal of impacted materials.
2. Alternative 4 would be nearly as protective. This alternative addresses soil contamination at the former MGP plant site to a greater extent because of the Residential Soil Cleanup Objectives and therefore will create conditions for groundwater quality to improve through natural attenuation processes.
3. Alternative 3 would rank third because of removal only to Commercial Soil Cleanup Objectives.
4. Alternative 2 would be the least protective because it would not involve removal of impacted materials and more potential for accidental exposure would exist.

Conformance with SCGs

Alternatives 3, 4 and 5 would provide conformance with the SCGs appropriate for the land uses for each alternative. Alternatives 4 and 5 would provide additional conformance to SCGs, as they would result in creating conditions for groundwater quality to improve through natural attenuation processes.

Long-term Effectiveness and Permanence

All three of the removal alternatives would result in some degree of permanent reduction of the source of impacts to groundwater. The ranking of the alternatives with respect to this criterion would be proportional to the amount of COCs removed and identical to the ranking indicated for Overall Protection of Human Health and Environment, above.

Reduction of Toxicity, Mobility, or Volume

All of the removal alternatives would reduce the volume and mobility of MGP impacts at the site. The ranking of the alternatives with respect to this criterion would be proportional to the amount of COCs removed and identical to the ranking indicated for Overall Protection of Human Health and Environment, above. The excavation to Commercial SCOs would result in the removal of most of the mass of the COCs at OU-1.

Short-term Impacts and Effectiveness

All of the removal alternatives would have some degree of short-term impacts, as they all involve shoring, on-site water treatment, and heavy excavation. The primary delineator is the amount of excavation involved in each. The principal short-term impact to the community would be truck traffic, and additional excavation and backfill volume would result in additional truck traffic over a longer time period to complete the work. Their short-term effectiveness, as indicated by the time until response objectives are achieved, is largely equivalent with respect to soil (which all would rapidly achieve), but differs for groundwater (which only the Removal to Unrestricted levels could possibly achieve with short-term effectiveness).

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

1. Alternative 2, relying on Institutional and engineering controls, would have the least short-term impact and would be immediately effective.
2. Alternative 3 would involve primarily excavation, but with less short-term impact than either Alternative 4 or 5 with regard to truck traffic and duration of work.
3. Alternative 4 would rank next because of its greater removal volume.
4. Alternative 5 would involve the greatest excavation quantities and depths, resulting in the greatest short-term impacts, but would be the most effective at achieving RAOs.

Implementability

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

1. Alternatives 2 is most implementable, because it involves institutional and engineering with little uncertainty and are readily implementable.
2. Alternatives 3 and 4 are equally implementable, because they encompass the same level of technical difficulty, uncertainty, and the same level of constructability.

3. Alternative 5 is less implementable than the other alternatives, because of the depth of the excavation, and the uncertainty with regard to achieving the Unrestricted SCOs at a depth of more than 32 feet in saturated soils. Excavation at that depth will require a greater 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 best land use value and reduction in long-term liability for its estimated cost, of approximately $8.0 million.
2. Alternative 3 and 5 are equally cost effective, as each provides for more or less land use value and reduction in long-term liability for their estimated costs, of $6.7 million and $11.3 million, respectively.
3. Alternative 2 is the least cost effective as it does not provide land use value or reduction in long-term liability for its estimated cost of $530,000.

6.4 Recommended Remedy for OU-1

Upon consideration of the alternatives and their respective attributes and limitations, Alternative 4, Removal of Soil to Residential Levels, emerged as the recommended remedy for OU-1. As summarized in the cost effectiveness analysis, Alternative 4 will achieve an advantageous land use value and reduction in impacts, with more certainty than Alternative 5, Removal of Soil to Unrestricted levels, and more effectiveness and permanence than Alternative 2, Institutional and Engineering Controls. Alternative 4 would address the soil impacts at the former MGP site to a greater extent because of the lower SCOs, and therefore will create conditions for groundwater quality to improve through natural attenuation processes. Alternative 4 provides an emphasis on a balanced effectiveness and cost. This alternative is implementable with moderate short-term impacts, and meets the RAOs for the site.

The recommended remedy, Alternative 4, Removal of Soil to Residential Levels, would involve excavation of an estimated 15,100 CY of subsurface soil and 3,700 CY of surface soil, followed by in-situ groundwater treatment and MNA of groundwater, for an estimated cost of $8.0 million, as further described above in Section 6.2.4.

7. Development and Analysis of Alternatives for OU-2

In this section, the remedial alternatives for OU-2 are developed and evaluated. A recommended alternative is presented at the conclusion of this section. A summary and comparison of the remedial alternatives is provided in Table 7-1.

7.1 Development of Alternatives for OU-2

A range of alternatives was developed for OU-2, based on the land use approaches, RAOs and general response actions identified in Sections 3 and 4, and the applicable technologies identified in Section 5. A total of five alternatives were developed and retained for detailed analysis:

1. No Action
2. NAPL recovery
3. NAPL recovery and phased soil removal to Part 375 Residential levels, with in-situ groundwater treatment and MNA
4. NAPL recovery and phased soil removal to Part 375 Residential levels, with soil removal in the MW-32S Area in Phase 1, and with in-situ groundwater treatment and MNA
5. Soil removal to Part 375 Unrestricted levels, following purchase and demolition of the apartment buildings

7.2 Detailed Analysis of Alternatives

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

1. Overall protection of human health and the environment
2. Conformance with SCGs
3. Long-term effectiveness and permanence
4. Reduction of toxicity, mobility, or volume of contamination through treatment
5. Short-term impacts and effectiveness of controls
6. Im plementability
7. Cost effectiveness (FS costs are within the range of +50% to -30%)
8. Land Use

7.2.1 Alternative 1 No Action

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

7.2.2 Alternative 2 NAPL Recovery and In-situ Groundwater Treatment / MNA

Description

This alternative provides for protection of human health and the environment while having low short-term impacts and low remedial action cost. However, the RAOs would not be met. The current residential land use would not be in conformance to the SCGs because the subsurface soils contain impacts exceeding Residential levels (applicable to the single family residence parcels), and Restricted Residential levels (applicable to multi-family residence parcels).

This remedial alternative includes the following sequential actions:

- NAPL removal from the areas in the Apartment Complex parcel that contain recoverable NAPL.
- Maintenance of existing paved areas as low-permeability soil cover to impede infiltration of precipitation in the most impacted areas, and as a cap to prevent contact.
- In-situ treatment and MNA to address groundwater impacts.
- A land use restriction agreement and Site Management Plan to provide institutional and engineering controls for each property to prevent exposure to impacted subsurface soil and groundwater. A use restriction agreement would be attempted to be negotiated with all the property owners within the OU-2 area by Orange and Rockland.

Alternative 2 is presented conceptually in Figure 16. NAPL recovery operations, consisting of wells or trenches, or both, would be attempted in areas where NAPL was indicated to be present, potentially in flowable form that could be recoverable: These areas are 1) the area near MW-32S, 2) the area near MW-31S, 3) the area near MW28S, 4) the area near SB-86, and 5) the area including SB-58, SB-94, SB-95, SB 99, and SB-59. Other areas shown on Figure 16 as containing source material, which is greater than 0.2 feet thick, were not indicated in the RIR to contain free-flowing NAPL of recoverable quantities. The NAPL would be collected in secured and monitored containment vessels and periodically transported off-site to a permitted treatment and disposal or recycling/re-use facility.

The in-situ groundwater treatment and MNA program to address groundwater quality would be initiated at the completion of the NAPL recovery program. Monitoring would occur annually and would include the MNA parameters and protocols described as best practices in the recent review article applicable to MNA at MGP sites (Neuhauser, et al, 2009). The details of the each program will be described in a NYSDEC-approved MNA Work Plan prepared during remedial design. The specific technology would be determined during the design phase for this remedy, after monitoring, if necessary. In-situ groundwater oxygenation technology was used as a basis for the FS cost estimate. For the purposes of cost estimation, a 30-year groundwater management program was assumed. However, the specific review period (typically after the first five years) and total monitoring time period would be determined in coordination with NYSDEC and NYSDOH and included in the Groundwater Management Work Plan.

This alternative includes the following administrative and engineering controls:

- Land use agreements and SMPs with all property owners in OU-2, prohibiting the use of groundwater and establishing specific protocols to manage all ground-intrusive work deeper than two feet bgs, and all activities in which contact with drain pipe sediments would be possible. The NYSDEC-approved SMP for the for the Apartment Complex property would establish specific protocols to manage any breaching of the concrete floor slabs of the buildings on that property, as a provision to ensure that exposures to impacted soil vapors do not occur. The SMP would also manage ground-intrusive work under a work plan approved by NYSDEC and NYSDOH.

- The SMP will require that the existing pavement cover on the properties be maintained in low-permeability condition, which may require sealing or repaving of the macadam. It will also require that the concrete floor slabs of the Apartment Complex buildings be maintained in an unbreached condition, subject to the protocols for floor slab work established in the SMP.

- The SMP will include a provision for an annual certification that these engineering controls are in place on each of the properties in OU-2.

Overall Protection of Human Health and the Environment

This remedial alternative is protective of human health and the environment. The institutional controls of this alternative would provide for protection from human health or environmental exposure to impacted subsurface soils, drainage pipe sediments, soil vapor, and groundwater.

Conformance with SCGs

This alternative will not be in conformance with SCGs because removal of SCG exceedances in soil or groundwater would not be anticipated to be achieved. NAPL recovery alone would not result in effective removal or treatment of COCs in soil to Part 375 SCO levels. Source material would remain on site and therefore the combination of NAPL recovery, in-situ groundwater treatment and MNA would not be expected to achieve groundwater RAOs in the foreseeable future.

Long-term Effectiveness and Permanence

This alternative would have low long-term effectiveness and permanence. NAPL recovery alone would not result in effective removal or treatment of COCs in soil to Part 375 SCO levels, and the combination of NAPL recovery and in-situ treatment and MNA would not be expected to achieve groundwater RAOs in the foreseeable future. O&R's financial resources and the Site Management Plan provisions would provide for maintenance of the institutional and engineering controls, as well as the groundwater monitoring provisions, for the foreseeable future. However, because O&R does not own the properties on OU-2, use restriction agreements and SMPs would need to be established with each property owner. Because impacted materials would remain on site, the remedy would be not be permanent.

Reduction of Mobility, Toxicity, or Volume Through Treatment

This remedial alternative will result in substantial reduction of mobility and volume of NAPL by removing the most mobile fraction of NAPL, in areas where NAPL was accessible to recovery. Groundwater in-situ treatment and MNA would result in moderate reduction of toxicity and mass of dissolved COC over time. The volume of impacted soil would not be reduced.

Short-term Impacts and Effectiveness of Controls

The NAPL removal and engineering controls of this alternative would cause only minor short-term impacts, primarily during the construction and implementation of the NAPL recovery systems in the Apartment Complex parcel. These impacts would be mitigated by controlling access to the affected portions of the property during construction, and use of odor control foam and plastic covering during any excavation work for NAPL recovery trenches. Further reductions in short-term impacts could be achieved by placing the NAPL collection pumps and vessels in subsurface utility vaults so that they would not be obstructions in the Apartment Complex parking areas or back yards.

Implementability

Technical Feasibility. This alternative has very high technical feasibility. The NAPL recovery and engineering controls of this alternative rely on conventional construction techniques.
Administrative Feasibility. This alternative is administratively feasible only to the extent that the land use restriction agreements and SMPs can be established and maintained on each of the OU-2 properties.
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 although the cost is low, the long-term liability of the site would remain as a potential future cost.

The projected costs for this alternative are as follows:

Capital Cost	$0.9 million	
O&M Cost	$1.5 million	(including present worth of groundwater management for 30 years)
Contingency	$0.6 million	(A 25% allowance for undefined costs and conditions)
Total	$3.0 million	

Details of the cost estimate are provided in Appendix A.

Land Use

The current residential land use would not be in conformance to the SCGs for land use for sites such as OU-2 containing substantial impacts in subsurface soils.

7.2.3 Alternative 3 NAPL Recovery and Phased Soil Excavation with In-situ Groundwater Treatment and MNA

Description

This alternative provides for additional protection of human health and the environment while having moderate short-term impacts and moderate remedial action cost. The final remedy would provide cleanup to Part 375 Residential levels on all of the residential parcels in OU-2.

Alternative 3 is depicted conceptually in Figure 17 (Phase 1) and Figure 18 (Phase 2). The rationale for phased soil excavation is that while all of the impacted soils on the West Street Single Family Residence parcels are accessible for excavation, a substantial portion of the impacted soils on the Apartment Complex parcel and the Maple Avenue Single Family Residence parcels are not accessible at this point because they lie beneath occupied residential buildings.

An option to remove soil from the front and back yards of the 111-117 Maple Avenue in Phase 1 was considered to provide for more rapid conformance to the RAOs for this alternative. However, this option presents several problems. There is considerable uncertainty regarding whether or not impacts are present in the back yards. The building which houses the four Maple Avenue Single Family Residences at 111 through 117 Maple Avenue may lie above slight impacts, exceeding Residential levels, located 10 feet or more beneath the slab-on-grade building; however, no borings were advanced beneath the building or in the back yards of these parcels during the RI, so there are no subsurface soil data for that area. This is indicated in Figure 17 by the dashed lines in the northeastern portion of the backyards of the parcels, showing the possible extent of a thin layer of source material located on top of the clay layer at approximately 12 feet bgs in this area. Excavation immediately adjacent to this building would be very disruptive to the occupants and would not eliminate the need for long-term land use restrictions and SMP provisions for the property, since impacts may remain beneath the building after excavation. An excavation in front of the building would not be readily implementable because of the lack of space for equipment and trucks to operate between the building, the excavation pit, and Maple Avenue. Maple Avenue is very narrow in this area and could not accommodate excavation equipment or trucks and normal street traffic. In addition, the excavation in the front and back yards would have a high level of inconvenience and short-term impacts to the residents of the building. The excavations, which would have dimensions of approximately 25 feet x 60 feet x 10 feet deep in the front yard, and 20 feet x 80 feet x 12 feet deep in the back yard would remove a total of approximately 1,300 CY of soil. The quantity of impacted soil removed, based on the boring log observations and analytical results of the RIR, would be approximately 1 foot in thickness located approximately 10 feet bgs, which represents a volume of 114 CY. The soil vapor intrusion evaluation in two residences of the building, 111 and 117 Maple Avenue, indicated no soil vapor intrusion was occurring and the subslab soil vapor concentrations were low and represented a low potential for future vapor intrusion (RETEC, 2005). The other two residences were not available for sampling at the time of the vapor intrusion evaluation.

Given the uncertainty regarding whether the impacts are actually present in the back yard area, the limited benefit of the removal, and the limited implementability of the action, this option was not included in the Phase 1 excavations.

At the Apartment Complex buildings, observations from RI borings indicate that some of the impacted soil immediately adjacent to and possibly beneath the Apartment Complex buildings may be source material containing flowable NAPL, as shown in Figure 17 by the dashed lines beneath the buildings of 131 through 141 Maple Avenue. Excavation of the impacted soil adjacent to these buildings would present the problem of recontamination of the clean backfilled soils, and potential increase in the mobilization of NAPL and source material. In addition, excavation immediately adjacent to this building would be very disruptive to the occupants and would not eliminate the need for long-term institutional controls and engineering controls for the property since impacts could remain beneath the building after excavation.

The final level of cleanup for the Apartment Complex parcel would be to Part 375 Residential cleanup objectives, which is consistent with the proposed cleanup level for the other residential parcels on OU-2. Although the current use of the Apartment Complex parcel would allow cleanup to Restricted Residential levels, this alternative proposes use of Residential levels to be consistent with the remedy at the other properties and to allow for the owner of the Apartment Complex parcel to build single family residences on a portion or allow of the Apartment Complex parcel in the future. The difference in volume between excavation to Restricted Residential SCOs and Residential SCOs was estimated to be 2,500 CY, as shown on Table 4-2.

This remedial alternative therefore consists of the following sequential actions:

Phase 1

These actions would occur in the short-term, following the preparation of the remedial design:

- NAPL recovery as described in Alternative 2. This would be conducted until the eventual demolition of the apartment complex and subsequent excavation to take place in Phase 2.
- Single Family Residences: Excavation of the West Street Properties of soil exceeding Part 375 Residential SCOs, to a maximum depth of 15 feet bgs, and source material to a depth of approximately 17 feet, for an estimated total of 9,000 CY. Install a vertical barrier, such as

an HDPE liner, to mitigate recontamination of the area adjacent source material present in the Apartment Complex, in the area of MW-32S.

- Groundwater monitoring following Phase 1 to document groundwater conditions prior to Phase 2.
- Establish institutional controls and engineering controls as described in Alternative 2.

Phase 2

Phase 2 actions would occur in the future, when the opportunities present themselves to complete the excavation actions at 111-117 Maple Avenue and the Apartment Complex parcels. This would occur when one or more of the parcels was the subject of future property development that included the demolition of one or more of the buildings. The timing of remedial actions at the Maple Avenue residences would be decided during the design of the remedy. It is recognized that these opportunities may or may not occur simultaneously:

- Apartment Complex: Excavate the source material. Excavate soil exceeding Part 375 Residential SCOs, to a maximum depth of 15-feet bgs, for an estimated total of 44,800 CY.
- 111-117 Maple Street properties: Excavate any source material present, and the soil exceeding Part 375 Residential SCOs, to a maximum depth of 15 feet bgs, for an estimated total of 6,000 CY.
- Groundwater management, consisting of in-situ treatment and MNA, would be implemented. In-situ groundwater treatment would reduce the total time for long-term monitoring with MNA to less than the 30 year period assumed for Alternative 2. The total period for groundwater management was assumed to be reduced to 10 years.
- Revise the institutional controls and engineering controls to apply only to the general prohibition on groundwater use for all properties on OU-2, until such time as the groundwater management program was completed and groundwater RAOs were achieved. A SMP applicable to a limited portion of Maple Avenue may also be provided, if it is determined to be necessary.

The following considerations would apply to these excavation activities:

- Areas to be excavated were identified by reviewing the RI data and by using a visualization model, as described in Section 4.2 – Volume Estimates. Volume estimate details are provided in Appendix B. During the pre-design investigation phase, the excavation areas would first be delineated and pre-characterized for disposal in accordance with the requirements of the proposed receiving facilities.
- For the purposes of cost estimating, it was assumed that many of the excavations completed in Phase 1 would be completed in relatively small areas, typically 20 feet wide by 40 feet long using pre-engineered shoring (trench boxes), as was done for much of the 93B IRM

excavations in the back yard areas. This would, to the extent practicable, maintain vehicle access or provide alternate access, maintain parking areas and minimize the disturbance to the current residents. Odor, vapor, and dust control would be accomplished by conducting these small excavations and controlling odors from the open excavations and excavated soils with foam and plastic sheeting, as was done during the 93B IRM work, as further described in Section 5 – Excavation Technologies. The trench boxes would be moved progressively across the site as the segmented excavation was completed.

- For the purposes of cost estimating, it was assumed that many of the excavations completed in Phase 2 would be done within a temporary fabric structure, to the extent practicable, as further described in Section 5- Excavation Technologies. The temporary fabric structure would be designed to be moved progressively across the site as the segmented excavation was completed. It would provide for additional control of odors and vapors which would be especially important during excavation of the grossly impacted source materials in the subsurface soils of the Apartment Complex parcel.

- The structural integrity of the existing buildings and existing underground utilities would be protected. These underground utilities include four 36-inch stormwater drainage pipes and one 54-inch stormwater/culvert. Overhead utilities, including the many overhead electrical and telephone poles and lines, would need to be protected or relocated. A vibration monitoring and control plan would be implemented for construction activities that would cause this concern, such as installation of sheet piling.

- The water table is typically 2 to 7 feet below grade. Localized excavation pit dewatering would be performed in each of the areas, with protocols and materials available for reducing the upwelling of groundwater due to the artesian conditions present, especially when the subsurface clay layer is breached, as was done during the 93B IRM work. Dewatering is further discussed in Section 5 – Excavation Technologies.

- The excavated materials will be loaded into lined, covered trucks for transport to permitted off-site treatment/disposal facilities. For the purposes of this FS, the primary treatment/disposal facilities were assumed to be low-temperature thermal desorption facilities (LTTD). Debris or other material not acceptable to the LTTD would be disposed of at permitted landfill facilities.

- Site restoration would include provisions for site drainage, provision of landscaping, replacement of small shed structures and grass yards, and replacement of paved areas with equivalent materials and construction.

Overall Protection of Human Health and the Environment

This remedial alternative is protective of human health and the environment. Substantial levels of protection would be achieved at the conclusion of Phase 1 by the removal of impacted materials from the single family residences along West Street, and the NAPL recovery on the Apartment Complex Property. The overall protection provided by the excavation to Residential levels at the West Street Single Family Residences is substantial because these grassed backyards with resident owners would be some of the most likely areas to eventually be disturbed by groundbreaking activities. The potential for contact with impacted subsurface soils in the Apartment Complex parcel is lower due the macadam parking lot that covers most of the open ground surface. A high level of overall protection would be achieved at the conclusion of Phase 2 by the removal of source materials and soils exceeding Part 375 Residential levels from the Apartment Complex and the 111-117 Maple Avenue parcels.

Conformance with SCGs

SCGs for soils will be achieved by the removal of source materials and soils exceeding Part 375 Residential levels, except for the soils beneath Maple Avenue. Any impacted soil beneath Maple Avenue may be addressed by a SMP. The SMP, if necessary, would provide for removal of impacted soil beneath Maple Avenue during utility maintenance and upgrades.

SCGs for groundwater will be achieved over time by removal of the source materials and MNA. Groundwater use restrictions will be required until this is accomplished.

Long-term Effectiveness and Permanence

This remedy relies primarily on removal actions which will generally be effective and permanent, and will eliminate direct exposure potential upon removal. They would also effectively and permanently decrease the potential for continued migration of dissolved COCs to groundwater. Until the completion of Phase 2, this alternative would have decreased effectiveness and permanence in the areas where recontamination could occur.

In-situ groundwater treatment and MNA have been demonstrated as an effective and permanent approach at similar MGP sites (Levinson, 2009, Neuhauser, et al, 2009).

Reduction of Mobility, Toxicity, or Volume Through Treatment

This remedial alternative will result in phased substantial reduction of mobility, toxicity, and volume of COC. Excavation of source material and impacted materials will reduce the volume of COC at the site. In-situ treatment and MNA of the groundwater will further decrease the concentrations of COC.

Short-term Impacts and Effectiveness

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 NAPL recovery and transportation off site by implementing a community air monitoring plan. Excavation of MGP source material and impacted soil would be performed inside temporarily fenced areas, and managed using odor-control foam and plastic sheeting. Temporary fabric structures may be used during Phase 2 for odor and vapor control. Noise from the operation of the air handling equipment would be mitigated by an enclosure.

Truck traffic from the operations would be a significant impact, and would be necessary for the work. Truck traffic would include mobilization and demobilization of heavy construction equipment, trucking of impacted material from the site, and trucking of backfill material into 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 and O&M activities will wear the appropriate PPE as required in a site-specific health and safety plan.
Environmental Impacts. The potential for environmental impacts for this alternative would be low. Potential releases during the removal of MGP source material will be addressed by the use of spill prevention and air emission control measures.
Time Until Response Objectives are Achieved. The objectives for subsurface soil would be met for the West Street Single Family Residence parcels with the completion of Phase 1, which is estimated to take approximately 3 months to complete. The objectives for subsurface soil in the other parcels of OU-2 would not be met until the completion of Phase 2, which is not possible to schedule at this time, but would take approximately 1 year to complete.

This alternative will not have a significant impact on the concentrations of COCs in the groundwater over the short-term. In-situ treatment and MNA will continue until RAOs are met, with monitoring periodically re-evaluated, for a total period (Phase 1 and Phase 2) assumed to be 10 years. The time until the response objectives area achieved is not possible to predict until the site-specific MNA trend is determined during the MNA monitoring.

Implementability

Technical Feasibility. Removal by excavation is technically feasible using conventional excavation equipment. Excavation, transportation, and disposal of impacted soils are conventional remedial techniques.

NAPL recovery, in-situ groundwater treatment and MNA use conventional and technically implementable techniques.

Administrative Feasibility. This alternative is administratively feasible only to the extent that the land use restrictions and SMPs can be established and maintained on each of the OU-2 properties. Access agreements would also need to be obtained for the OU-2 property owners to allow work to be done on their properties. Site access agreements at some properties have not been attainable in the past for the RI work.
Availability of Services and Materials. The services and materials required for this alternative are readily available. Multiple facilities may need to be identified for both treatment of excavated soil and provision of clean backfill material, acceptable to NYSDEC, due to the significant quantities of material involved. Excavation uses conventional construction equipment that is readily available.

Cost Effectiveness

This remedy would allow for the restoration of the properties to their current, or all single family residential land uses.

The projected costs for Alternative 3 are as follows:

Phase 1 Capital Cost	$5.0 million	
Phase 1 O&M Cost	$0.6 million	(NAPL recovery and groundwater monitoring)
Phase 1 Contingency	$1.4 million	(A 25% allowance for undefined costs and conditions)
Phase 1 Total	$7.0 million	

Phase 2 Capital Cost $18.4 million (this is a future cost, but has not been discounted for present worth)

Phase 2 O&M Cost	$0.5 million	(groundwater management for 10 years)
Phase 2 Contingency	$4.7 million	(A 25% allowance for undefined costs and conditions)
Phase 2 Total	$23.6 million	

The total estimated cost for Phase 1 and Phase 2 is $30.6 million.

Details of the cost estimate are provided in Appendix A.

Land Use

The present uses of the properties are single family residential and multi-family rental properties. Adjacent properties in the area have similar land uses. This alternative would remedy the properties to their current allow land uses, or for all single family residences, and is commensurate with adjacent uses.

7.2.4 Alternative 4 NAPL Recovery, Phased Removal to Part 375 Residential Levels and Removal of the MW-32S Area in Phase 1, with In-situ Groundwater Treatment and MNA

Description

This alternative is identical to Alternative 3, except that instead of installing a vertical barrier to mitigate recontamination from the MW-32S NAPL area, this area would be excavated in Phase 1. This alternative would therefore provide additional effectiveness and permanence, while having moderate short-term impacts.

Alternative 4 is depicted conceptually in Figures 19 and 20 (Phase 1) and Figure 21 (Phase 2). The rationale for including the MW-32S area in Phase 1 is to avoid recontamination of the adjacent excavation area within the West Street Residential parcels. NAPL has flowed into and accumulated in MW-31S and MW-32S and recontamination of the adjacent areas may not be sufficiently mitigated by the vertical barrier proposed in Alternative 3. The MW-32S area is accessible for excavation, although short-term impacts and constructability will need to be addressed, as discussed below. All other aspects included in the description of Alternative 3, would apply to Alternative 4.

This remedial alternative includes the following sequential actions:

Phase 1

These actions would occur in the short-term, following the preparation of the remedial design:

- NAPL recovery as described in Alternative 2. This would be conducted until the eventual demolition of the apartment complex and subsequent excavation, to take place in Phase 2.
- Single Family Residences: Excavation of the West Street Properties of soil exceeding Part 375 Residential SCOs, to a maximum 15-feet bgs, and source material to a depth of approximately 17 feet, for an estimated total of 9,000 CY.
- Apartment Complex and Alleyway: Excavate the source material in the MW-32S area to eliminate the potential for recontamination of the adjacent West Street excavation areas. Although this is primarily a source material excavation, it would also remove soils from this area and the adjacent Alleyway area exceeding Part 375 Residential SCOs, to a maximum depth of 15 feet bgs. The rationale for this excavation is to complete these proximate excavations during Phase 1, so that these areas would be complete and would be available as equipment staging areas or vehicle access and parking areas during Phase 2. The estimated excavation volume would be a total of 3,000 CY.
- Groundwater monitoring following Phase 1 to document groundwater conditions prior to Phase 2.
- Establish institutional controls and engineering controls as described in Alternative 2.

Phase 2

Phase 2 actions would occur in the future, when the opportunities presents themselves to complete the excavation actions at 111-117 Maple Avenue and the Apartment Complex parcels. This would occur when one or more of the parcels was the subject of future property development that included the demolition of one or more of the buildings. The timing of remedial actions at the Maple Avenue residences would be decided during the design of the remedy. It is recognized that these opportunities may or may not occur simultaneously:

- Apartment Complex: Excavate the source material. Excavate soil exceeding Part 375 Residential SCOs, to a maximum depth of 15-feet bgs. The estimated total volume is 41,800 CY.

- 111-117 Maple Street properties: Excavate any source material present, and the soil exceeding Part 375 Residential SCOs (to a maximum of 15 feet bgs), estimated at 6,000 CY.
- Groundwater management, consisting of in-situ treatment and MNA, would be implemented. In-situ groundwater treatment would reduce the total time for long-term monitoring with MNA to less than the 30 year period assumed for Alternative 2. The total period for groundwater management was assumed to be reduced to 10 years.
- Revise the institutional controls and engineering controls to apply only to the general prohibition on groundwater use for all properties on OU-2. A SMP applicable to a limited portion of Maple Avenue may also be provided, if it is determined to be necessary.

Phase 1

The Phase 1 work for Alternative 4 would proceed as described in Alternative 3. The excavation of the MW-32S area would require protection of the 54-inch drain line. For example, a sheet pile wall could provide shoring for the excavation sidewall and protection of the drain line. The design of the shoring support structures should avoid creating vertical migration pathways through the peat and clay layers which appear to be confining the DNAPL in many areas. The sheet pile wall would also serve the dual objective of preventing recontamination from the adjacent soils south of the drain line. The soils south of the drain line would not be removed until Phase 2. RIR boring logs and observations indicated that the soils south of the drain line in this area did not contain substantial quantities of flowable NAPL.

Phase 2

This phase would proceed as described in Alternative 3, except the volume of excavation would be decreased by the excavation done in the MW-32S area in Phase 1.

Overall Protection of Human Health and the Environment

This remedial alternative is protective of human health and the environment. Substantial levels of protection would be achieved at the conclusion of Phase 1 by the removal of impacted materials from the single family residences along West Street, and the NAPL recovery on the Apartment Complex Property. The overall protection provided by the excavation to Residential levels at the West Street Single Family Residences is substantial because these grassed backyards with resident owners would be some of the most likely areas to eventually be disturbed by groundbreaking activities. The potential for contact with impacted subsurface soils in the Apartment Complex parcel is lower due the macadam parking lot that covers most of the open ground surface. A high level of overall protection would be achieved at the conclusion of Phase 2 by the removal of source materials and soils exceeding Part 375 Residential levels from the Apartment Complex and the 111-117 Maple Avenue parcels.

Conformance with SCGs

SCGs for soils will be achieved by the removal of source materials and soils exceeding Part 375 Residential levels, except for the soils beneath Maple Avenue. Any impacted soil beneath Maple Avenue may be addressed by a SMP. The SMP, if necessary, would provide for removal of impacted soil beneath Maple Avenue during utility maintenance and upgrades.

RAOs for groundwater will be achieved over time by removal of the source materials, and MNA. Groundwater use restrictions will be required until this is accomplished.

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. They would also effectively and permanently decrease the potential for continued migration of dissolved COCs to groundwater.

Groundwater in-situ treatment and MNA has been demonstrated as an effective and permanent approach at similar MGP sites (Neuhauser, et al, 2009).

Reduction of Mobility, Toxicity, or Volume Through Treatment

This remedial alternative will result in phased substantial reduction of mobility, toxicity, and volume of COC. Excavation of source material and impacted materials will reduce the volume of COC at the site. In-situ treatment and MNA of the groundwater will further decrease the concentrations of COC.

Short-term Impacts and Effectiveness

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 NAPL recovery and transportation off site by implementing a community air monitoring plan. Excavation of MGP source material and impacted soil would be performed inside temporarily fenced areas, and managed using odor-control foam and plastic sheeting. Temporary fabric structures may be used during Phase 2 for odor and vapor control. Noise from the operation of the air handling equipment would be mitigated by an enclosure.

Truck traffic from the operations would be a significant impact, and would be necessary for the work. Truck traffic would include mobilization and demobilization of heavy construction equipment, trucking of impacted material from the site, and trucking of backfill material into 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 and O&M activities will wear the appropriate PPE as required in a site-specific health and safety plan.

Environmental Impacts. The potential for environmental impacts for this alternative would be low. Potential releases during the removal of MGP source material will be addressed by the use of spill prevention and air emission control measures.

Time Until Response Objectives are Achieved. The objectives for subsurface soil would be met for the West Street Single Family Residence parcels and the MW-32S area of the Apartment Complex with the completion of Phase 1, which is estimated to take approximately 4 months to complete. The objectives for subsurface soil in the other parcels of OU-2 would not be met until the completion of Phase 2, which is not possible to schedule at this time, but would take a total of approximately 11 months to complete. These timeframes differ from those for Alternative 3 by one month because in Alternative 4 the excavation of the MW-32S area would be done in Phase 1.

This alternative will not have a significant impact on the concentrations of COCs in the groundwater over the short-term. In-situ treatment and MNA will continue until RAOs are met, with monitoring periodically re-evaluated, for a total period assumed to be 10 years. The time until the response objectives area achieved is not possible to predict until the site-specific MNA trend is determined during the MNA monitoring.

Implementability

Technical Feasibility. Removal by excavation is technically feasible using conventional excavation equipment. Excavation, transportation, and disposal of impacted soils are conventional remedial techniques. NAPL recovery, in-situ groundwater treatment and MNA use conventional and technically implementable techniques.

Administrative Feasibility. This alternative is administratively feasible only to the extent that the land use restrictions and SMPs can be established and maintained on each of the OU-2. Access agreements would also need to be obtained for the OU-2 property owners to allow work to be done on their properties. Site access agreements at some properties have not been attainable in the past for the RI work.

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

Cost Effectiveness

This remedy would allow for the restoration of the properties to their current, or all single family residential land uses.

The projected costs for Alternative 4 are as follows:

Phase 1 Capital Cost	$6.9 million	
Phase 1 O&M Cost	$0.7 million	(NAPL recovery and groundwater monitoring)
Phase 1 Contingency	$1.8 million	(A 25% allowance for undefined costs and conditions)

Phase 1 Total $9.4 million

Phase 2 Capital Cost	$17.3 million	(this is a future cost, but has not been discounted for present worth)
Phase 2 O&M Cost	$0.5 million	(groundwater management for 10 years)
Phase 2 Contingency	$4.4 million	(A 25% allowance for undefined costs and conditions)
Phase 2 Total	$22.2 million	

The total estimated cost for Phase 1 and Phase 2 is $31.6 million.

Details of the cost estimate are provided in Appendix A.

Land Use

The present uses of the properties are single family residential and multi-family rental properties. Adjacent properties in the area have similar land uses. This alternative would remedy the properties to their current allow land uses, or for all single family residences, and is consistent with adjacent uses.

7.2.5 Alternative 5 Purchase and Demolition of Buildings followed by Removal of Soil Exceeding Unrestricted Levels

Description

This alternative would require the buildings on the Apartment Complex and the building at 111-117 Maple Avenue to first be purchased and demolished, followed by excavation of all of OU-2 to Part 375 Unrestricted levels. This alternative would therefore provide maximum protection, but is not currently implementable and would have very severe short-term impacts to the community.

This remedial alternative includes the following sequential actions:

- Purchase and Demolition of buildings.
- Apartment Complex, Alleyway, 111-117 Maple Avenue and West Street Single Family Residences: Excavation of source material, and soil exceeding Part 375 Unrestricted SCOs. for an estimated total of 82,400 CY.
- Impacted Section of Maple Avenue: Excavate the source material, and soils exceeding Part 375 Unrestricted SCOs is 7,200 CY.

Alternative 5 is presented conceptually in Figure 22. Under this alternative excavation of MGP source material and material exceeding Part 375 Unrestricted SCOs will take place on the Single Family Residence parcels on Maple Avenue and West Street, the Apartment complex property, and the impacted section of Maple Avenue. Because of the completeness of the removal, no NAPL recovery, in-situ treatment and MNA, or institutional controls and engineering controls would be applicable.

The following considerations would apply to these excavation activities:

- During the pre-design investigation phase, the excavation areas would first be delineated and pre-characterized for disposal in accordance with the requirements of the proposed receiving facilities.
- Odor, vapor, and dust control would be performed primarily be accomplished by conducting all excavation of NAPL-containing soil within a temporary fabric structure as further described in Section 5.1.1- Excavation Technologies. The temporary fabric structure would be designed to be moved progressively across the site as the segmented excavation was completed.
- The structural integrity of the existing single family residences along West Street and existing underground utilities would be protected. These underground utilities include four 36-inch stormwater drainage pipes and one 54-inch stormwater/culvert. Overhead utilities would require relocation in order for the fabric structures to be erected.
- The water table is typically 2 to 7 feet below grade. Localized excavation pit dewatering would be performed in each of the areas. Dewatering is further discussed in Section 5.1.1.
- The excavated materials will be loaded into sealed and covered trucks for transport to permitted off-site disposal facilities.

The excavated areas would be backfilled with clean soil. A total of approximately 89,600 CY of impacted soil and debris would be excavated and transported off site under this alternative. An equivalent quantity of clean soil would be imported as excavation backfill. Paved areas would be restored during site restoration to provide an equivalent value of surface to the property owner.

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 of this alternative.

Conformance with SCGs

SCGs for soils will be achieved by the removal of source materials and soils exceeding Part 375 Residential levels. It is anticipated that this complete removal action would also result in achieving groundwater RAOs within a short time period.

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

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 NAPL recovery and transportation off site. A temporary fabric structure would be used for the excavations.

Truck traffic from the operations would be a significant impact, and would be necessary for the work. Truck traffic would include mobilization and demobilization of heavy construction equipment, trucking of impacted material from the site, and trucking of backfill material into 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 environmental impacts for this alternative would be low. Potential releases during the removal of MGP source material will be addressed by the use of spill prevention and air emission control measures.

Time Until Response Objectives are Achieved. The soil cleanup objectives would be met upon completion of the removal, which is estimated to take a total of approximately 23 months to complete. Groundwater objectives would be met after a final attenuation period, estimated to have a duration of three 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 not only by lack of capacity of low temperature treatment facilities, but also by lack of readily available clean fill.

Administrative Feasibility. This alternative is not administratively feasible because it requires more than 250 residents in the Apartment Complex and Maple Avenue Single Family residences to be vacated, and the buildings to be purchased and demolished. There are currently no known plans for these actions.

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

Cost Effectiveness

This remedy would not be cost effective, as the high costs would not have a commensurately high value in additional environmental protection or increase in options for land use.

The projected costs for this alternative are as follows:

Capital Cost	$33.5 million	
Confirmatory Monitoring Cost	$0.1 million	(groundwater monitoring for 3 years)
Contingency	$8.4 million	(A 25% allowance for undefined costs and conditions)
Total	$42.0 million	

Details of the cost estimate are provided in Appendix A.

Land Use

The present uses of the properties are single family residential and multi-family rental properties. Adjacent properties in the area have similar land uses. This alternative would remediate the properties to their currently allowed land uses, or for all single family residences, and is consistent with adjacent uses. Under this Alternative, land use would be unrestricted, would also allow for agricultural uses. However, agricultural uses would not be applicable for this location within the Village of Haverstraw.

7.3 Comparison of Alternatives

A comparative analysis of the alternatives for OU-2 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 7-1. The following discussion provides a comparison of the four substantive alternatives, without the No Action alternative, which is not considered a viable alternative.

Overall Protection of Human Health and the Environment

All four of the alternatives would result in acceptable overall protection of human health and the environment. The two soil removal alternatives, Alternatives 3 and 4, would meet the RAOs for soil and achieve overall protection of human health and the environment.

The three removal Alternatives, 3, 4, and 5 would meet the RAOs for groundwater over time. They would achieve overall protection of human health and the environment by the soil and NAPL removal and the implementation of groundwater in-situ treatment and MNA, and the establishment of the land use restriction agreements and SMPs.

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

1. Alternative 5 would be the most protective, because it would involve removal of impacted materials to Part 375 Unrestricted Levels.
2. Alternative 4 would be the second most protective, as it would involve removal of impacted materials to Part 375 Residential levels and removal of more source material earlier in the phased process than Alternative 3.
3. Alternative 3 would be the next most protective, because it would involve removal of impacted materials to Part 375 Residential levels and removal of source material which are not included in Alternative 2.
4. Alternative 2 would be the least protective, as it would not include soil removal.

Conformance with SCGs

Soils: All alternatives except Alternative 2 would achieve phased conformance with soil SCGs. Alternatives 3 and 4 would comply upon completion of Phase 2. Alternative 5 would comply upon its completion.

Groundwater: Alternative 5 would remediate the site to Part 375 Unrestricted levels for soil and would meet groundwater RAOs after a final attenuation period, estimated to have a duration of three years. Alternatives 3 and 4 would rely on NAPL removal, source removal, removal of impacted soils, in-situ groundwater treatment and MNA to eventually achieve groundwater objectives. Alternative 2 would rely on NAPL removal and MNA to achieve groundwater objectives. Groundwater use restrictions would be in place during the period of groundwater treatment and attenuation for Alternatives 2, 3, and 4.

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

1. Alternative 5 would achieve conformance with SCGs for soil upon completion of soil removal, and could achieve groundwater RAOs within an estimated 3 years after completion of soil removal.
2. Alternatives 3 and 4 would achieve conformance with SCGs soil, but groundwater use would be restricted until in-situ groundwater treatment and MNA were complete.
3. Alternative 2 would not achieve conformance with soil SCGs and would not be expected to achieve conformance with groundwater RAOs.

Long-term Effectiveness and Permanence

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

Reduction of Toxicity, Mobility, or Volume

All of the alternatives would reduce the volume and mobility of MGP-impacts at the site. The ranking of the alternatives with respect to this criterion would be proportional to the amount of COCs removed and identical to the ranking indicated for Overall Protection of Human Health and Environment, above. The excavation of soil to Residential SCOs would result in the removal of most of the mass of the COCs at OU-2. The large additional volume of soil excavated to achieve Unrestricted SCOs would result in the removal of only a small additional mass of COCs.

Short-term Impacts and Effectiveness

All of the alternatives would have some degree of short-term impacts, as they all involve removal of impacted soils and NAPL in active operations on site. The principal short-term impact to the community would be truck traffic. Additional excavation and backfill volume would result in additional truck traffic over a longer time period to complete the work. Their short-term effectiveness, as indicated by the time until response objectives are achieved, differs from alternative to alternative with respect to the objectives for subsurface soil and NAPL, but is largely equivalent with respect to surface soil (which all would achieve) and groundwater (which all would achieve only over a period of an estimated 10 years, except for Alternative 5, which would be more rapidly effective).

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

1. Alternative 4 would involve primarily excavation, with an earlier effectiveness at achieving RAOs than Alternative 3, and less short-term impacts than Alternative 5.
2. Alternative 3 would involve primarily excavation, with less short-term impacts than either Alternatives 4 or 5, but with less timely effectiveness than both Alternatives 4 and 5.
3. Alternative 2 would involve less short-term impacts than the other alternatives, would take more time to achieve groundwater RAOs and would not achieve subsurface soil RAOs.
4. Alternative 5 would involve the greatest excavation quantities and depths, resulting in the greatest short-term impacts, but would most rapidly achieve RAOs.

Implementability

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

1. Alternative 2 is the most implementable, because it is readily implementable technically and administratively, since the agreement to conduct NAPL recovery on the Apartment Complex property may be more readily obtained than agreements from many property owners to conduct excavation, as is required for the other alternatives.
2. Alternatives 3 and 4 are equally implementable, because they encompass the same level of technical difficulty and the same level of constructability.

3. Alternative 5 is virtually not implementable. This option would involve the relocation of the residents of the Apartment building for purchase and demolition to take place. It would also involve the closure of Maple Avenue to excavate impacted soils from beneath the road.

Cost Effectiveness

Alternate 4 would remediate the site to allow residential land uses, as well as allowing future uses consistent with the Residential use provisions of Part 375. It would provide more short-term effectiveness than Alternative 3, while incurring only slightly higher costs than Alternative 3. The primary difference between Alternative 3 and Alternative 4 is that the MW-32S area would be excavated in Phase 1 in Alternative 4. The estimated costs for Alternative 4 are slightly higher than Alternative 3 because additional costs for a fabric structure and shoring would be incurred if the additional excavation were done in conjunction with the smaller backyard excavations rather than the larger excavations in Phase 2. Alternative 5 represents the greatest short-term effectiveness, but offers minimal gains in land use with a large increase in capital cost.

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

1. Alternative 4: Phase 1 $9.4 million. Phase 2 $22.2 million. Total $31.6 million.
2. Alternative 3: Phase 1 $7.0 million. Phase 2 $23.6 million. Total $30.6 million.
3. Alternative 2: Total $3.0 million.
4. Alternative 5: Total $42.0 million.

FS cost estimates are within the range of +50% to -30%.

7.4 Recommended Remedy for OU-2: Phased Soil Removal to Part 375 Residential Levels, with Removal of Soil in the MW-32S Area in Phase 1, and In-situ Groundwater Treatment / MNA

Upon consideration of the alternatives and their respective attributes and limitations, Alternative 4 emerged as the recommended remedy for OU-2. This alternative would involve a phased removal of impacted soil, NAPL recovery, and finally, in-situ groundwater treatment and MNA. It would involve inconveniences, but would not greatly disrupt the apartment complex property and residents, or the property owners adjacent to OU-2. This alternative would address most of the single family residences and a large portion of the source material in the near term, and provide conformance with RAOs in the long term. The remedy is further described in Section 7.2.4, above.

Approximately 12,000 CY of soil would be removed in the first phase of the remedy, and a total of approximately 47,800 CY of soil would be removed throughout the second phase of the remedy. The estimated cost of Phase 1 is $9.4 million, and the estimated total cost of Phase 2 is $22.2 million.

8. Conclusions

The recommended remedy for OU-1 and OU-2 is for removal of soil to Part 375 Residential cleanup levels, followed by in-situ groundwater treatment and MNA to address groundwater RAOs. Taken together, the remedy for OU-1 and OU-2 will address the terrestrial portion of the site. OU-3, a small area of impacted sediment in the Hudson River embayment near the site, will be addressed in a separate FS. The recommended remedy for OU-1 and OU-2 represents a consistent approach appropriate for residential and recreational land use and fitting with the local community. The OU-1 and OU-2 excavation work will be designed and implemented in concert 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 synergy and least short-term impacts, to the ultimate benefit of property owners and the surrounding Haverstraw community.

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Tables

Table 5-1
Summary of Remedial Technology Screening
Clove and Maple Avenues Former MGP

General Response Action	Technology	Effectiveness	Implementability	Relative Cost	Applicability to OU-1 and OU-2
Institutional and Engineering Site Controls	**Fencing and Signage for Access Control** **Site Management Plans (SMPs).** SMPs are administered through deed restrictions or property agreements. Administrative controls include restrictions on the use of groundwater, contingency plans for excavating impacted soils, and periodic engineering inspections.	Can be 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	All are applicable to OU-1 and OU-2. Retained for alternative development.
Containment	**Surface Cover Soil and Caps**	Effective for controlling exposure from surface soils. Includes low permeability barriers to minimize infiltration of precipitation to source areas, reducing migration of dissolved contaminants.	Technology proven and readily implemented.	Low	Applicable to OU-1 and OU-2. Retained for alternative development
	Subsurface Vertical Barriers: **HDPE Sheeting** **Steel Sheet Piling** **Bentonite/Cement Slurry 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.	Medium relative to other technologies.	Applicable to OU-1 and OU-2. Retained for alternative development
	In-Situ Stabilization/Solidification: **Auger Mixing** **Excavator Bucket Mixing** **Pressure Grouting** **(These technologies provide aspects of treatment as well as containment).** Physically binds or encloses a COC mass 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.	Effective at meeting groundwater and soil related RAOs. The effectiveness is dependent on the ability to get the stabilizing agent in contact with the NAPL or COCs. Effectiveness may therefore be limited in clayey soils such as those at Haverstraw.	Technology proven and implementable under some conditions. Not readily implementable in clay soils in OU-1 and OU-2, and densely populated sites such as OU-2.	Relatively high development and mobilization costs. Costs of ISS for saturated soils can be lower than excavation costs.	Not Retained
On-Site and In-Situ Treatment	**On-Site (Post Excavation) Soil Treatment.** **Solidification/stabilization** **Chemical oxidation** **Low Temperature Thermal and Biotreatment**	On-site treatment of soils in controlled treatment units can effectively treat excavated soils to enable them to meet SCOs and be re-used on site. Site-specific treatability studies are required to establish actual effectiveness.	On-site treatment requires an available area and time to implement. It also requires an appropriate location and distance from residential areas. Requires time to develop site-specific process parameters. Implementability will therefore depend on the site-specific circumstances at the time of excavation.	Cost effective for large volumes of soil where economies of scale can be realized.	Not implementable at OU-1 or OU-2. Not Retained.
	In-Situ Chemical Oxidation	These technologies are being implemented on a demonstration basis at MGP sites. Effectiveness is uncertain and variable under conditions with DNAPL impacts and highly organic peat soils such as those at the Haverstraw site.	Technology is in the demonstration phase. Moderate implementability.	Variable	Not Retained
	Enhanced Groundwater Bioremediation: **Aerobic and Anaerobic biodegradation of PAHs and BTEX** **Anaerobic biodegradation of BTEX** **Oxygen Injection and Addition of Oxygen Releasing Compounds (ORC).** Active management processes in which natural groundwater conditions are modified in order to facilitate bioremediation of the COCs to innocuous end-products.	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.	Technology is proven and is being implemented at MGP sites in New York State.	Low	Applicable to OU-1 and OU-2 Retained for alternative development
	Monitored Natural Attenuation 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 ground water. These processes include biodegradation, dispersion, dilution, sorption, volatilization, and chemical or biological stabilization, transformation, or destruction of contaminants.	Effective at meeting soil and groundwater related RAOs when used in conjunction with source control. Monitoring is required to demonstrate favorable groundwater conditions and the effectiveness of the remedy.	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. Through computer modeling of groundwater flow and contaminant dispersion and degradation, a determination is made as to the efficacy of the approach.	Low	Applicable to OU-1 and OU-2. Retained for alternative development

General Response Action	Technology	Effectiveness	Implementability	Relative Cost	Applicability to OU-1 and OU-2
	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. Less effective for SVOCs and for soils.	Variable soil permeability and site constraints may restrict implementability of remedy.	Moderate	Not Retained
Removal and Off-Site Treatment/ Disposal	**Excavation/Removal of Soil.** 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.	Effective at meeting soil RAOs and addressing groundwater RAOs (see also Dewatering, below).	Technology proven and readily implemented for soils not covered by buildings or streets. 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	Applicable to OU-1 and OU-2. Retained for alternative development
	Dewatering of Excavation Areas. Construction dewatering, which is necessary for soil excavation, will also be effective in removing a substantial quantity of impacted groundwater. On-site pretreatment followed by off-site final treatment is typically conducted.	Effective as an active groundwater management technology to decrease groundwater impacts.	Technology proven and readily implemented.	High	Applicable to OU-1 and OU-2. Retained for alternative development
	NAPL Recovery. This technology involves the extraction of free-phase NAPL from a well or trench. The NAPL accumulates in the well, and is then pumped into a designated tank or container for offsite disposal or recycling at an appropriate facility.	Does not meet groundwater and soil related RAOs. However, it is effective at removing free-phase NAPL from the subsurface; and therefore, reducing the COC flux into the groundwater.	Technology proven and readily implemented. Pilot tests are typically be required to determine recovery rates, NAPL mobility, well or trench design, pumping and control equipment.	Moderate	Applicable to OU-1 and OU-2. Retained for alternative development

Table 6-1
Comparative Analysis of Alternatives
Haverstraw - Clove and Maple OU1

	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
	No Action	Institutional and Engineering Controls (IC/ECs)	- Excavate Source Material and Material exceeding Part 375 Commercial levels - IC/ECs - In Situ Groundwater Treatment and Groundwater MNA	- Excavate Source Material and Material exceeding Part 375 Residential levels - IC/ECs - In Situ Groundwater Treatment and Groundwater MNA	- Excavate Source Material and Material exceeding Part 375 Unrestricted levels
Detailed Analysis Criterion					
1. Overall Protection of Human Health and the Environment	Not Achieved	Moderate protection - Physical barriers between COC and public, institutional controls.	High protection	High protection	Highest protection
2. Conformance with SCG's	Does not conform	Does not conform	Achieved for soils Groundwater use restrictions required until groundwater RAOs are met	Achieved for soils Groundwater use restrictions required until groundwater RAOs are met	Achieved for soils and groundwater. No Groundwater use restrictions
3. Long Term Effectiveness and Performance	Not Achieved	No Long Term Effectiveness	Effective upon completion for soils. Effective over time for groundwater	Effective upon completion for soils. Effective over time for groundwater	Effective upon completion for soils and groundwater
4. Reduction of Toxicity, Mobility, or Volume	Not Achieved	No reduction in Toxicity, Mobility or Volume	Excavation of 11,800 CY Subsurface Soil Excavation of 870 CY Surface Soil Moderate reduction in volume and mobility. Reductions in groundwater over time.	Excavation of 15,000 CY Subsurface Soil Excavation of 1,300 CY Surface Soil High reduction in volume and mobility. Reductions in groundwater over time.	Excavation of 21,000 CY Subsurface Soil Excavation of 1,300 CY Surface Soil Highest reduction in volume, mobility and toxicity
5. Short Term Impacts and Effectiveness	No Short Term Impacts	No short term Impacts	Moderate short term impacts.	Higher short term impacts.	Highest short term impacts
6. Implementability	Implementable	Implementable	Implementable	Implementable	Less implementable due to depth of excavations and heavy dewatering activities.
7. Cost Effectiveness	No Cost	Minimal cost / Minimal reduction of long-term liability. No gain of land use value. $530,000	Moderate cost resulting in minimal gains in land use value. $6.7 million	Moderate cost resulting in gaining of residential land uses. $8.0 million	High cost resulting in unlimited land use. $11.3 million
8. Land Use	Future Use - No use	Future Use - Fenced controlled vacant lot	Future Use - Commercial or passive recreational	Future Use - Single Family or Multi-Family Residential, or active recreational	Future Use - Unrestricted Use. However, agricultural uses are not applicable to this location.

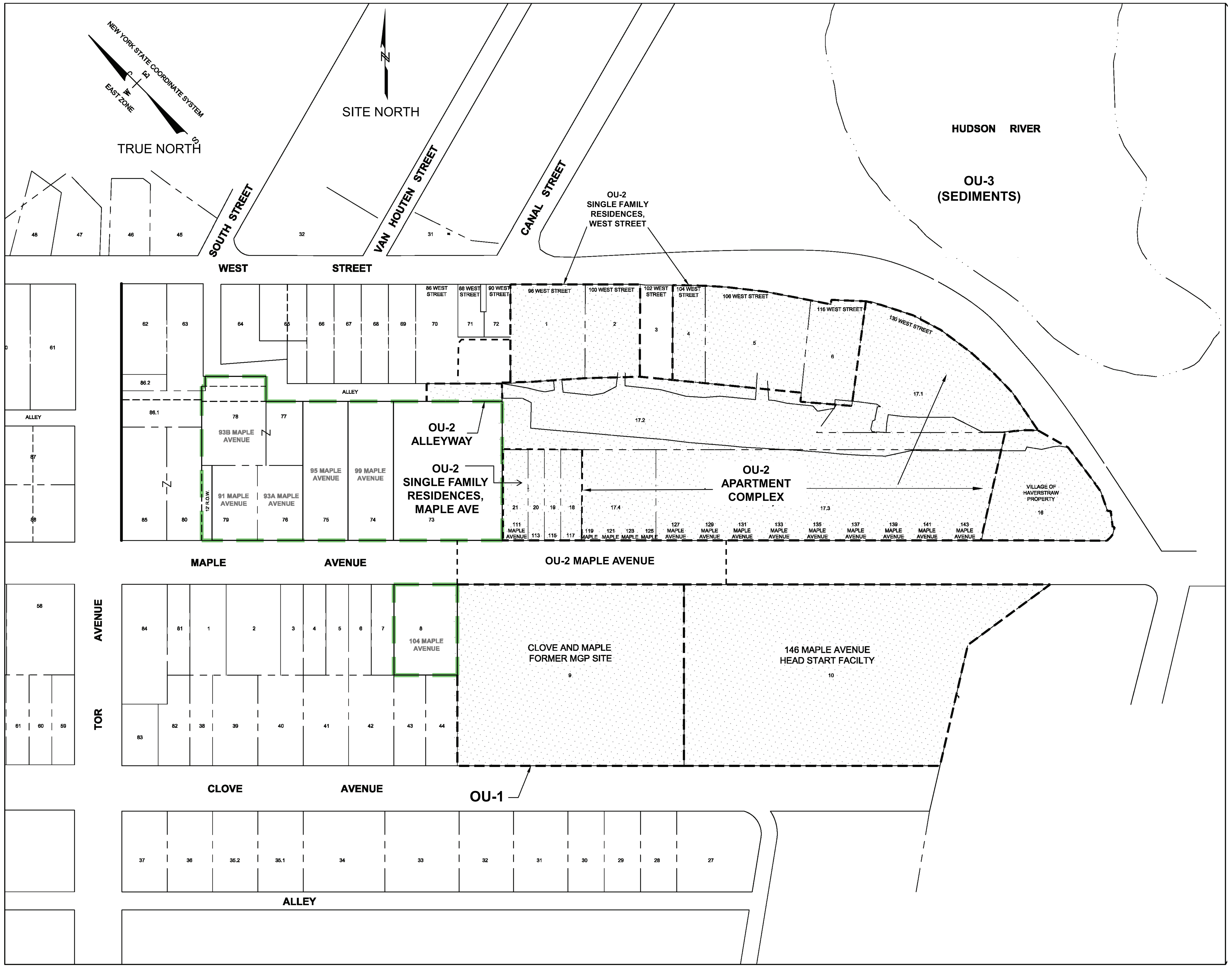
Table 7-1
Comparative Analysis of Alternatives
Haverstraw - Clove and Maple OU2

	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
	No Action	- NAPL Recovery - Low permeability cover - Institutional and Engineering Controls (IC/ECs) - Groundwater MNA - In Situ Groundwater Treatment	**Phase 1** - NAPL Recovery - Excavate the West Street single family residences to Part 375 Residential Levels - IC/ECs	**Phase 1** - NAPL Recovery - Apartment Complex-Excavate MW32S Area and Alleyway - Excavate the West Street single family residences to Part 375 Residential Levels - IC/ECs	- Purchase and Demolition of buildings - Excavate Material exceeding Part 375 Unrestricted levels in: - Apartment Complex - Single Family Residences on West St and Maple Ave - Impacted portion of Maple Avenue - Groundwater MNA
			Phase 2 - After eventual demolition of the apartment complex and 111-117 Maple Ave: - Excavate Maple Ave residences to Part 375 Residential Levels - Excavate Apartment complex to Part 375 Residential level -In Situ GW Treatment and Revised IC/ECs	**Phase 2** - After eventual demolition of the apartment complex and 111-117 Maple Ave: - Excavate Maple Ave residences to Part 375 Residential Levels - Excavate Apartment complex to Part 375 Residential level - In Situ GW Treatment and Revised IC/ECs	
Detailed Analysis Criterion					
1. Overall Protection of Human Health and the Environment *	No additional protection achieved	Low additional protection achieved - no reduction in COC's	Moderate protection after Phase I High protection after Phase II	Moderate protection after Phase I High protection after Phase II	High protection
2. Conformance with SCG's	Does not conform	Does not conform	Achieved for soils Groundwater use restrictions required	Achieved for soils Groundwater use restrictions required	Achieved for soils and groundwater. No Groundwater use restrictions
3. Long Term Effectiveness and Performance	Not Achieved	No Long Term Effectiveness	Effective upon phased completion for soils. Effective over time for groundwater	Effective upon phased completion for soils. Effective over time for groundwater	Effective upon completion for soils and groundwater
4. Reduction of Toxicity, Mobility, or Volume	Not Achieved	Minimal reduction in Toxicity, Mobility and Volume	Phase 1 Excavation of 9,000 CY Phase 2 Excavation of 50,800 CY Phased, substantial reduction in volume and mobility. Reductions in groundwater over time	Phase 1 Excavation of 12,000 CY Phase 2 Excavation of 47,800 CY Phased, substantial reduction in volume and mobility. Reductions in groundwater over time	Excavation of 89,600 CY Highest reduction in volume, mobility and toxicity
5. Short Term Impacts and Effectiveness	No Short Term Impacts	No short term Impacts	Moderate short term impacts. Most can be effectively mitigated	Moderate to High short term impacts. Most can be effectively mitigated	Highest short term impacts, Most can be effectively mitigated
6. Implementability	Implementable	Implementable	Implementable	Implementable	Not implementable due to the presence of buildings, active traffic, and utilities on Maple Avenue
7. Cost Effectiveness	No Cost	Minimal cost / Minimal protection of human health $3.0 million	Moderate Phase 1 cost with restoration to current land uses. Phase 1 $7.0 million Phase 2 $23.6 million	Moderate Phase 1 cost with restoration to current land uses. Phase 1 $9.4 million Phase 2 $22.2 million	High immediate cost no additional land use provided $42.0 million
8. Land Use	Not Applicable - SCG's not achieved	Not Applicable - SCG's not achieved	Future Use - Residential (Single Family Properties) Restricted Residential (Apartment Complex)	Future Use - Residential (Single Family Properties) Restricted Residential (Apartment Complex)	Future Use - Unrestricted Use. However, agricultural uses are not applicable to this location.

*** No current exposure exists at the site**

GEI Consultants

Figures



LEGEND

(line)	PROPERTY BOUNDARY
8	ASSESSOR'S LOT NUMBER
#104	STREET ADDRESS
(green dashed line)	INTERIM REMEDIAL MEASURES COMPLETED BETWEEN 2003 AND 2005 (93B MAPLE AVENUE FORMER MGP SITE)
(dashed box)	2008 REMEDIAL INVESTIGATION AREAS

NOT FOR BID OR CONSTRUCTION

User: jseybert
1/29/2009 11:42:44 AM
DWG: \\Sdfile01\M\p\070748S\F-Plate-1-Site Location Plan 1-28-09.dwg Plate 1 -Site Location

REVISION NO.	DATE	REVISION

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60 0 60 120
GRAPHIC SCALE IN FEET
1"=60'

CLOVE AND MAPLE FORMER MGP SITE
HAVERSTRAW, NEW YORK

ORANGE AND ROCKLAND UTILITIES, INC.

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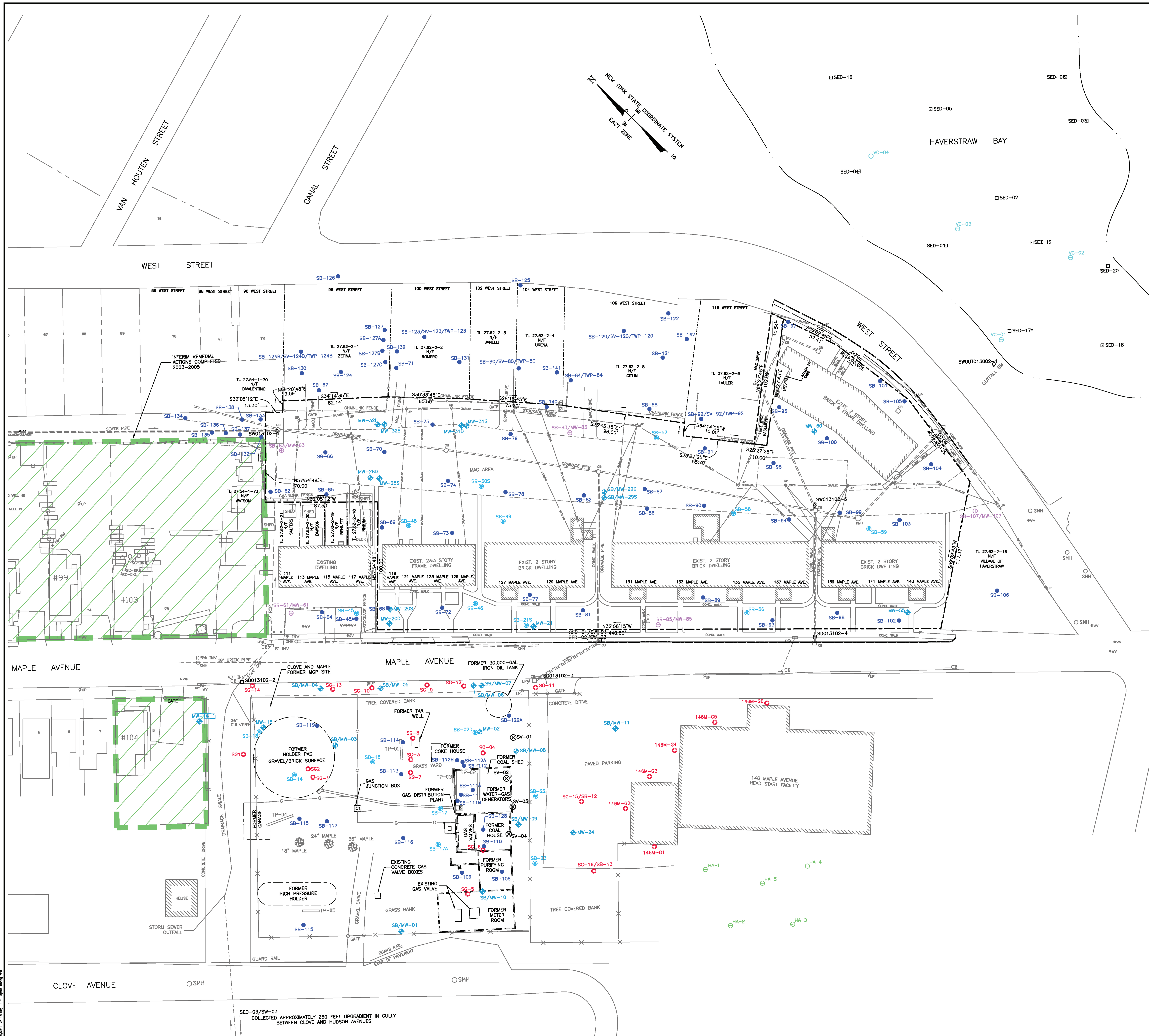
PROPERTY INDEX MAP

January 2010 Plate 1



NOTE:

PROPERTY INFORMATION SHOWN AND METES AND BOUNDS DERIVED FROM ATZL, SCATASSA & ZIGLER P.C. SURVEYORS–PLANNERS.
234 NORTH MAIN STREET, NEW CITY NEW YORK 10956.
156 ORANGE AVENUE, WALDEN NEW YORK 12586

DRAWING TITLED: BOUNDARY SURVEY PROJECT NO. 3147, DATED MAY 22, 2004.

TAX LOT INFORMATION:

VILLAGE OF HAVERSTRAW TAX MAP
TL 27.62–2–17.1, 17.2, 17.3, AND 17.4

NOTE:

THE INFORMATION PRESENTED ON THIS MAP FIGURE IS ACCURATE TO THE BEST OF OUR BELIEF; NO CLAIM IS MADE TO THE LOCATION OF DRY WELLS, SEPTIC SYSTEMS, GASOLINE TANKS, OR HEATING OIL TANKS. ALL UTILITIES WILL BE IDENTIFIED IN THE FIELD USING THE ONE CALL SYSTEM AND A GEOPHYSICAL SURVEY BY A PRIVATE GEOPHYSICS CONTRACTOR.

LEGEND

VC–03	VIBRACORE SAMPLE LOCATION		PROPERTY BOUNDARY, SURVEYED
SG–1	PRE–2008 SOIL GAS SAMPLE LOCATION		PROPERTY BOUNDARY APPROXIMATE
MW–20	PRE–2008 MONITORING WELL LOCATION		HISTORICAL STRUCTURE
SB–17	PRE–2008 SOIL BORING LOCATION		RIVER SHORELINE
HA–1	1998–2001 CLOVE & MAPLE AVE RI HAND AUGER BORING LOCATION		WOOD FENCE
SB–83/MW–83	2008 SRI MONITORING WELL LOCATION		CHAIN–LINK FENCE
TP–2	1998–2001 CLOVE & MAPLE AVE RI TEST PIT LOCATION	G	GAS MAINS
SW013102–6	1998–2001 CLOVE & MAPLE AVE RI STORM SEWER WATER SAMPLE LOCATION	OH/ELEC	OVERHEAD WIRE
SD013102–2	1998-2001 CLOVE & MAPLE AVE RI STORM SEWER SEDIMENT SAMPLE LOCATION	UP	UTILITY POLE
SB–106	2008 SRI SOIL BORING LOCATION; WHERE INDICATED – "SV" REPRESENTS CO–LOCATED SOIL VAPOR POINT; "TWP" REPRESENTS CO–LOCATED TEMPORARY WELL POINT	WG	WATER GATE VALVE
SV–01	2008 SOIL GAS SAMPLE ONLY	HYD	FIRE HYDRANT
	STORM SEWER	SMH	SEWER MANHOLE
	EXISTING STRUCTURE	CB	CATCH BASIN
			INTERIM REMEDIAL ACTIONS COMPLETED 2003–2005 (93B MAPLE AVENUE FORMER MGP SITE)

GEODETIC REFERENCES:
– NEW YORK STATE PLANE COORDINATE SYSTEM, EAST ZONE.
– DATUM: NGVD 1927.

NOT FOR BID OR CONSTRUCTION

REVISION NO.	DATE	REVISION

30 0 30 60
GRAPHIC SCALE IN FEET
1" = 30'

CLOVE AND MAPLE FORMER MGP SITE
HAVERSTRAW, NEW YORK

ORANGE AND ROCKLAND UTILITIES, INC.

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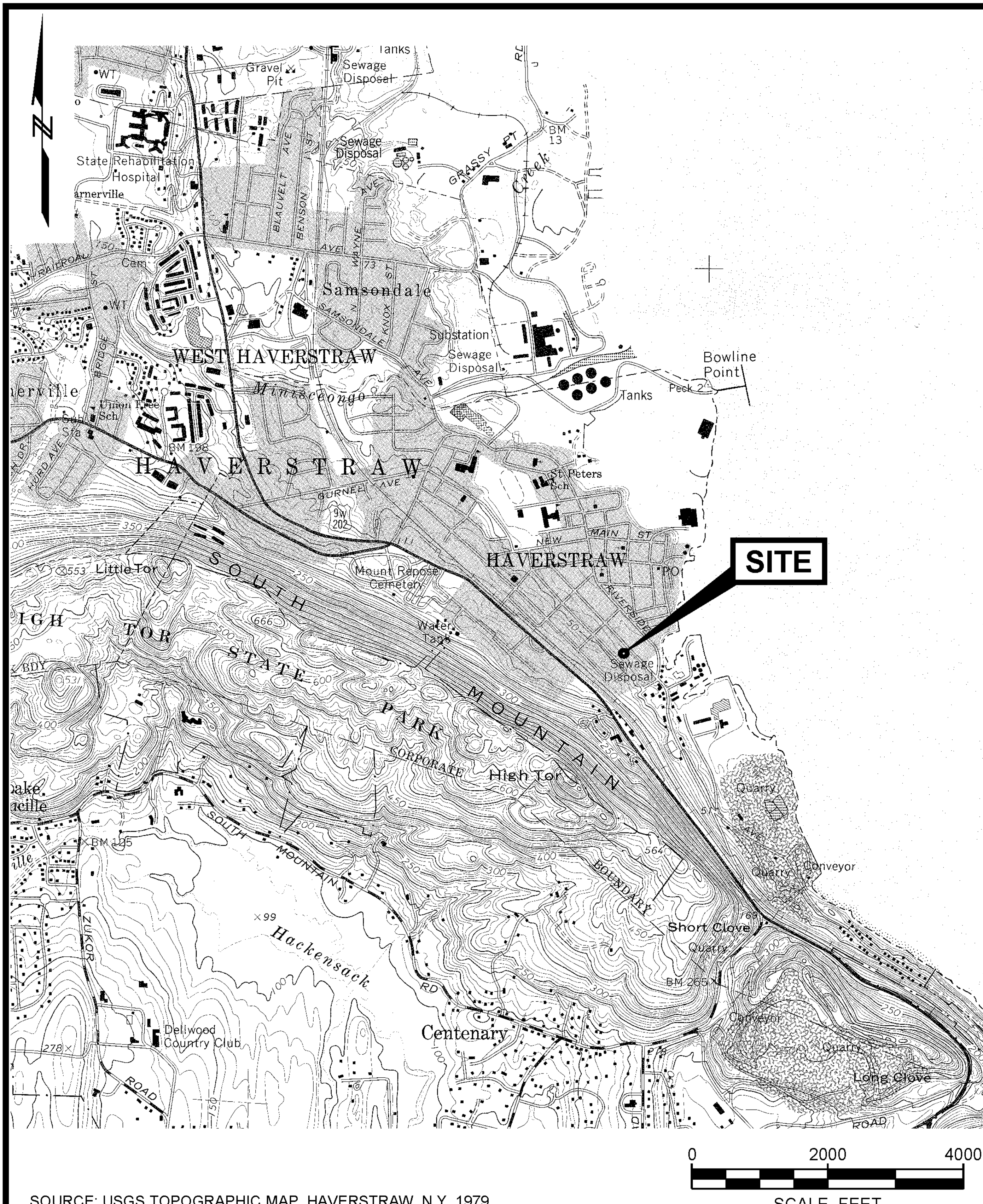
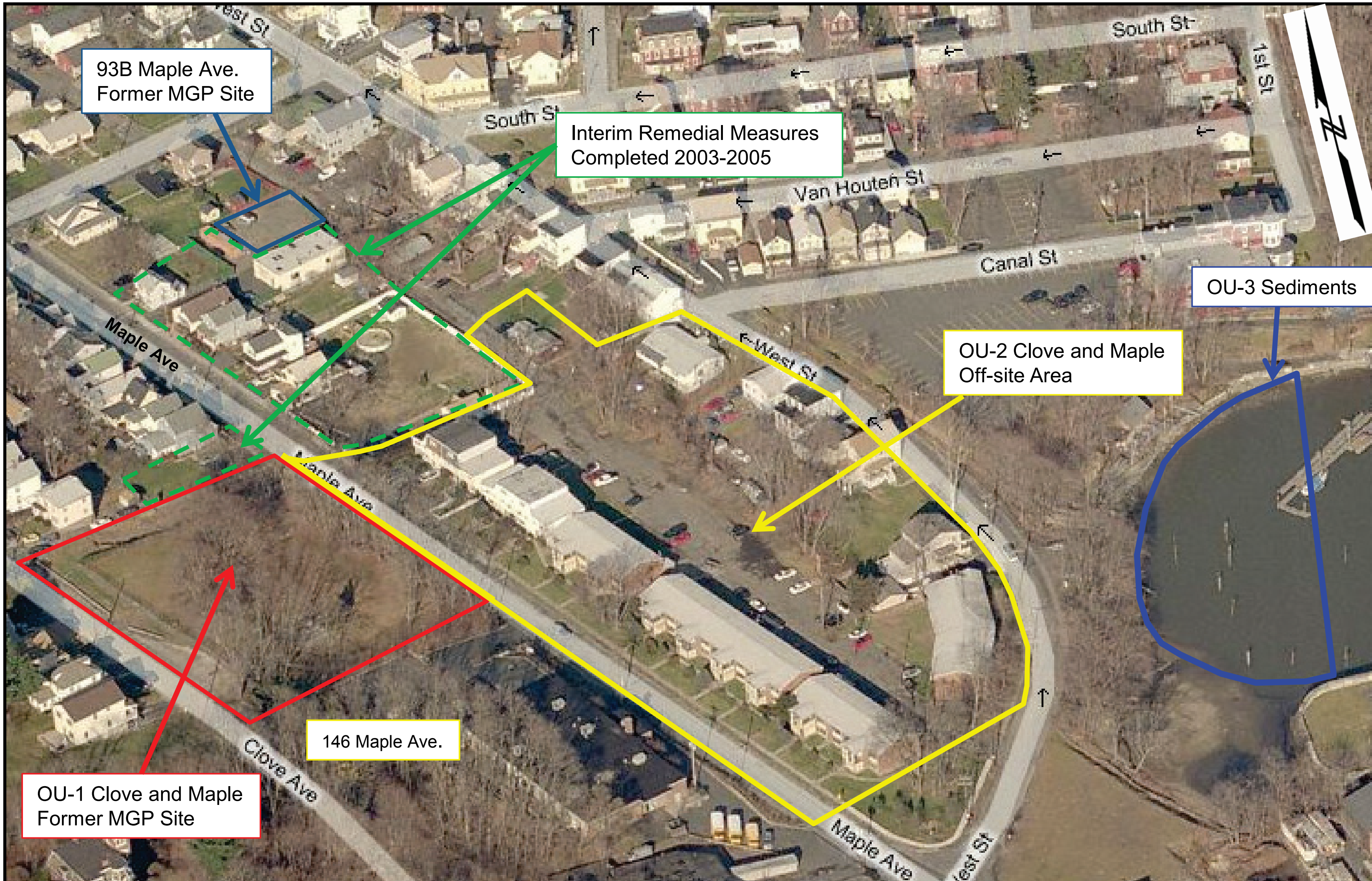
SITE LAYOUT
RI SAMPLING
LOCATIONS

November 2009 Plate 2

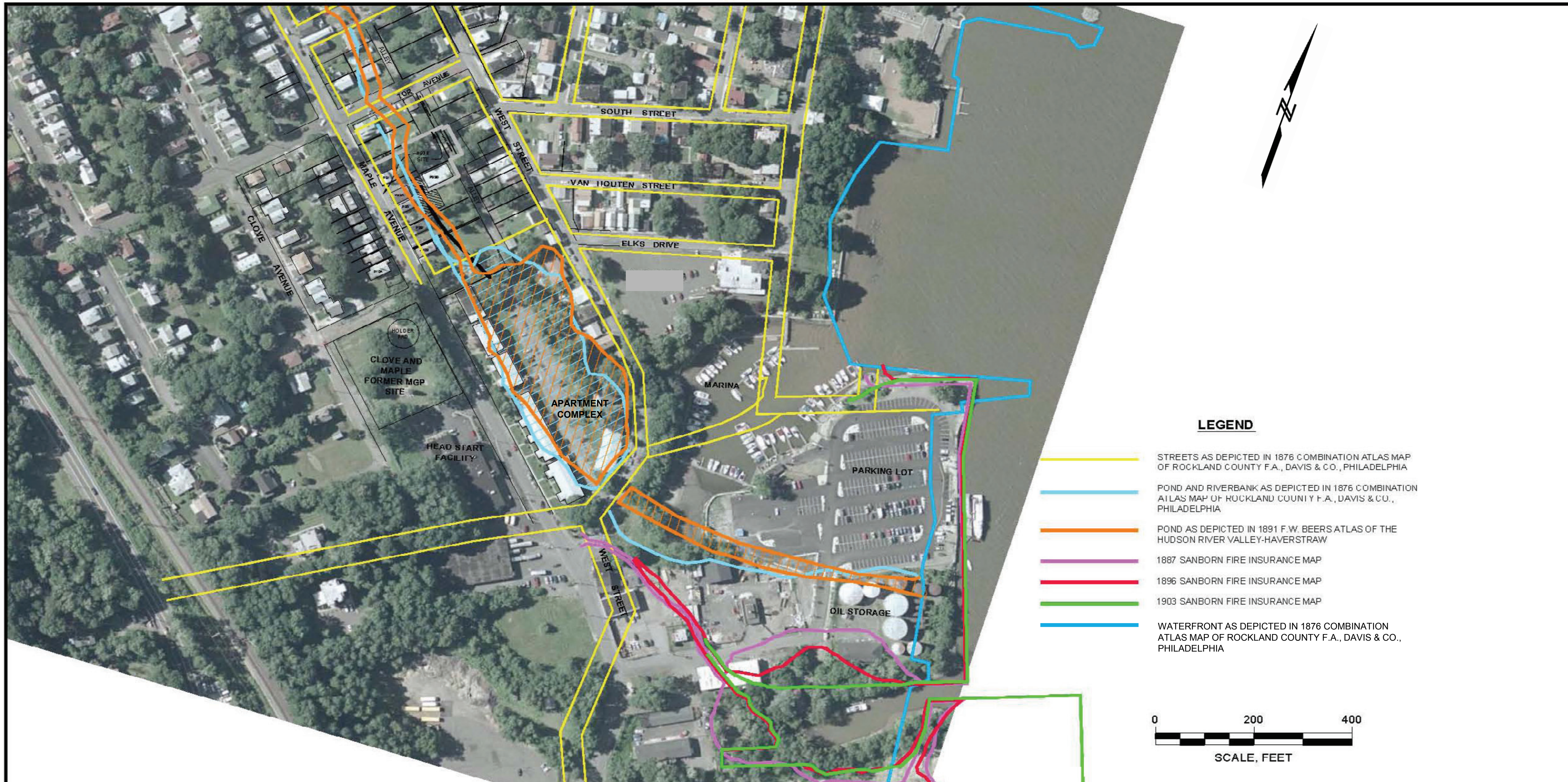


SOURCE: USGS TOPOGRAPHIC MAP, HAVERSTRAW, N.Y. 1979

	CLOVE AND MAPLE FORMER MGP SITE HAVERSTRAW, NEW YORK	GEI Consultants	**Site Location Map – Feasibility Study**
	ORANGE AND ROCKLAND UTILITIES, INC.	**Project 091950-1**	**October 2009** **Figure 1**



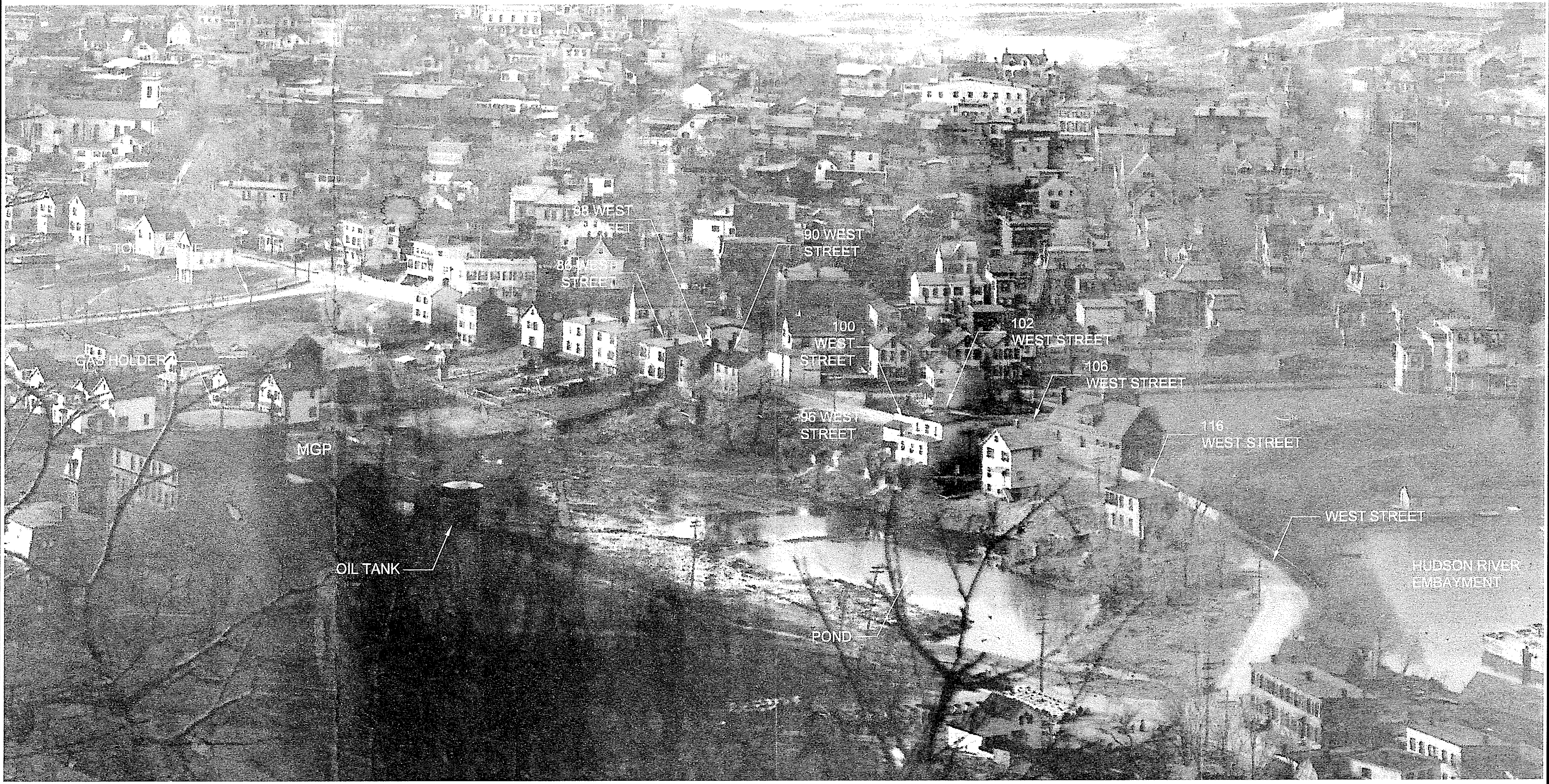
CLOVE AND MAPLE FORMER MGP SITE HAVERSTRAW, NEW YORK	GEI Consultants	**OU-1 AND OU-2 LOCATION AERIAL PHOTOGRAPH**
ORANGE AND ROCKLAND UTILITIES, INC.	**Project 091950-1**	**January 2010** **Figure 2**



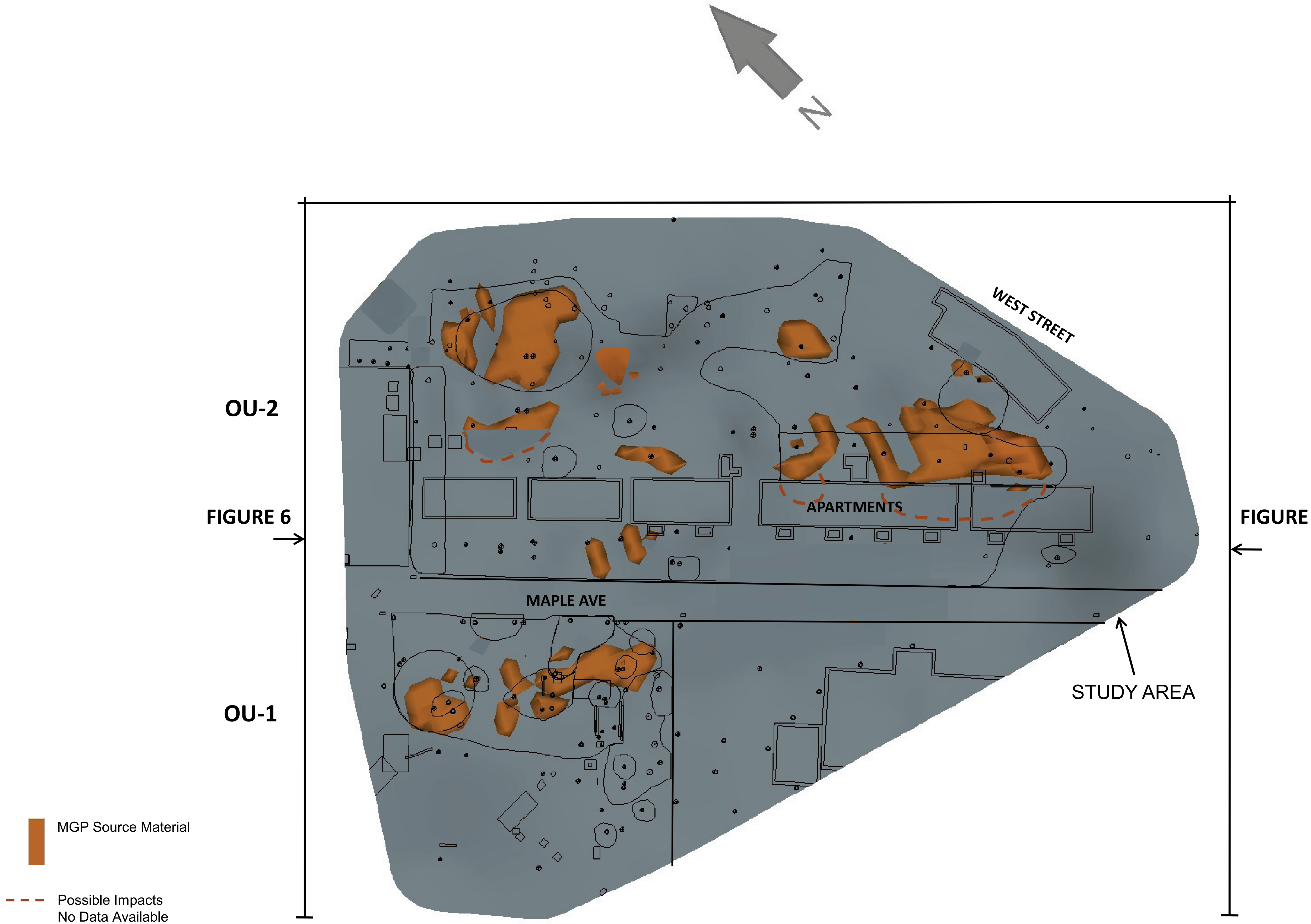
NOTES:

1. Based on Figure 4, Historical Composite Streets and Waterways, Remedial Investigation Report, CMX, May, 2009.

CLOVE AND MAPLE FORMER MGP SITE **HAVERSTRAW, NEW YORK**	GEI Consultants	**HISTORICAL COMPOSITE STREETS AND WATERWAYS**
ORANGE AND ROCKLAND UTILITIES, INC.		January 2010 Figure 3



CLOVE AND MAPLE FORMER MGP SITE HAVERSTRAW, NEW YORK	GEI Consultants	HISTORIC PHOTOGRAPH: FORMER CLOVE AND MAPLE MGP AND SURROUNDING AREA, CIRCA 1890
ORANGE AND ROCKLAND UTILITIES, INC.		January 2010 Figure 4



CLOVE AND MAPLE FORMER MGP SITE
HAVERSTRAW, NEW YORK

ORANGE AND ROCKLAND UTILITIES, INC.

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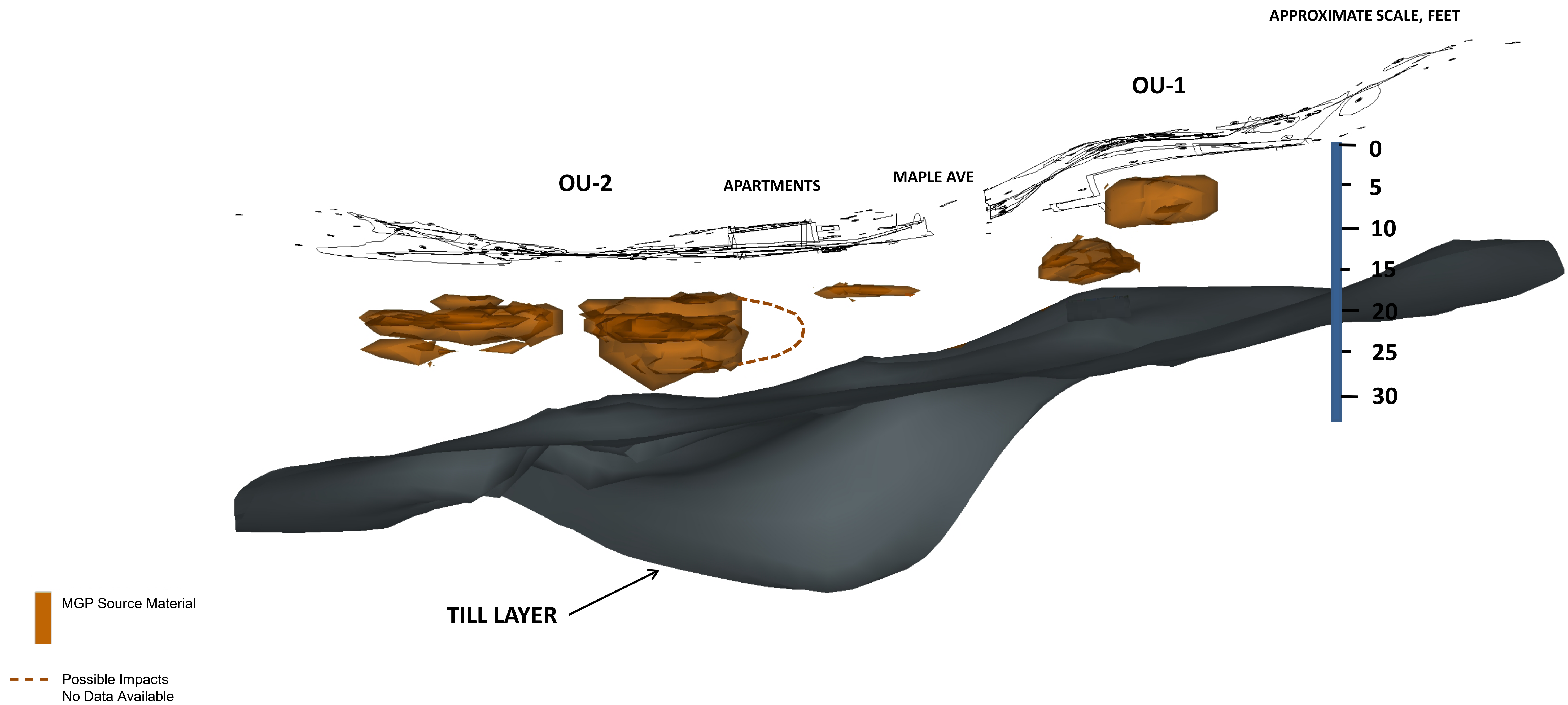
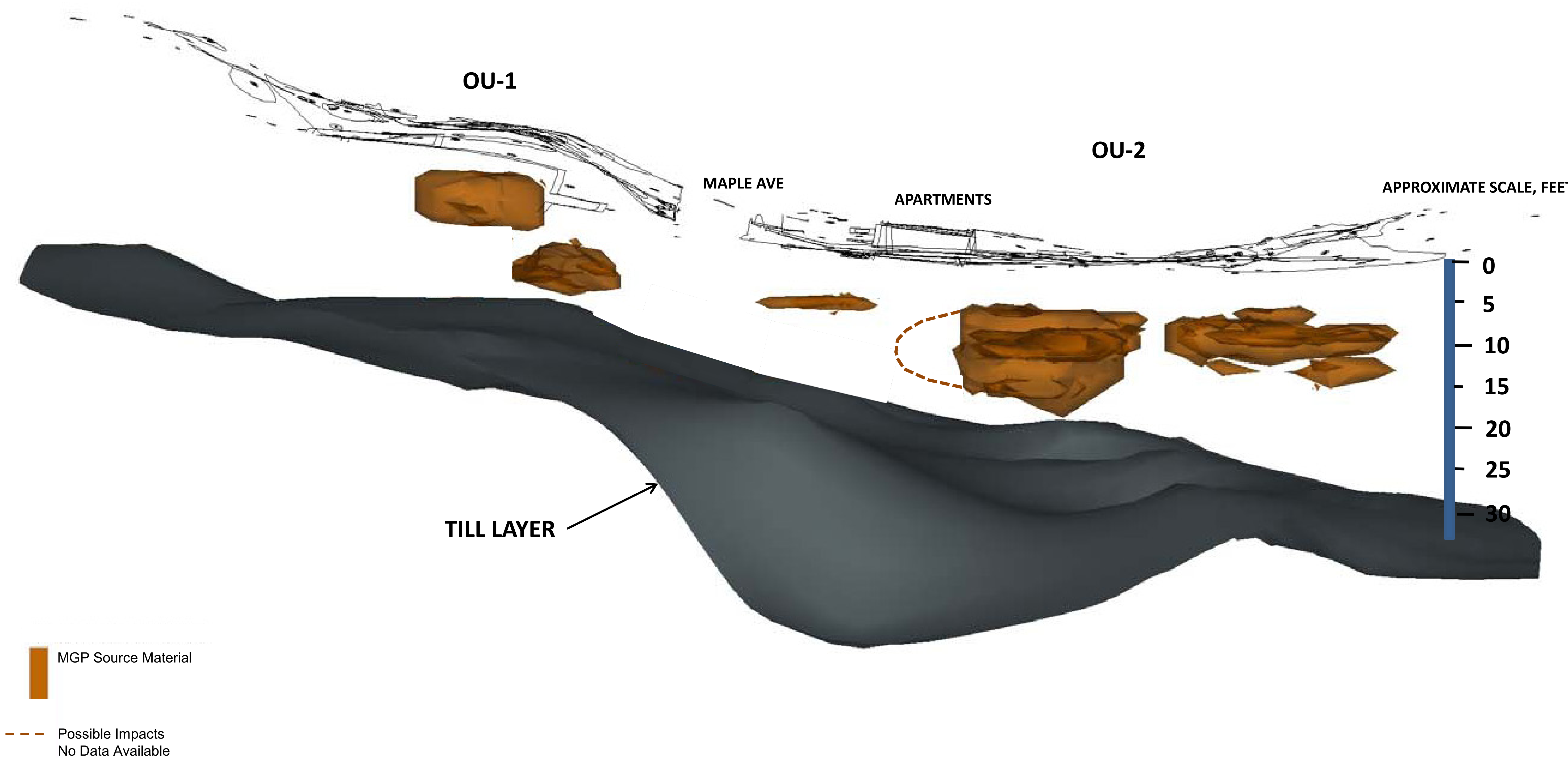
MGP SOURCE MATERIAL: PLAN VIEW OU-1 AND OU-2

January 2010 Figure 5



CLOVE AND MAPLE FORMER MGP SITE HAVERSTRAW, NEW YORK	GEI Consultants	MGP SOURCE MATERIAL: VIEW EAST FROM 103 MAPLE AVE
ORANGE AND ROCKLAND UTILITIES, INC.		January 2010 Figure 6



CLOVE AND MAPLE FORMER MGP SITE
HAVERSTRAW, NEW YORK

ORANGE AND ROCKLAND UTILITIES, INC.

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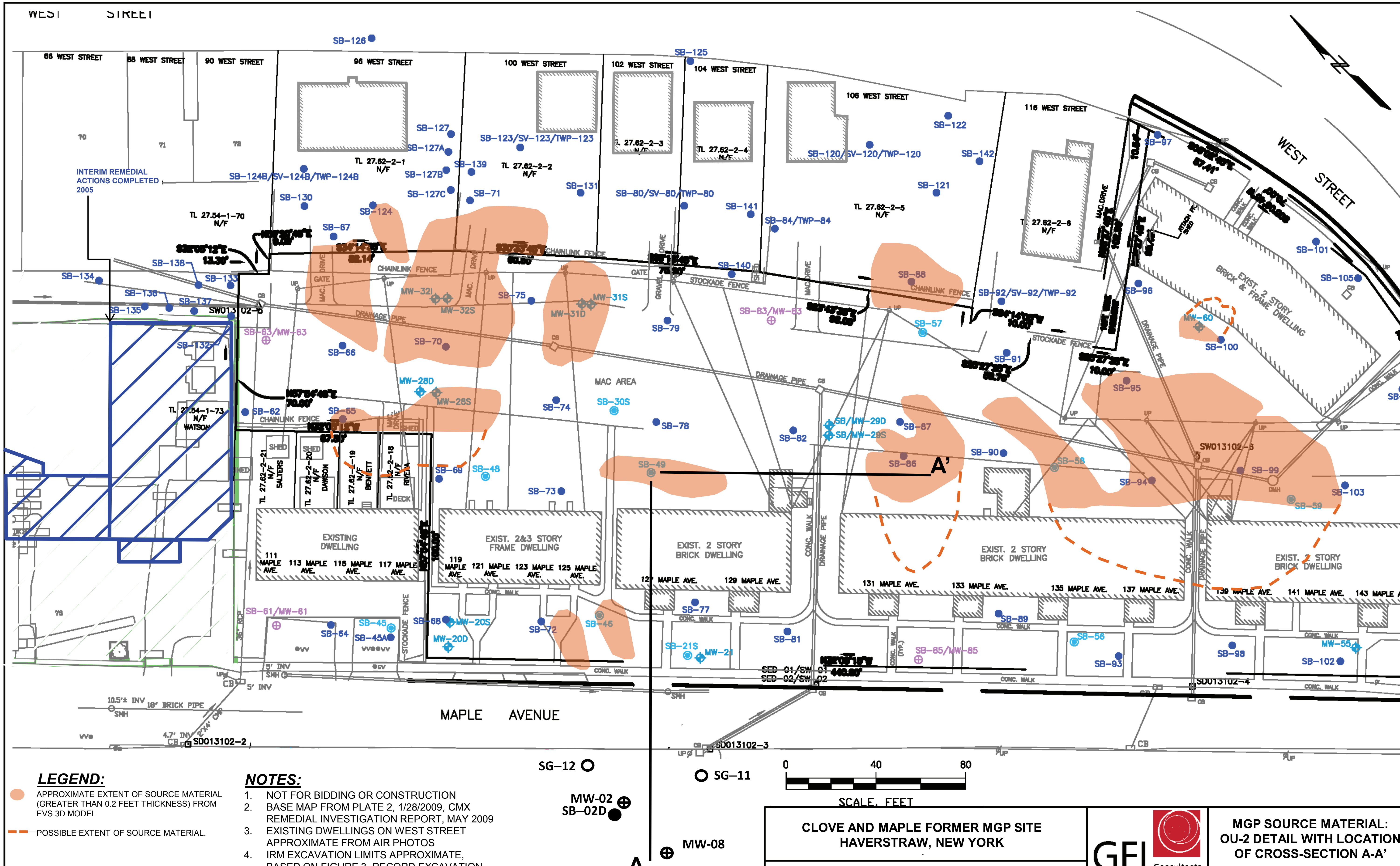
MGP SOURCE MATERIAL: VIEW WEST FROM CORNER OF WEST ST AND MAPLE AVE

January 2010

Figure 7



LEGEND:

APPROXIMATE EXTENT OF SOURCE MATERIAL (GREATER THAN 0.2 FEET THICKNESS) FROM EVS 3D MODEL

POSSIBLE EXTENT OF SOURCE MATERIAL.

NOTES:

1. NOT FOR BIDDING OR CONSTRUCTION
2. BASE MAP FROM PLATE 2, 1/28/2009, CMX REMEDIAL INVESTIGATION REPORT, MAY 2009
3. EXISTING DWELLINGS ON WEST STREET APPROXIMATE FROM AIR PHOTOS
4. IRM EXCAVATION LIMITS APPROXIMATE, BASED ON FIGURE 3, RECORD EXCAVATION PLAN, GEI IRM CERTIFICATION REPORT, 93B MAPLE AVE, MARCH 31, 2006.

CLOVE AND MAPLE FORMER MGP SITE
HAVERSTRAW, NEW YORK

ORANGE AND ROCKLAND UTILITIES, INC.

GEI Consultants

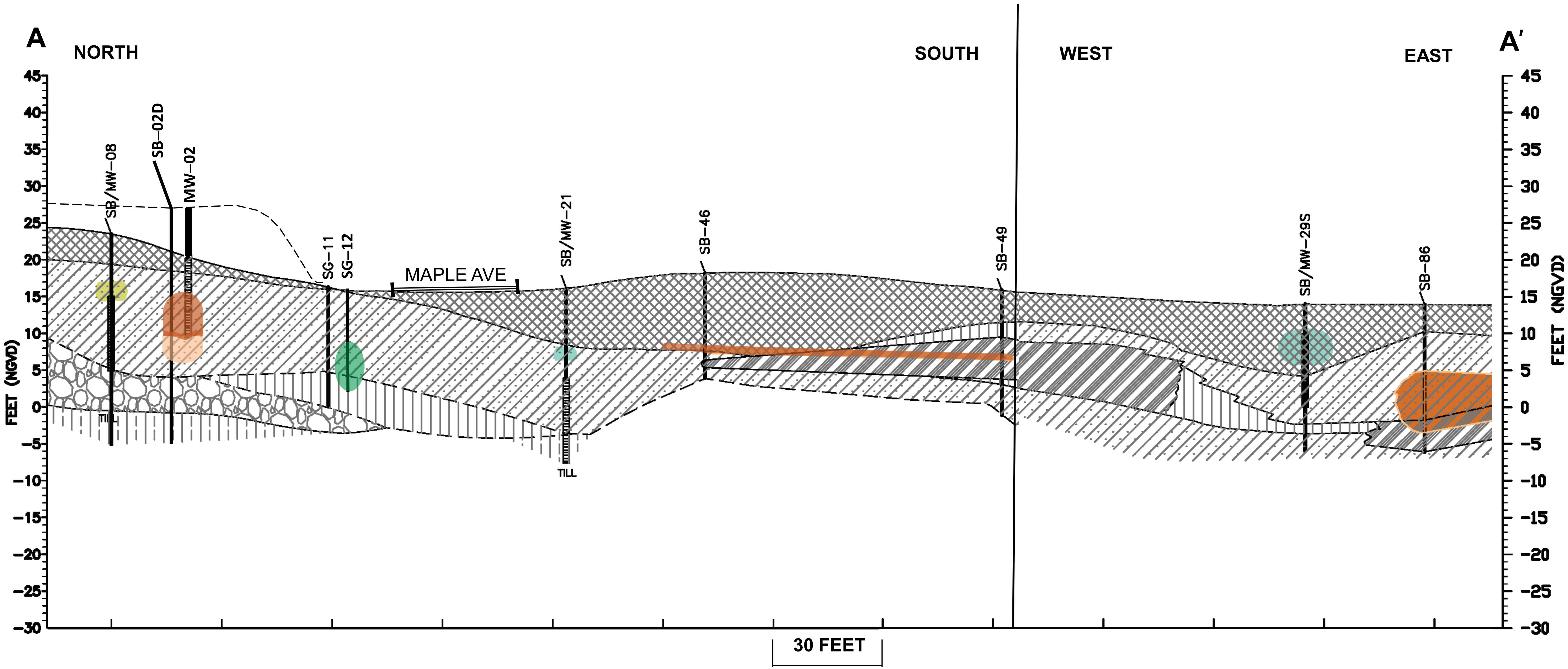
Project 091950-1

MGP SOURCE MATERIAL: OU-2 DETAIL WITH LOCATION OF CROSS-SECTION A-A'

January 2010

Figure 8

I:\GEI\ORANGE & ROCKLAND\HAVERSTRAW\RIR\ OU1 AND OU2 F-Plate 2-Site Layout 1-28-09.dwg \Oct 22, 2009



LEGEND:

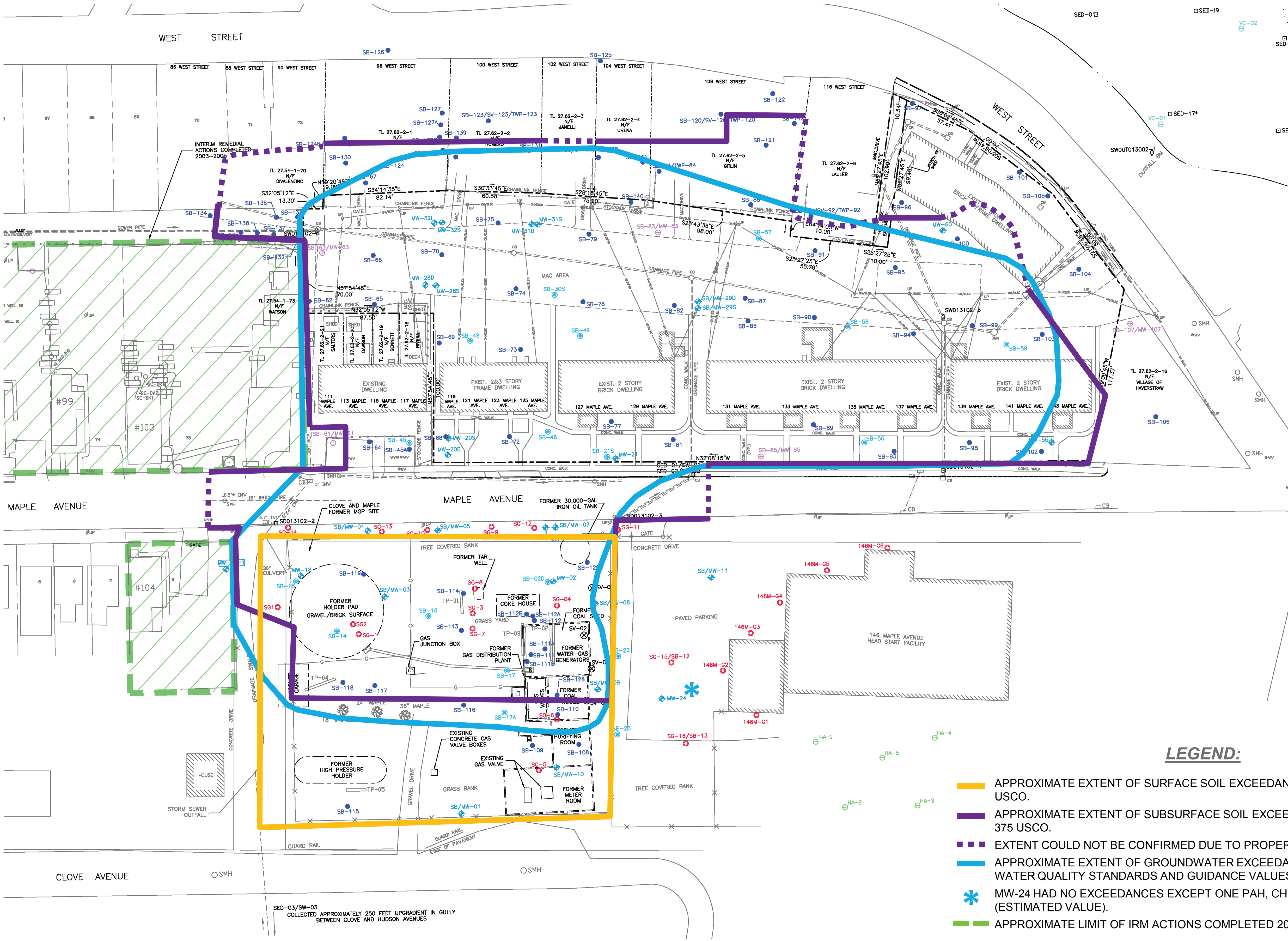
MW10	SOIL BORING OR MONITORING WELL LOCATION		HYDROCARBON–LIKE ODORS		FILL MATERIAL	UNIT 1
			MGP–LIKE ODORS		COARSE–GRAINED SANDS AND GRAVELS	UNIT 2
	SCREENED INTERVAL		SHEENS OR STAINING ONLY		CLAY AND FINE SAND/ SILT MIXTURES	UNIT 2
			MGP OIL–LIKE BLEBS, LENSES		FINE SANDS	UNIT 2
			MGP TAR–LIKE MATERIAL, CHARACTERIZED BY LOW VISCOSITY NAPL		SILT AND FINE TO COARSE–GRAINED SAND	UNIT 2
	INFERRED CONTACT				PEAT, ORGANIC CLAY	UNIT 2
					CLAY MATERIAL	UNIT 3
					TILL MATERIAL	UNIT 4

NOTE:
GREYED–BACK AREAS DEPICT SECTIONS OF THE SITE WHICH WERE REMEDIATED IN 2005.

NOTES:

1. NOT FOR BIDDING OR CONSTRUCTION
2. BASE FIGURE FROM PLATE 4A, CROSS SECTION D-D' and H-H', 1/28/2009, CMX REMEDIAL INVESTIGATION REPORT, MAY 2009
3. VERTICAL SCALE EXAGGERATED 2X HORIZONTAL SCALE

CLOVE AND MAPLE FORMER MGP SITE HAVERSTRAW, NEW YORK	GEI Consultants	CROSS-SECTION A-A'
ORANGE AND ROCKLAND UTILITIES, INC.	Project 091950-1	January 2010 Figure 9



LEGEND:

- APPROXIMATE EXTENT OF SURFACE SOIL EXCEEDANCES OF NYSDEC PART 375 USCO.
- APPROXIMATE EXTENT OF SUBSURFACE SOIL EXCEEDANCES OF NYSDEC PART 375 USCO.
- EXTENT COULD NOT BE CONFIRMED DUE TO PROPERTY ACCESS RESTRICTIONS.
- APPROXIMATE EXTENT OF GROUNDWATER EXCEEDANCES OF NYSDEC AMBIENT WATER QUALITY STANDARDS AND GUIDANCE VALUES.
- * MW-24 HAD NO EXCEEDANCES EXCEPT ONE PAH, CHRYSENE, AT 0.5 mg/LJ (ESTIMATED VALUE).
- APPROXIMATE LIMIT OF IRM ACTIONS COMPLETED 2003-2005.

CLOVE AND MAPLE FORMER MGP SITE
HAVERSTRAW, NEW YORK

ORANGE AND ROCKLAND UTILITIES, INC.

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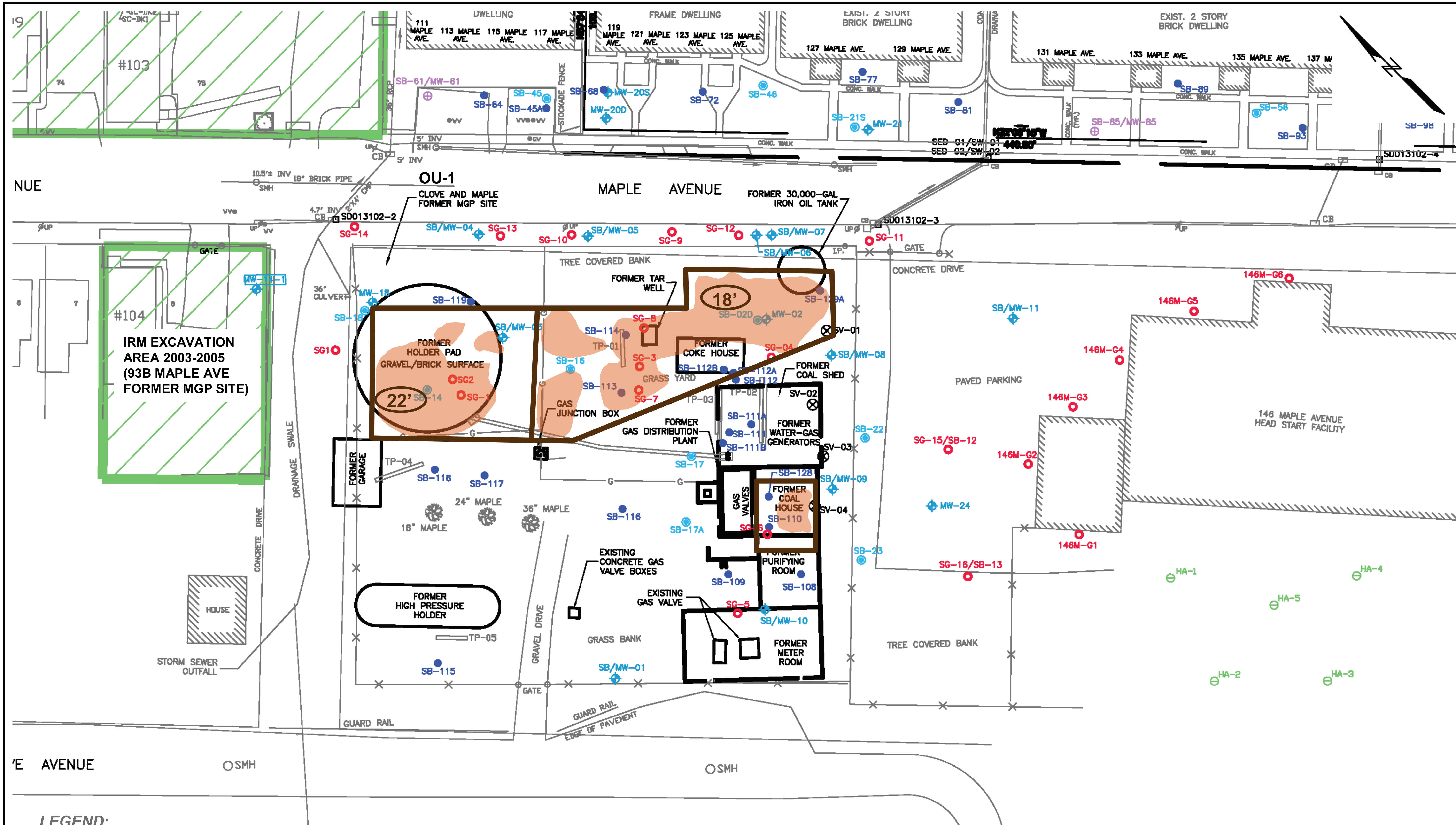
EXTENT OF SOIL AND GROUNDWATER IMPACTS

August 2010 — Figure 10



LEGEND:

- APPROXIMATE LIMITS OF SOURCE MATERIAL EXCAVATION
- 22' APPROXIMATE DEPTH OF EXCAVATION
- APPROXIMATE EXTENT OF SOURCE MATERIAL FROM EVS 3D MODEL

NOTES:

1. NOT FOR BIDDING OR CONSTRUCTION
2. BASE MAP FROM PLATE 2, 1/28/2009, CMX REMEDIAL INVESTIGATION REPORT, MAY 2009

0 40 80

SCALE, FEET

CLOVE AND MAPLE FORMER MGP SITE
HAVERSTRAW, NEW YORK

ORANGE AND ROCKLAND UTILITIES, INC.

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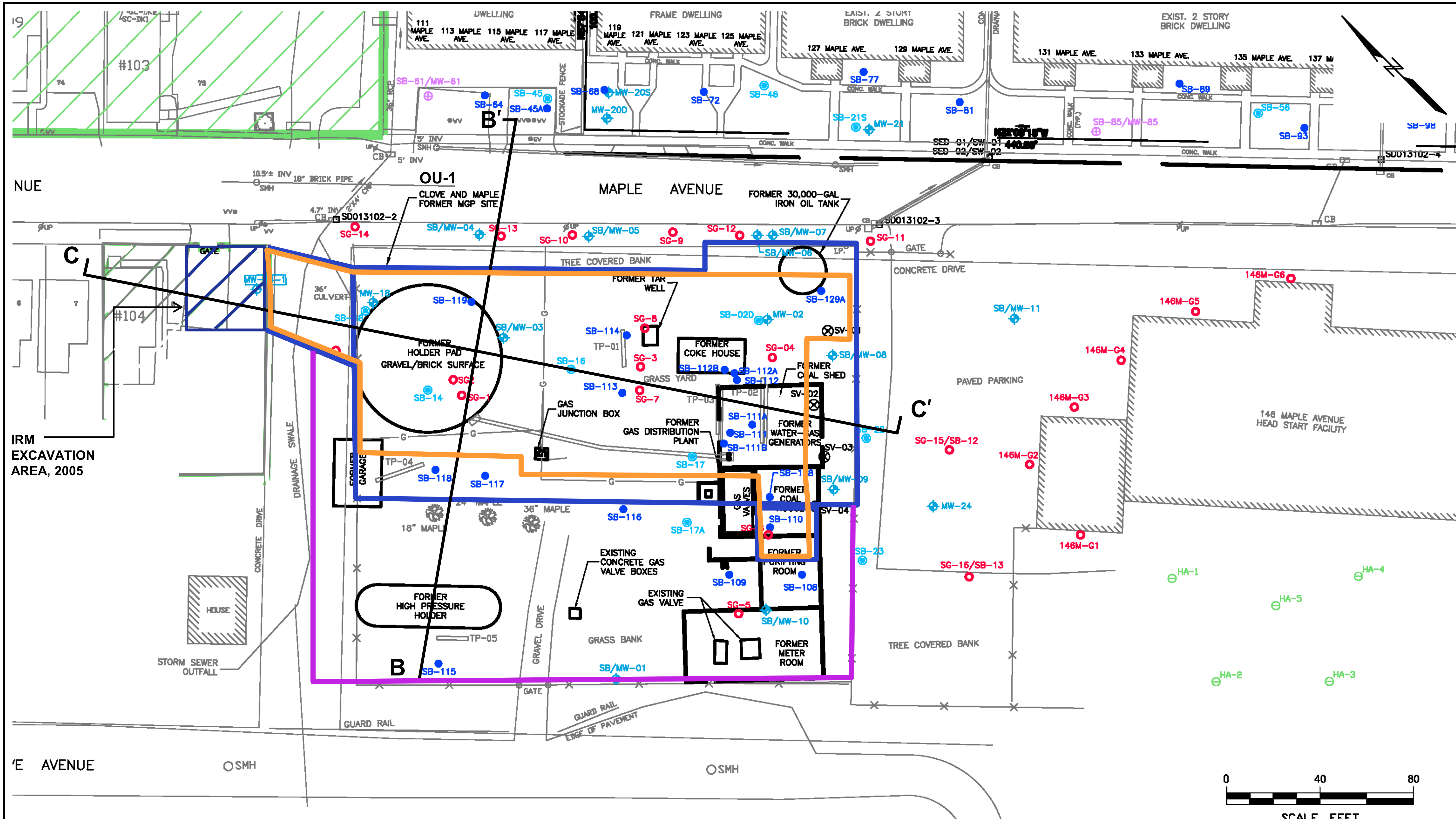
Project 091950-1

OU-1 – EXCAVATION OF SOURCE MATERIAL

January 2010

Figure 11

I:\GEI\ORANGE & ROCKLAND\HAVERSTRAW\RIR\ OU1 AND OU2 F-Plate 2-Site Layout 1-28-09.dwg \Oct 22, 2009



LEGEND:

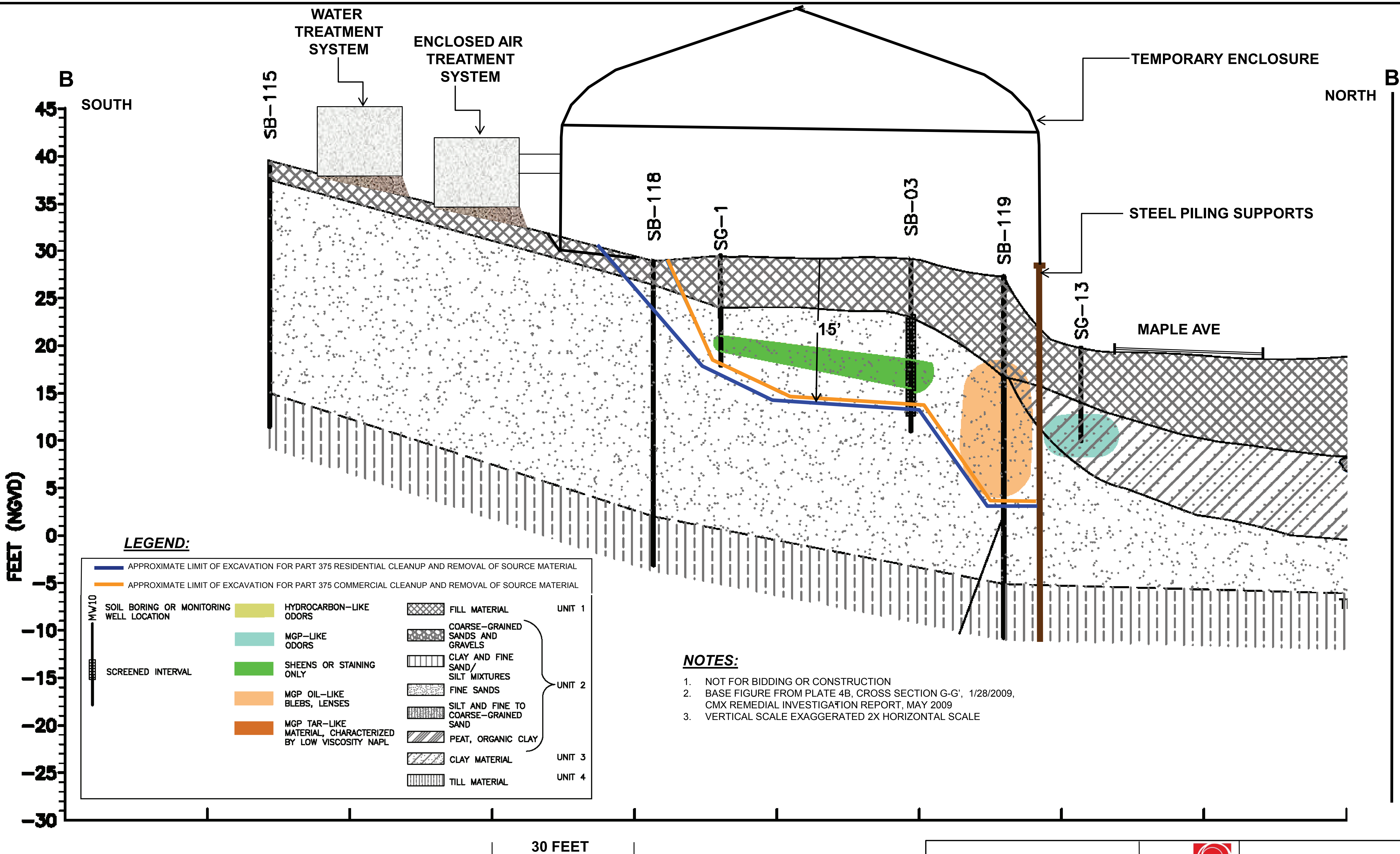
- APPROXIMATE LIMITS OF EXCAVATION FOR PART 375 COMMERCIAL CLEANUP (ALTERNATIVE 3)
- APPROXIMATE LIMITS OF EXCAVATION FOR PART 375 RESIDENTIAL CLEANUP (ALTERNATIVE 4)
- APPROXIMATE LIMITS OF REMOVAL OF SURFACE SOIL AND PLACEMENT OF CLEAN SOIL: 1 FOOT FOR ALTERNATIVE 3, OR 2 FEET FOR ALTERNATIVE 4

NOTES:

1. NOT FOR BIDDING OR CONSTRUCTION
2. BASE MAP FROM PLATE 2, 1/28/2009, CMX REMEDIAL INVESTIGATION REPORT, MAY 2009

CLOVE AND MAPLE FORMER MGP SITE HAVERSTRAW, NEW YORK	GEI Consultants	OU-1 ALTERNATIVES 3 AND 4
ORANGE AND ROCKLAND UTILITIES, INC.	Project 091950-1	August 2010 Figure 12

I:\GEI\ORANGE & ROCKLAND\HAVERSTRAW\RIR\ OU1 AND OU2 F-Plate 2-Site Layout 1-28-09.dwg \Oct 22, 2009



NOTES:

1. NOT FOR BIDDING OR CONSTRUCTION
2. BASE FIGURE FROM PLATE 4B, CROSS SECTION G-G', 1/28/2009, CMX REMEDIAL INVESTIGATION REPORT, MAY 2009
3. VERTICAL SCALE EXAGGERATED 2X HORIZONTAL SCALE

CLOVE AND MAPLE FORMER MGP SITE
HAVERSTRAW, NEW YORK

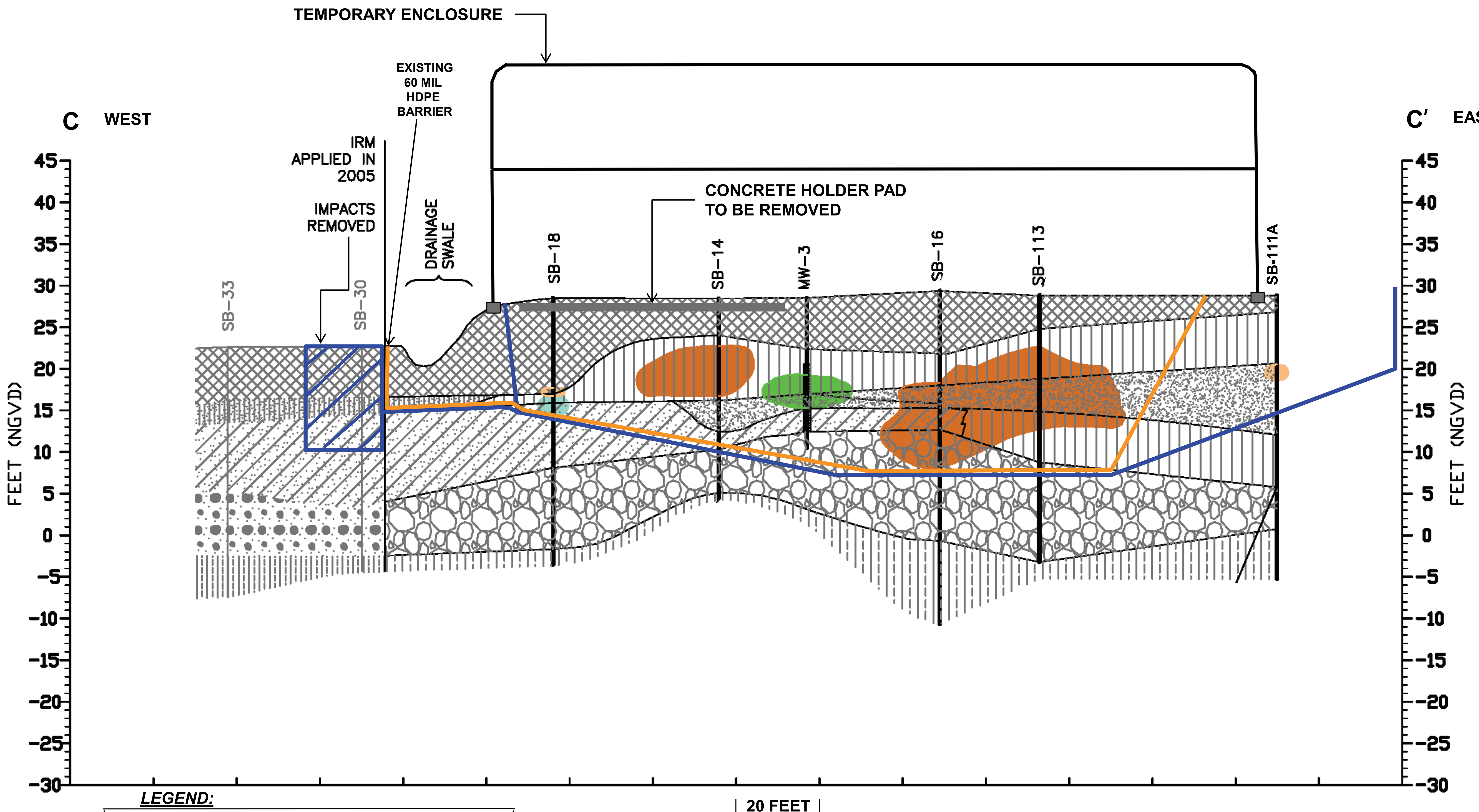
ORANGE AND ROCKLAND UTILITIES, INC.

GEI Consultants

OU-1 ALTERNATIVE 4
CROSS-SECTION B-B'

January 2010

Figure 13



LEGEND:

APPROXIMATE LIMIT OF EXCAVATION FOR PART 375 RESIDENTIAL CLEANUP AND REMOVAL OF SOURCE MATERIAL
APPROXIMATE LIMIT OF EXCAVATION FOR PART 375 COMMERCIAL CLEANUP AND REMOVAL OF SOURCE MATERIAL

MW10 SOIL BORING OR MONITORING WELL LOCATION
SCREENED INTERVAL

HYDROCARBON-LIKE ODORS
MGP-LIKE ODORS
SHEENS OR STAINING ONLY
MGP OIL-LIKE BLEBS, LENSES
MGP TAR-LIKE MATERIAL, CHARACTERIZED BY LOW VISCOSITY NAPL

FILL MATERIAL — UNIT 1
COARSE-GRAINED SANDS AND GRAVELS; CLAY AND FINE SAND/SILT MIXTURES; FINE SANDS; SILT AND FINE TO COARSE-GRAINED SAND; PEAT, ORGANIC CLAY — UNIT 2
CLAY MATERIAL — UNIT 3
TILL MATERIAL — UNIT 4

NOTES:

1. NOT FOR BIDDING OR CONSTRUCTION
2. BASE FIGURE FROM PLATE 4A, CROSS SECTION E-E', 1/28/2009, CMX REMEDIAL INVESTIGATION REPORT, MAY 2009
3. VERTICAL SCALE EXAGGERATED 2X HORIZONTAL SCALE

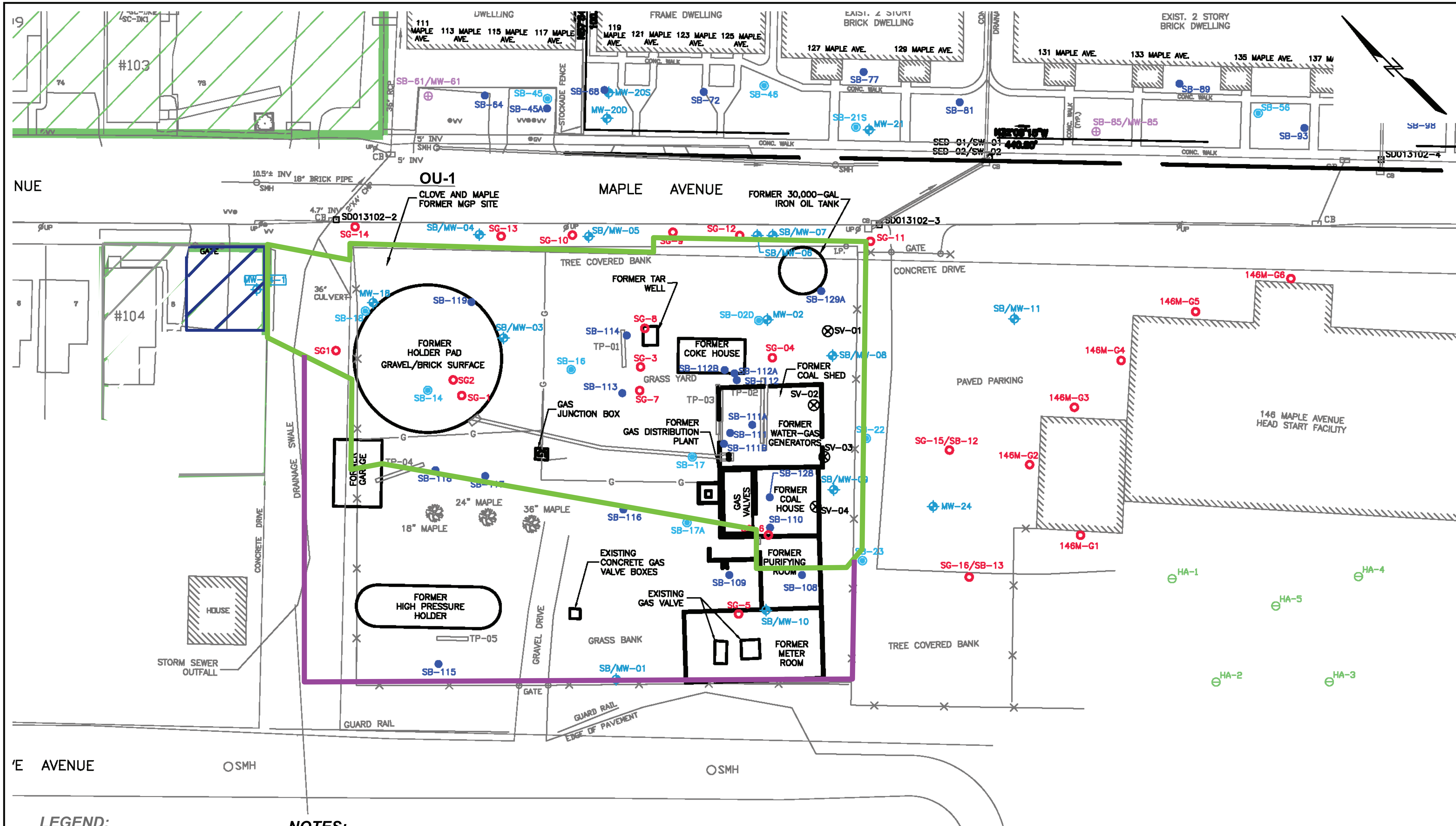
CLOVE AND MAPLE FORMER MGP SITE
HAVERSTRAW, NEW YORK

ORANGE AND ROCKLAND UTILITIES, INC.

GEI Consultants

OU-1 ALTERNATIVE 4
CROSS-SECTION C-C'

January 2010 | Figure 14



LEGEND:

APPROXIMATE LIMITS OF EXCAVATION TO PART 375 UNRESTRICTED CLEANUP LEVELS

APPROXIMATE LIMITS OF REMOVAL OF SURFACE SOIL AND PLACEMENT OF 2 FEET OF CLEAN SOIL TO MEET UNRESTRICTED USE REQUIREMENTS

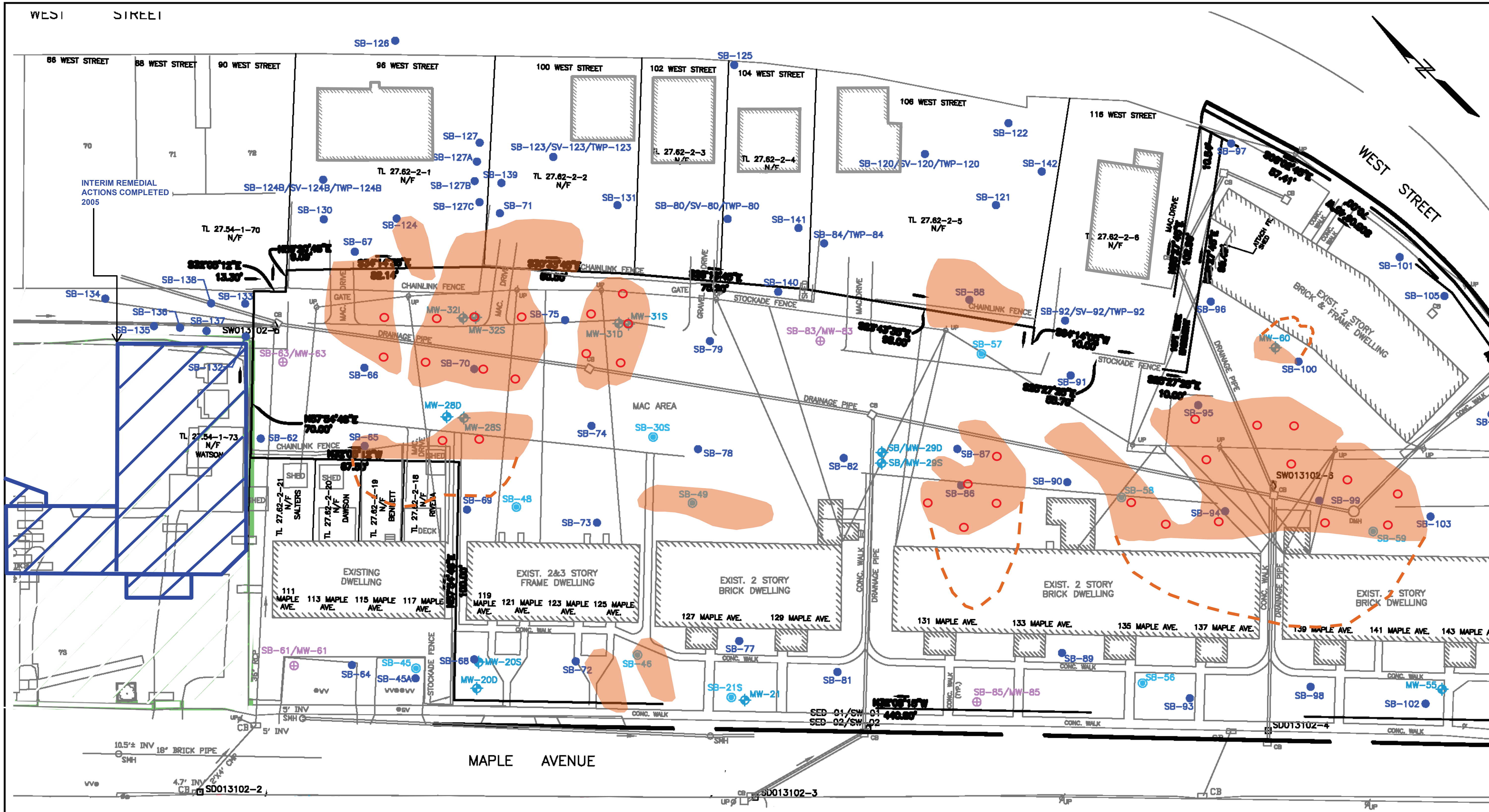
NOTES:

1. NOT FOR BIDDING OR CONSTRUCTION
2. BASE MAP FROM PLATE 2, 1/28/2009, CMX REMEDIAL INVESTIGATION REPORT, MAY 2009

0 40 80
SCALE, FEET

CLOVE AND MAPLE FORMER MGP SITE HAVERSTRAW, NEW YORK	GEI Consultants	OU-1 ALTERNATIVE 5
ORANGE AND ROCKLAND UTILITIES, INC.	Project 091950-1	August 2010 — Figure 15

I:\GEI\ORANGE & ROCKLAND\HAVERSTRAW\RIR\ OU1 AND OU2 F-Plate 2-Site Layout 1-28-09.dwg \Oct 22, 2009



LEGEND:

- APPROXIMATE EXTENT OF SOURCE MATERIAL (GREATER THAN 0.2 FEET THICKNESS) FROM EVS 3D MODEL
- POSSIBLE EXTENT OF SOURCE MATERIAL.
- NAPL RECOVERY AREA. LOCATION OF RECOVERY WELLS TO BE DETERMINED DURING DESIGN.

NOTES:

1. NOT FOR BIDDING OR CONSTRUCTION
2. BASE MAP FROM PLATE 2, 1/28/2009, CMX REMEDIAL INVESTIGATION REPORT, MAY 2009
3. EXISTING DWELLINGS ON WEST STREET APPROXIMATE FROM AIR PHOTOS
4. IRM EXCAVATION LIMITS APPROXIMATE, BASED ON FIGURE 3, RECORD EXCAVATION PLAN, GEI IRM CERTIFICATION REPORT, 93B MAPLE AVE, MARCH 31, 2006.

0 40 80
SCALE, FEET

CLOVE AND MAPLE FORMER MGP SITE
HAVERSTRAW, NEW YORK

ORANGE AND ROCKLAND UTILITIES, INC.

GEI Consultants

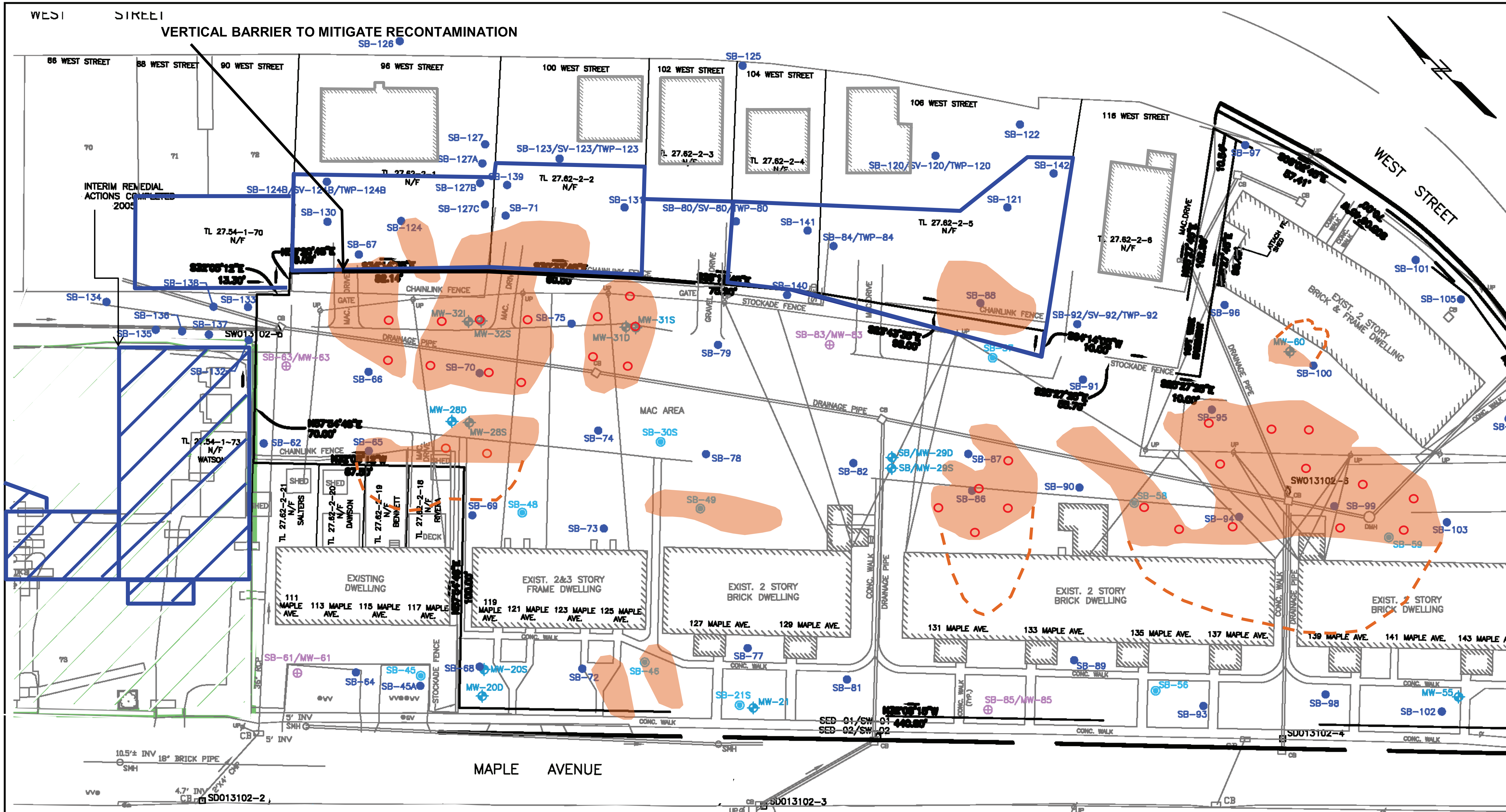
Project 091950-1

OU-2 ALTERNATIVE 2

January 2010

Figure 16

I:\GEI\ORANGE & ROCKLAND\HAVERSTRAW\RIR\ OU1 AND OU2 F-Plate 2-Site Layout 1-28-09.dwg \Oct 22, 2009



LEGEND:

- APPROXIMATE LIMITS FOR PART 375 RESIDENTIAL CLEANUP
- APPROXIMATE EXTENT OF SOURCE MATERIAL (GREATER THAN 0.2 FEET IN THICKNESS) FROM EVS 3D MODEL
- POSSIBLE EXTENT OF SOURCE MATERIAL
- NAPL RECOVERY AREA. LOCATION OF RECOVERY WELLS TO BE DETERMINED DURING DESIGN.

NOTES:

1. NOT FOR BIDDING OR CONSTRUCTION
2. BASE MAP FROM PLATE 2, 1/28/2009, CMX REMEDIAL INVESTIGATION REPORT, MAY 2009
3. EXISTING DWELLINGS ON WEST STREET APPROXIMATE FROM AIR PHOTOS
4. IRM EXCAVATION LIMITS APPROXIMATE, BASED ON FIGURE 3, RECORD EXCAVATION PLAN, GEI IRM CERTIFICATION REPORT, 93B MAPLE AVE, MARCH 31, 2006.

0 40 80

SCALE, FEET

CLOVE AND MAPLE FORMER MGP SITE
HAVERSTRAW, NEW YORK

ORANGE AND ROCKLAND UTILITIES, INC.

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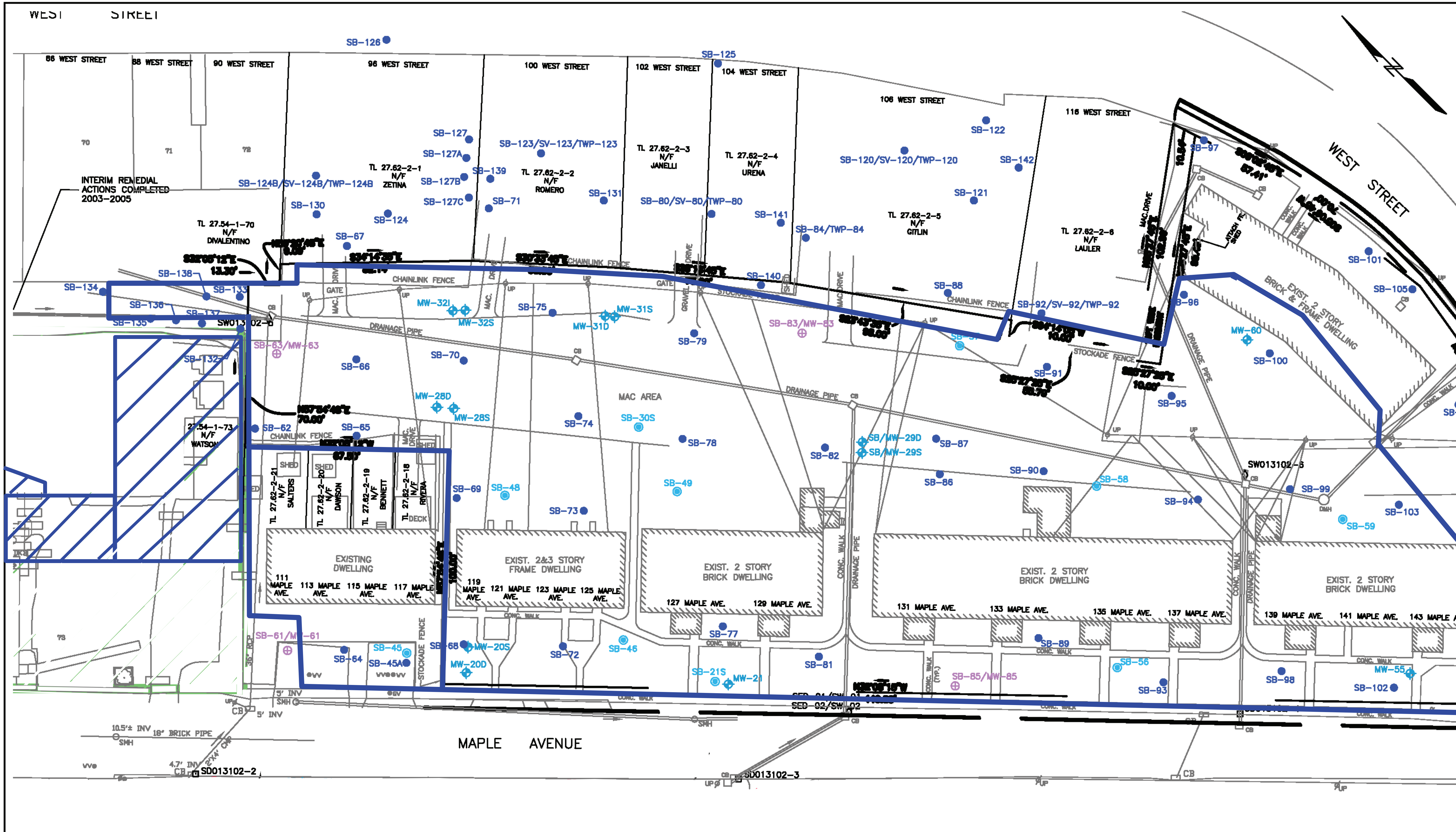
Project 091950-1

OU-2 ALTERNATIVE 3 – PHASE 1

January 2010

Figure 17

I:\GEI\ORANGE & ROCKLAND\HAVERSTRAW\RIR\ OU1 AND OU2 F-Plate 2-Site Layout 1-28-09.dwg \Oct 22, 2009



LEGEND:

APPROXIMATE LIMITS OF EXCAVATION FOR PART 375 RESIDENTIAL CLEANUP OBJECTIVES

NOTES:

1. NOT FOR BIDDING OR CONSTRUCTION
2. BASE MAP FROM PLATE 2, 1/28/2009, CMX REMEDIAL INVESTIGATION REPORT, MAY 2009

0 40 80

SCALE, FEET

CLOVE AND MAPLE FORMER MGP SITE
HAVERSTRAW, NEW YORK

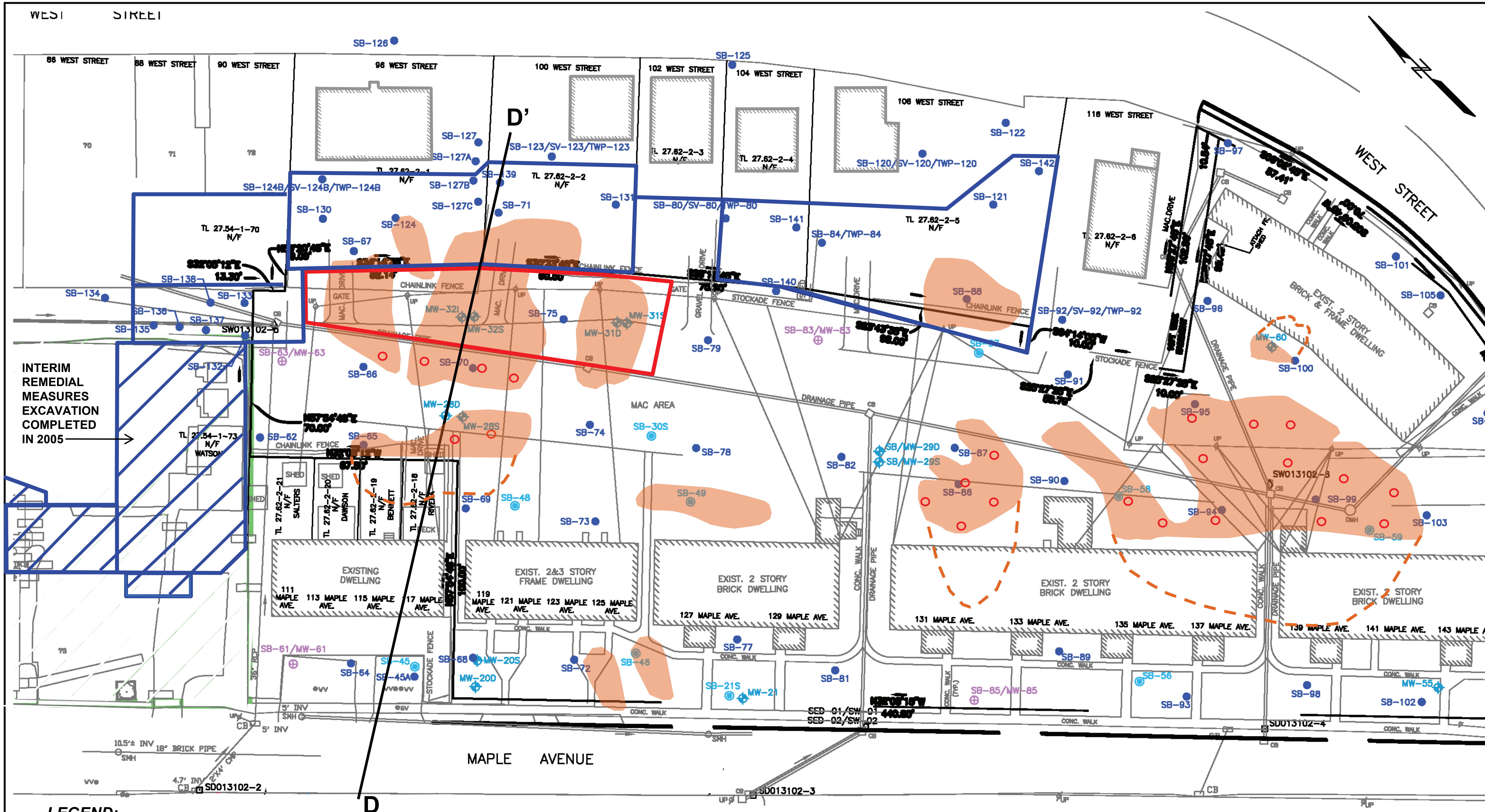
ORANGE AND ROCKLAND UTILITIES, INC.

GEI Consultants

OU-2 ALTERNATIVE 3 – PHASE 2

Project 091950-1 | January 2010 | Figure 18

I:\GEI\ORANGE & ROCKLAND\HAVERSTRAW\RIR\ OU1 AND OU2 F-Plate 2-Site Layout 1-28-09.dwg \Oct 22, 2009



LEGEND:

- APPROXIMATE LIMITS FOR PART 375 RESIDENTIAL CLEANUP
- EXCAVATION OF SOURCE MATERIAL
- APPROXIMATE EXTENT OF SOURCE MATERIAL (GREATER THAN 0.2 FEET IN THICKNESS) FROM EVS 3D MODEL
- EXTENT OF POTENTIAL SOURCE MATERIAL BENEATH BUILDINGS
- NAPL RECOVERY AREA. LOCATION OF RECOVERY WELLS TO BE DETERMINED DURING DESIGN.

NOTES:

1. NOT FOR BIDDING OR CONSTRUCTION
2. BASE MAP FROM PLATE 2, 1/28/2009, CMX REMEDIAL INVESTIGATION REPORT, MAY 2009
3. EXISTING DWELLINGS ON WEST STREET APPROXIMATE FROM AIR PHOTOS
4. IRM EXCAVATION LIMITS APPROXIMATE, BASED ON FIGURE 3, RECORD EXCAVATION PLAN, GEI IRM CERTIFICATION REPORT, 93B MAPLE AVE, MARCH 31, 2006.

0 40 80
SCALE, FEET

CLOVE AND MAPLE FORMER MGP SITE
HAVERSTRAW, NEW YORK

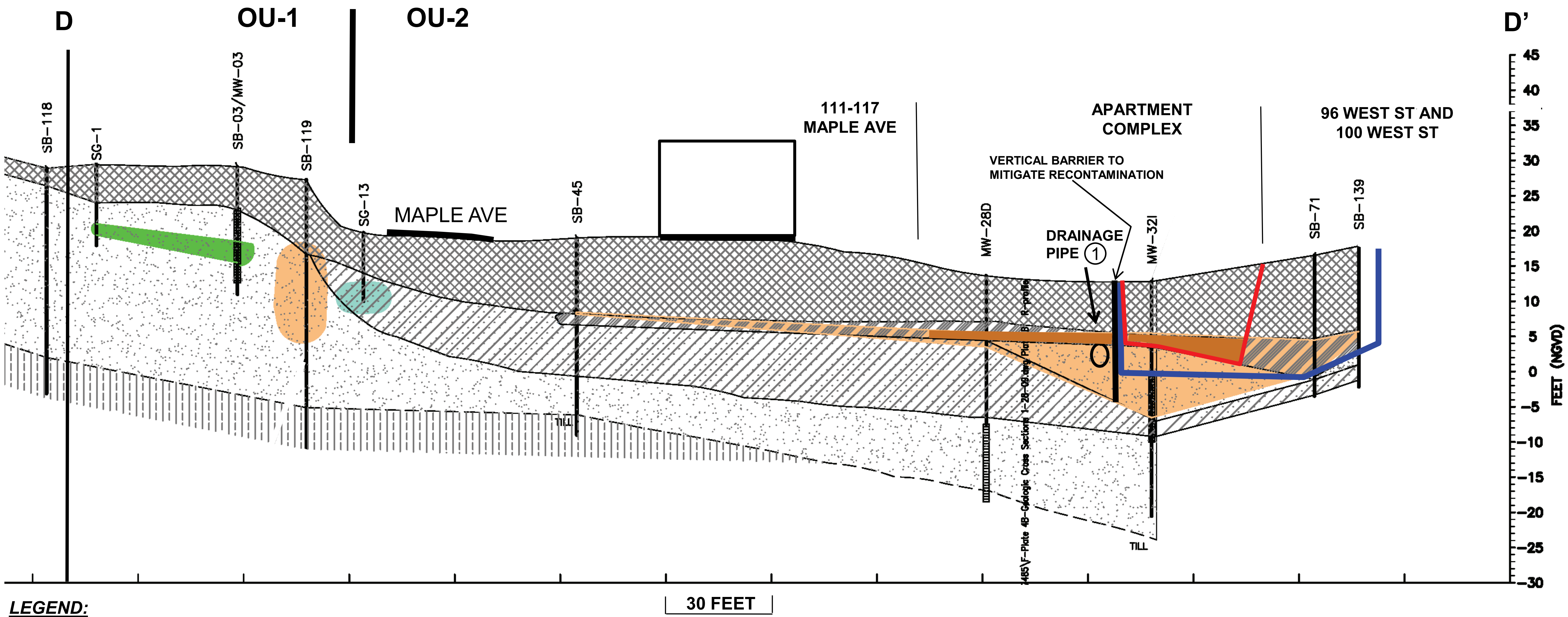
ORANGE AND ROCKLAND UTILITIES, INC.

GEI Consultants

OU-2 ALTERNATIVE 4 – PHASE 1

Project 091950-1 | January 2010 | Figure 19

I:\GEI\ORANGE & ROCKLAND\HAVERSTRAW\RIR\ OU1 AND OU2 F-Plate 2-Site Layout 1-28-09.dwg \Oct 22, 2009



LEGEND:

APPROXIMATE LIMITS OF EXCAVATION OF SOURCE MATERIAL

APPROXIMATE LIMITS OF EXCAVATION FOR PART 375 RESIDENTIAL CLEANUP

MW10 — SOIL BORING OR MONITORING WELL LOCATION

SCREENED INTERVAL

HYDROCARBON-LIKE ODORS

MGP-LIKE ODORS

SHEENS OR STAINING ONLY

MGP OIL-LIKE BLEBS, LENSES

MGP TAR-LIKE MATERIAL, CHARACTERIZED BY LOW VISCOSITY NAPL

FILL MATERIAL — UNIT 1

COARSE-GRAINED SANDS AND GRAVELS

CLAY AND FINE SAND/ SILT MIXTURES

FINE SANDS

SILT AND FINE TO COARSE-GRAINED SAND

PEAT, ORGANIC CLAY

(UNIT 2)

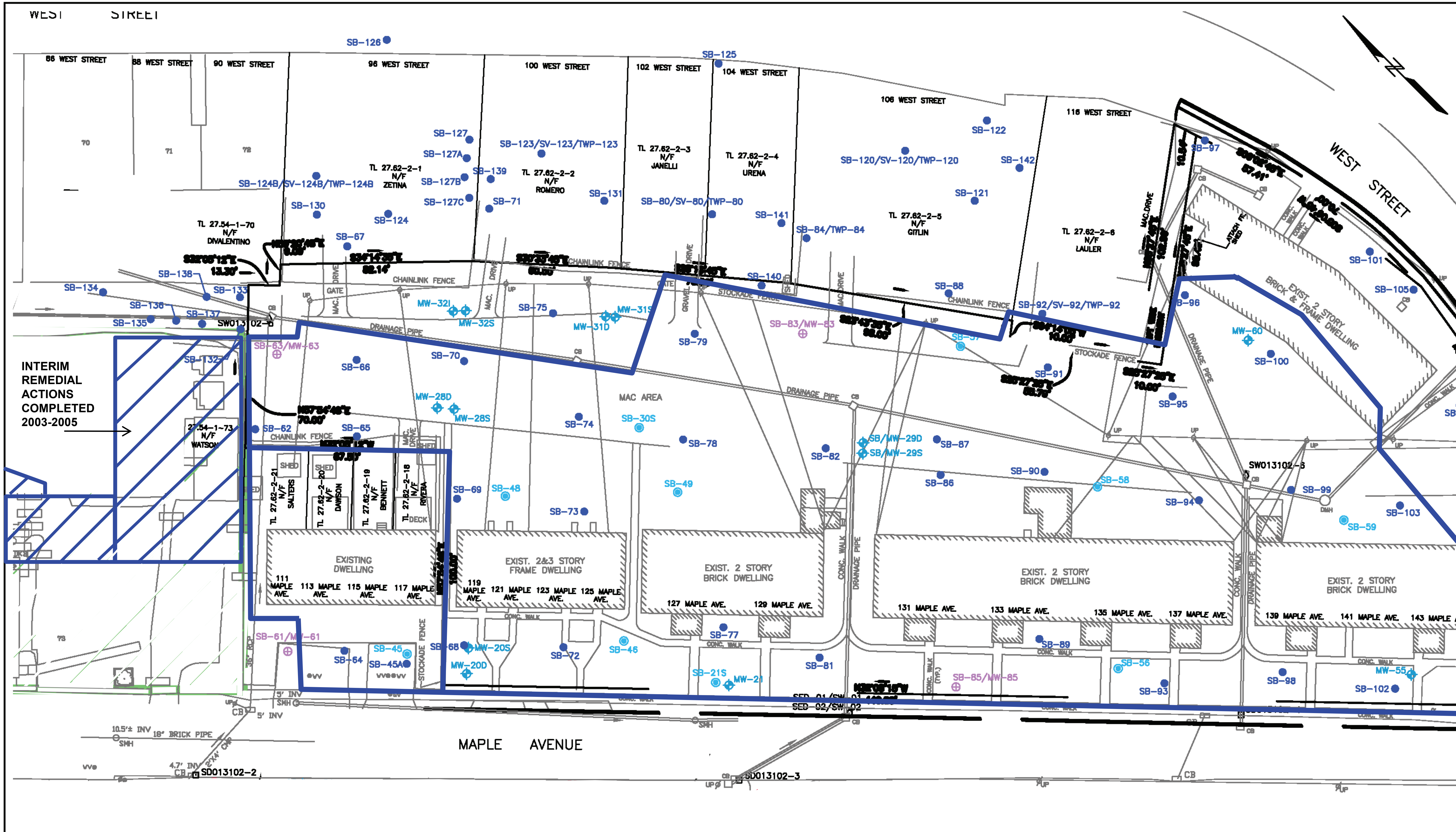
CLAY MATERIAL — UNIT 3

TILL MATERIAL — UNIT 4

NOTES:

1. SIZE, TYPE, DEPTH, AND LOCATION OF DRAINAGE PIPE TO BE CONFIRMED DURING REMEDIAL DESIGN.
2. NOT FOR BIDDING OR CONSTRUCTION
3. BASE FIGURE FROM PLATE 4B, CROSS SECTION G-G', 1/28/2009, CMX REMEDIAL INVESTIGATION REPORT, MAY 2009
4. VERTICAL SCALE EXAGGERATED 2X HORIZONTAL SCALE

CLOVE AND MAPLE FORMER MGP SITE HAVERSTRAW, NEW YORK	GEI Consultants	ALTERNATIVE 4 PHASE 1 CROSS SECTION D-D'
ORANGE AND ROCKLAND UTILITIES, INC.		January 2010 Figure 20



LEGEND:

APPROXIMATE LIMITS OF EXCAVATION FOR PART 375 RESIDENTIAL CLEANUP OBJECTIVES

NOTES:

1. NOT FOR BIDDING OR CONSTRUCTION
2. BASE MAP FROM PLATE 2, 1/28/2009, CMX REMEDIAL INVESTIGATION REPORT, MAY 2009

0 40 80

SCALE, FEET

CLOVE AND MAPLE FORMER MGP SITE
HAVERSTRAW, NEW YORK

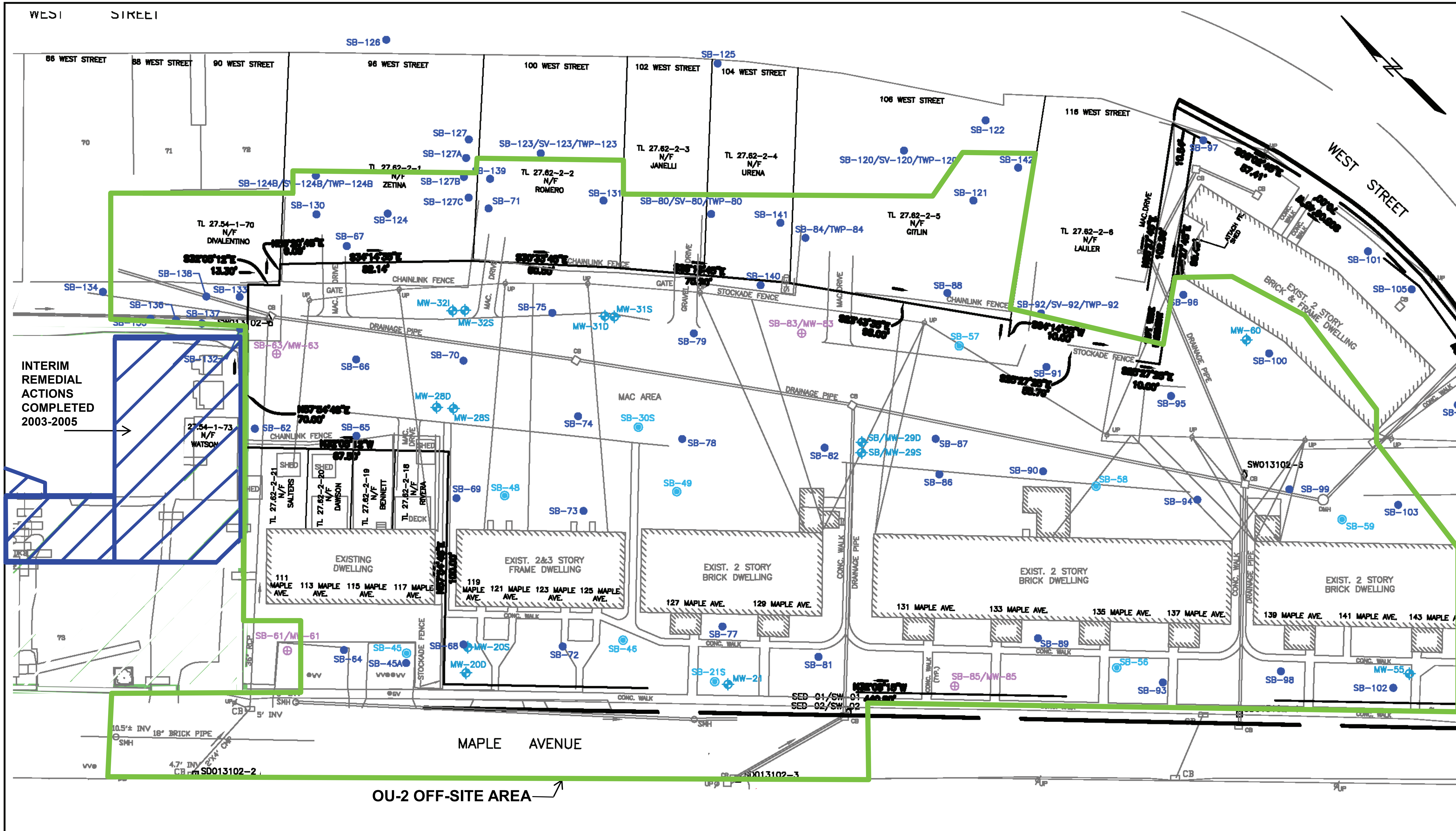
ORANGE AND ROCKLAND UTILITIES, INC.

GEI Consultants

OU-2 ALTERNATIVE 4 – PHASE 2

Project 091950-1 | January 2010 | Figure 21

I:\GEI\ORANGE & ROCKLAND\HAVERSTRAW\RIR\ OU1 AND OU2 F-Plate 2-Site Layout 1-28-09.dwg \Oct 22, 2009



LEGEND:

APPROXIMATE LIMITS OF EXCAVATION FOR PART 375 UNRESTRICTED CLEANUP OBJECTIVES

NOTES:

1. NOT FOR BIDDING OR CONSTRUCTION
2. BASE MAP FROM PLATE 2, 1/28/2009, CMX REMEDIAL INVESTIGATION REPORT, MAY 2009

0 40 80

SCALE, FEET

CLOVE AND MAPLE FORMER MGP SITE
HAVERSTRAW, NEW YORK

ORANGE AND ROCKLAND UTILITIES, INC.

GEI Consultants

Project 091950-1

OU-2 ALTERNATIVE 5 – PART 375 UNRESTRICTED SOIL CLEANUP OBJECTIVES

January 2010

Figure 22

I:\GEI\ORANGE & ROCKLAND\HAVERSTRAW\RIR\ OU1 AND OU2 F-Plate 2-Site Layout 1-28-09.dwg \Oct 22, 2009

Appendix A

Remedial Alternative Cost Estimates

Table A-1
Detailed Cost Estimate for OU-1 - Alternative 2 - Institutional/Engineering Controls and Monitoring
Clove and Maple MGP
Haverstraw, New York

Remedial Component	Unit	Unit Price	Quantity	Total Cost
COMMON COST COMPONENTS				
Preconstruction				
2 Permitting and Regulatory Submittals	Lump Sum	$ 50,000	1	$ 50,000
			Subtotal	$ 50,000
Construction Management				
10 Site Management Plan	Lump Sum	$ 20,000	1	$ 20,000
			Subtotal	$ 20,000
Long term monitoring and maintenance				
31 Periodic Monitoring, Reporting, and Maintenance	Year	$ 30,000	30	$ 461,174
assume I=5%			**Subtotal**	$461,174
Interest rate provided by NYSDEC				
REMEDIAL COST SUMMARY				
Total Capital Costs				$ 70,000
Total O & M costs				$ 461,174
Total Capital and O&M costs				$ 531,174
			TOTAL COST	**$ 531,174**
			ROUNDED COST	**$530,000**

Table A-2
Detailed Cost Estimate for OU-1 - Alternative 3 - Part 375 Commercial
Clove and Maple MGP
Haverstraw, New York

Remedial Component	Unit	Unit Price	Quantity	Total Cost
COMMON COST COMPONENTS				
Preconstruction				
1 Engineering Design, Plans, Specs, Bid	Lump Sum	$ 200,000	1	$ 200,000
2 Permitting and Regulatory Submittals	Lump Sum	$ 75,000	1	$ 75,000
3 Pre Construction Analytical Sampling (design excavation limits and pre-characterization)	Lump Sum	$ 75,000	1	$ 75,000
			Subtotal	$ 350,000
			% Total Costs	5%
Construction Management				
4 Construction Oversight	Day	$ 1,068	79	$ 84,372
5 Air Monitoring during construction	Day	$ 775	63	$ 48,825
6 Air Monitoring System (Continuous VOC monitoring)	Month	$ 30,000	3.0	$ 90,000
7 Geotechnical and Structural Evaluation and Survey (for Maple Avenue)	Lump Sum	$ 10,000	1	$ 10,000
8 Site Survey (Preconstruction and Post-Remediation)	Acre	$ 5,000	1	$ 5,000
9 Completion Report	Lump Sum	$ 20,000	1	$ 20,000
10 Site Management Plan	Lump Sum	$ 20,000	1	$ 20,000
			Subtotal	$ 278,197
			% Total Costs	4%
General Conditions				
11 Mobilization/Demobilization	Lump Sum	$ 68,070	1	$ 68,070
12 Site Preparation (fence and shrub removal)	Lump Sum	$ 13,220	1	$ 13,220
13 Temporary Offices for construction period +2 months	Month	$ 358	5	$ 1,790
14 Temporary Utilities	Month	$ 1,189	5	$ 5,945
			Subtotal	$ 89,025
			% Total Costs	1%
Removal of former MGP structures				
15 Demolition of former gas holder concrete foundation	Square feet	$ 22	3117	$ 68,574
16 Disposal Costs and Hauling of Bulky Waste	Ton	$ 119	234	$ 27,846
			Subtotal	$ 96,420
			% Total Costs	1%
REMEDIAL COMPONENTS				
Excavate and Backfill Materials				
17 Excavations to remove Unsaturated Soils	Cubic Yard	$ 19	5,305	$ 100,105
17a Excavations to remove Surface Soils Outside of Subsurface soil footprint	Cubic Yard	$ 19	870	$ 16,417
18 Excavations to remove Saturated Soils	Cubic Yard	$ 38	6,535	$ 246,696
18a Deep Excavation - 20-32ft	Cubic Yard			$ -
19 Excavation Wall Stabilization (Soldier piles, Sheet piling, etc.)	Square Feet	$ 45	10,795	$ 485,775
20 Temporary Enclosure	Month	$ 104,762	3.0	$ 314,286
21 Air Handling System - monthly rental	Month	$ 17,700	3.0	$ 53,100
22 Air Handling System - Mob./Demob./Carbon Changeout	Cubic Foot	$0.25	660,000	$ 165,000
23 Backup Odor Suppressant	Drum	$ 440	20	$ 8,800
24 Dewatering Treatment System	Lump Sum	$ 70,500	1	$ 70,500
25 Water Disposal Costs	Gallon	$0.05	2,500,000	$ 125,000
26 Disposal Costs and Hauling of Bulky Waste	Ton	$ 119	40	$ 4,749
27 Disposal Costs Hauling and Thermal Treatment	Ton	$ 90	21,026	$ 1,892,340
28 Backfill excavations	Cubic Yard	$ 45	12,710	$ 571,950
29 Topsoil placement and grading including 1-ft cover outside of excavation	Lump Sum	$ 50,000	1	$ 50,000
30 Seeding	Lump Sum	$ 20,000	1	$ 20,000
			Subtotal	$ 4,124,718
			% Total Costs	61%
In-Situ Groundwater Treatment and Long term monitoring and maintenance				
31 In-Situ Groundwater Treatment and Long term monitoring and maintenance	Year	$ 60,000	10	$ 463,304
assume I=5%			**Subtotal**	$463,304
Interest rate provided by NYSDEC			**% Total Costs**	7%
REMEDIAL COST SUMMARY				
Total Capital costs without contingency				$ 4,938,360
Total O & M costs				$ 463,304
Total Capital and O&M costs without contingency				$ 5,401,664
32 Allowance for undefined costs associated with utilities, subsurface structures, and extent of impacts.			25%	$ 1,350,416
			% TOTAL COSTS	20%
			TOTAL COST	**$ 6,752,080**
			ROUNDED COST	**$6,750,000**

Table A-3
Detailed Cost Estimate for OU-1 - Alternative 4 - Part 375 Residential
Clove and Maple MGP
Haverstraw, New York

Remedial Component	Unit	Unit Price	Quantity	Total Cost
COMMON COST COMPONENTS				
Preconstruction				
1 Engineering Design, Plans, Specs, Bid	Lump Sum	$ 200,000	1	$ 200,000
2 Permitting and Regulatory Submittals	Lump Sum	$ 75,000	1	$ 75,000
3 Pre Construction Analytical Sampling (design excavation limits and pre-characterization)	Lump Sum	$ 75,000	1	$ 75,000
			Subtotal	$ 350,000
			% Total Costs	4%
Construction Management				
4 Construction Oversight	Day	$ 1,068	85	$ 90,780
5 Air Monitoring during construction	Day	$ 775	68	$ 52,700
6 Air Monitoring System (Continuous VOC monitoring)	Month	$ 30,000	4.0	$ 120,000
7 Geotechnical and Structural Evaluation and Survey (for Maple Avenue)	Lump Sum	$ 10,000	1	$ 10,000
8 Site Survey (Preconstruction and Post-Remediation)	Acre	$ 5,000	1	$ 5,000
9 Completion Report	Lump Sum	$ 30,000	1	$ 30,000
10 Site Management Plan	Lump Sum	$ 20,000	1	$ 20,000
			Subtotal	$ 328,480
			% Total Costs	4%
General Conditions				
11 Mobilization/Demobilization	Lump Sum	$ 68,070	1	$ 68,070
12 Site Preparation (fence and shrub removal)	Lump Sum	$ 13,220	1	$ 13,220
13 Temporary Offices for construction period +2 months	Month	$ 358	6	$ 2,148
14 Temporary Utilities	Month	$ 1,189	6	$ 7,134
			Subtotal	$ 90,572
			% Total Costs	1%
Removal of former MGP structures				
15 Demolition of former gas holder concrete foundation	Square feet	$ 22	3117	$ 68,574
16 Disposal Costs and Hauling of Bulky Waste	Ton	$ 119	234	$ 27,846
			Subtotal	$ 96,420
			% Total Costs	1%
REMEDIAL COMPONENTS				
Excavate and Backfill Materials				
17 Excavations to remove Unsaturated Soils	Cubic Yard	$ 19	6,966	$ 131,448
17a Excavations to remove Surface Soils Outside of Subsurface soil footprint	Cubic Yard	$ 19	1,300	$ 24,531
18 Excavations to remove Saturated Soils	Cubic Yard	$ 38	8,012	$ 302,453
18a Deep Excavation - 20-32ft	Cubic Yard			$ -
19 Excavation Wall Stabilization (Soldier piles, Sheet piling, etc.)	Square Feet	$ 45	9,470	$ 426,150
20 Temporary Enclosure	Month	$ 125,714	4.0	$ 502,856
21 Air Handling System - monthly rental	Month	$ 17,700	4.0	$ 70,800
22 Air Handling System - Mob./Demob./Carbon Changeout	Cubic Foot	$0.25	792,000	$ 198,000
23 Backup Odor Suppressant	Drum	$ 440	20	$ 8,800
24 Dewatering Treatment System	Lump Sum	$ 70,500	1	$ 70,500
25 Water Disposal Costs	Gallon	$0.05	2,500,000	$ 125,000
26 Disposal Costs and Hauling of Bulky Waste	Ton	$ 119	40	$ 4,749
27 Disposal Costs Hauling and Thermal Treatment	Ton	$ 90	26,820	$ 2,413,800
28 Backfill excavations	Cubic Yard	$ 45	16,278	$ 732,510
29 Topsoil placement and grading including 1-ft cover outside of excavation	Lump Sum	$ 50,000	1	$ 50,000
30 Seeding	Lump Sum	$ 20,000	1	$ 20,000
			Subtotal	$ 5,081,597
			% Total Costs	63%
In-Situ Groundwater Treatment and Long term monitoring and maintenance				
31 In-Situ Groundwater Treatment and Long term monitoring and maintenance	Year	$ 60,000	10	$ 463,304
assume I=5%			**Subtotal**	$463,304
Interest rate provided by NYSDEC			**% Total Costs**	6%
REMEDIAL COST SUMMARY				
Total Capital costs without contingency				$ 5,947,069
Total O & M costs				$ 463,304
Total Capital and O&M costs without contingency				$ 6,410,373
32 Allowance for undefined costs associated with utilities, subsurface structures, and extent of impacts.			25%	$ 1,602,593
			% TOTAL COSTS	20%
			TOTAL COST	**$ 8,012,967**
			ROUNDED COST	**$8,000,000**

Table A-4
Detailed Cost Estimate for OU-1 - Alternative 5 - Part 375 Unrestricted
Clove and Maple MGP
Haverstraw, New York

Remedial Component	Unit	Unit Price	Quantity	Total Cost
COMMON COST COMPONENTS				
Preconstruction				
1 Engineering Design, Plans, Specs, Bid	Lump Sum	$ 200,000	1	$ 200,000
2 Permitting and Regulatory Submittals	Lump Sum	$ 75,000	1	$ 75,000
3 Pre Construction Analytical Sampling (design excavation limits and pre-characterization)	Lump Sum	$ 100,000	1	$ 100,000
			Subtotal	$ 375,000
			% Total Costs	3%
Construction Management				
4 Construction Oversight	Day	$ 1,068	127	$ 135,636
5 Air Monitoring during construction	Day	$ 775	102	$ 79,050
6 Air Monitoring System (Continuous VOC monitoring)	Month	$ 30,000	6.0	$ 180,000
7 Geotechnical and Structural Evaluation and Survey (for Maple Avenue)	Lump Sum	$ 10,000	1	$ 10,000
8 Site Survey (Preconstruction and Post-Remediation)	Acre	$ 5,000	1	$ 5,000
9 Completion Report	Lump Sum	$ 40,000	1	$ 40,000
10 Site Management Plan	Lump Sum	$ -		$ -
			Subtotal	$ 449,686
			% Total Costs	4%
General Conditions				
11 Mobilization/Demobilization	Lump Sum	$ 68,070	1	$ 68,070
12 Site Preparation (fence and shrub removal)	Lump Sum	$ 13,220	1	$ 13,220
13 Temporary Offices for construction period +2 months	Month	$ 358	8	$ 2,864
14 Temporary Utilities	Month	$ 1,189	8	$ 9,512
			Subtotal	$ 93,666
			% Total Costs	1%
Removal of former MGP structures				
15 Demolition of former gas holder concrete foundation	Square feet	$ 22	3117	$ 68,574
16 Disposal Costs and Hauling of Bulky Waste	Ton	$ 119	234	$ 27,846
			Subtotal	$ 96,420
			% Total Costs	1%
REMEDIAL COMPONENTS				
Excavate and Backfill Materials				
17 Excavations to remove Unsaturated Soils	Cubic Yard	$ 19	7,518	$ 141,865
17a Excavations to remove Surface Soils Outside of Subsurface soil footprint	Cubic Yard	$ 19	1,300	$ 24,531
18 Excavations to remove Saturated Soils	Cubic Yard	$ 38	11,489	$ 433,710
18a Deep Excavation - 20-32ft	Cubic Yard	$ 100	2,000	$ 200,000
19 Excavation Wall Stabilization (Soldier piles, Sheet piling, etc.)	Square Feet	$ 45	10,170	$ 457,650
20 Temporary Enclosure	Month	$ 146,666	6.0	$ 879,996
21 Air Handling System - monthly rental	Month	$ 17,700	6.0	$ 106,200
22 Air Handling System - Mob./Demob./Carbon Changeout	Cubic Foot	$0.25	924,000	$ 231,000
23 Backup Odor Suppressant	Drum	$ 440	20	$ 8,800
24 Dewatering Treatment System	Lump Sum	$ 70,500	1	$ 70,500
25 Water Disposal Costs	Gallon	$0.05	3,750,000	$ 187,500
26 Disposal Costs and Hauling of Bulky Waste	Ton	$ 119	40	$ 4,749
27 Disposal Costs Hauling and Thermal Treatment	Ton	$ 90	37,506	$ 3,375,540
28 Backfill excavations	Cubic Yard	$ 45	22,306	$ 1,003,770
29 Topsoil placement and grading including 1-ft cover outside of excavation	Lump Sum	$ 50,000	1	$ 50,000
30 Seeding	Lump Sum	$ 20,000	1	$ 20,000
			Subtotal	$ 7,195,810
			% Total Costs	64%
Post-remediation confirmatory monitoring				
31 Post-remediation Confirmatory Monitoring	Year	$ 50,000	3	$ 136,162
assume I=5%			**Subtotal**	$136,162
Interest rate provided by NYSDEC			**% Total Costs**	1%
REMEDIAL COST SUMMARY				
Total Capital costs without contingency				$ 8,210,582
Total post remediation confirmatory monitoring costs				$ 136,162
Total Capital and O&M costs without contingency				$ 8,346,745
32 Allowance for undefined costs associated with utilities, subsurface structures, and extent of impacts.			35%	$ 2,921,361
			% TOTAL COSTS	26%
			TOTAL COST	**$ 11,268,105**
			ROUNDED COST	**$11,270,000**

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Temporary Utilities

	Rate	Units				
RS Means 2009 01 51 13.80						$591
Heat, 24 hours 2-20X8 trailers	$66	CSF flr	3.2	=	$211	
Power for Job Duration	$52	CSF flr	3.2	=	$165	
Temp Const Water Bill	$68	Month	3.1	=	$214	
RS Means 2009 01 52 13.20						$1,126
Trailers, Funished (2-20X8)	$358	Month	3.1	=	$1,126	
RS Means 2009 01 52 13.40						$796
Telephone	$88	Month	3.1	=	$277	
Lights & HVAC	$165	Month	3.1	=	$519	
RS Means 2009 01 54 33						$2,359
Toilet Chemical (6410)	$750	Month	3.1	=	$2,359	
						$4,872

Mobilization/Demobilization

RS Means 2009 01 54 36.50 0100, 2500	Rate	Units			
Excavator, Mob up to 25 miles >150 HP	$420	ea	2	=	$840
Additional Miliage (75 miles total)	+10%	per 5 miles	100%	=	$840
Small Towed Equipment (4 pieces)	$318	ea	5	=	$1,590
Tempoary Security (01 56 32)	$45	Hr	1440	=	$64,800
					$68,070

Site Preparations

Temporary Fencing					
RS Means 2009 01 56 26.50					
Clain Link, 6' high, 11 ga	$11	LF	800	=	$8,920
Minor Site Demolition					
RS Means 2009 02 41 13.33 1200					
Masonary Walls, Brick, Solid	$5	CF		=	$0
Clear and Grub Site					
RS Means 2009 31 11 10.10 7040					
Tree Removal, congested area, Lift Truck 8"	$430	EA	10	=	$4,300
					$13,220

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Item 20

Temporary Enclosure 100'x220' = 22,000 total SF - Commercial

From Nyack Phase 1 - 280'x150' =	42,000	sf	$600,000	3	mo
$104,761.90 per month					

Temporary Enclosure 120'x220' = 26,400 total SF - Residential Resricted/Residential

From Nyack Phase 1 - 280'x150' =	42,000	sf	$600,000	3	mo
$125,714.29 per month					

Temporary Enclosure 140'x220' = 30,800 total SF - Unrestricted

From Nyack Phase 1 - 280'x150' =	42,000	sf	$600,000	3	mo
$146,666.67 per month					

Items 21, 22

Air Handling System

Air Handling System Rental	Month	$17,700.00
Fabric Enclosure Volume - 220'x100'x30'	CF	660,000
Fabric Enclosure Volume - 220'x120'x30'	CF	792,000
Fabric Enclosure Volume - 220'x140'x30'	CF	924,000
Unit price based on a ratio of CF of air compared to 2005 quote from Sprung.		$0.25

Items 24,25

Dewatering Disposal

Reference:
O&R Contract # LS-02292-4-22,
RAI Pay App 3, 31-Mar-05,
Creamer Environmental,
Job# 05-0258 - Haverstraw IRM

Temporary Water Treatment Plant Mob/Setup - LS - $70,500

Water Treatment and Discharge - $0.05/Gal

Item 27

Disposal Cost Hauling and Thermal Treatment $90/Ton per Item 24 reference

Item 28

Imported Backfill Costs

Select Grandular Fill RS Means 2009 31 23 23.15 5000			$16.15	per Bank C.Y
Hauling RS Means 2009 31 23 23.20 4672			$10.60	per Loose C.Y
20 CY Truck, 30 min wait/ld/unld/, 35 MPH avg, 40 mile cylc				
Assume Fluff Factor BCY to LCY	1.200			
Unit Cost Localization Factor (White Plains, NY)	1.136			
	TOTAL COST	Cubic Yards	$32.80	per CY Compacted ie BCY

Fill & Compact Costs

Assumes Spreading by hand - RS Means 2009 31 23 23.17 0100			$32.50	per Loose C.Y
Assume Fluff Factor BCY to LCY	1.200		$27.08	per CY Compacted
Compaction using Vibratory Plate - RS Means 2009 31 23 23.23 7220			$1.17	per Embankment .C.Y
18" Vibrating Plate, 12" lifts, 3 passes				
	TOTAL COST	Cubic Yards	$32.10	per CY Compacted ie BCY
	TOTAL FILL COST		$64.89	per CY Compacted ie BCY

Item 29

Topsoil and Seeding Costs

Topsoil Placement and Grading RS Means 2009 32 91 19.13 0800	$4.94	per S.Y.
Hydro-seeding RS Means 2009 32 92 19.14 4200	$50.00	per M.S.F

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Client: Orange & Rockland

Subject: Haverstraw Clove & Maple Commercial Excavation

BASE RATE : OU-1 Commercial Material Excavation

Unsaturated Excavations				5,305	CY			
5,305	CY	X	850	CY/Day	=	6.2	Days	
Saturated Excavations				8,012	CY			
8,012	CY	X	850	CY/Day	=	9	Days	

MODIFIED RATE

Assumptions

Standard Excavation Rate for 2.5 CY Bucket Excavator ~ 850 CY per 8 hr day or ~106 CY per hour

Assume 40% efficiency due to direct load, limited staging area, and remnant structures

Therefore excavation rate decreases to ~ 42 CY per hour or ~ 339 CY per 8 hour day

The excavation rate is based on 339 CY per day or ~610 tons per day

RS Means Heavy Construction 2009 Crew B-12S, B-20A (Labor Foreman Only)

Unit Cost Localization Factor (White Plains, NY) 1.136

	Excavation Rate CY	Total CY Excavated	Days Required
Unsaturated	339	5305	16
Saturated	169.5	8012	47
			63
Saturated Excavations		8012	47
Days of Dewatering			47

Item 17 - Unsaturated Excavation

	Hr Rate	Hrs Day	Days	Costs
Excavator Hourly Rate	$253	8	16	$31,659
Dozer Hourly Rate	$175	8	16	$21,965
Operator Rate(2)	$145	8	16	$18,190
Laborer Rate (3)	$167	8	16	$20,906
Laborer Rate Forman	$59	8	16	$7,410
Excavation Total				$100,130
Total CY Excavated				5305
Cost per CY Excavated				**$18.87**

Item 19

Excavation Wall Stabilization

Depth	LF	Area
15	415	6225
18	95	1710
22	130	2860
Total S.F.		10795
"@ $45/S.F		$485,775

Item 18 - Saturated Excavation

	Hr Rate	Hrs Day	Days	Costs
Excavator Hourly Rate	$253	8	47	$95,629
Dozer Hourly Rate	$175	8	47	$66,346
Operator Rate(2)	$145	8	47	$54,943
Laborer Rate (3)	$167	8	47	$63,148
Laborer Rate Forman	$59	8	47	$22,381
Excavation Total				$302,446
Total CY Excavated				6535
Cost per CY Excavated				**$46.28**

Total Construction Management Time

CONTINUOUS WORK

	Days	Weeks	Months
Excavation	63	13	3.1
Total CM	79	16	4

	Tons	Per Truck	Trucks
Excavation Rate	400	20	20.0
Excavation Rate	200	20	10.0

GEI Consultants

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Client: Orange & Rockland

Subject: Haverstraw Clove & Maple Residential

BASE RATE : OU-1 Residential Material Excavation

Unsaturated Excavations			6,966	CY				
6,966	CY	X	850	CY/Day	=	8.2	Days	
Saturated Excavations			8,012	CY				
8,012	CY	X	850	CY/Day	=	9	Days	

MODIFIED RATE

Assumptions

Standard Excavation Rate for 2.5 CY Bucket Excavator ~ 850 CY per 8 hr day or ~106 CY per hour

Assume 40% efficiency due to direct load, limited staging area, and remnant structures

Therefore excavation rate decreases to ~ 42 CY per hour or ~ 339 CY per 8 hour day

The excavation rate is based on 339 CY per day or ~610 tons per day

RS Means Heavy Construction 2009 Crew B-12S, B-20A (Labor Foreman Only)

Unit Cost Localization Factor (White Plains, N 1.136

	Excavation Rate CY	Total CY Excavated	Days Required
Unsaturated	339	6966	21
Saturated	169.5	8012	47
			68
Saturated Excavations		8012	47
Days of Dewatering			47

***Item 17 -* Unsaturated Excavation**

	Hr Rate	Hrs Day	Days	Costs
Excavator Hourly Rate	$253	8	21	$41,572
Dozer Hourly Rate	$175	8	21	$28,842
Operator Rate(2)	$145	8	21	$23,885
Laborer Rate (3)	$167	8	21	$27,452
Laborer Rate Forman	$59	8	21	$9,729
Excavation Total				$131,480
Total CY Excavated				6966
Cost per CY Excavated				**$18.87**

Item 19

Excavation Wall Stabilization

Depth	LF	Area
10	72	720
15	558	8370
22	50	1100
Total S.F.		9470
"@ $45/S.F		$426,150

***Item 18 -* Saturated Excavation**

	Hr Rate	Hrs Day	Days	Costs
Excavator Hourly Rate	$253	8	47	$95,629
Dozer Hourly Rate	$175	8	47	$66,346
Operator Rate(2)	$145	8	47	$54,943
Laborer Rate (3)	$167	8	47	$63,148
Laborer Rate Forman	$59	8	47	$22,381
Excavation Total				$302,446
Total CY Excavated				8012
Cost per CY Excavated				**$37.75**

Total Construction Management Time

CONTINUOUS WORK

	Days	Weeks	Months
Excavation	68	14	3.4
Total CM	85	17	4

	Tons	Per Truck	Trucks
Excavation Rate	400	20	20.0
Excavation Rate	200	20	10.0

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		Approved	By

BASE RATE : OU-1 Residential Restricted Material Excavation

Unsaturated Excavations			6,910	CY				
6,910	CY	X	850	CY/Day	=	8.1	Days	
Saturated Excavations			8,012	CY				
8,012	CY	X	850	CY/Day	=	9	Days	

MODIFIED RATE

Assumptions

Standard Excavation Rate for 2.5 CY Bucket Excavator ~ 850 CY per 8 hr day or ~106 CY per hour

Assume 40% efficiency due to direct load, limited staging area, and remnant structures

Therefore excavation rate decreases to ~ 42 CY per hour or ~ 339 CY per 8 hour day

The excavation rate is based on 339 CY per day or ~610 tons per day

RS Means Heavy Construction 2009 Crew B-12S, B-20A (Labor Foreman Only)

Unit Cost Localization Factor (White Plains, 1.136

	Excavation Rate CY	Total CY Excavated	Days Required
Unsaturated	339	6910	20
Saturated	169.5	8012	47
			68
Saturated Excavations		8012	47
Days of Dewatering			47

***Item 17 -* Unsaturated Excavation**

	Hr Rate	Hrs Day	Days	Costs
Excavator Hourly Rate	$253	8	20	$41,238
Dozer Hourly Rate	$175	8	20	$28,610
Operator Rate(2)	$145	8	20	$23,693
Laborer Rate (3)	$167	8	20	$27,231
Laborer Rate Forman	$59	8	20	$9,651
Excavation Total				$130,423
Total CY Excavated				6910
Cost per CY Excavated				**$18.87**

Item 19

Excavation Wall Stabilization

Depth	LF	Area
8	72	576
10	28	280
15	530	7950
18	0	0
22	50	1100
Total S.F.		9050
"@ $45/S.F		$407,250

***Item 18 -* Saturated Excavation**

	Hr Rate	Hrs Day	Days	Costs
Excavator Hourly Rate	$253	8	47	$95,629
Dozer Hourly Rate	$175	8	47	$66,346
Operator Rate(2)	$145	8	47	$54,943
Laborer Rate (3)	$167	8	47	$63,148
Laborer Rate Forman	$59	8	47	$22,381
Excavation Total				$302,446
Total CY Excavated				7749
Cost per CY Excavated				**$39.03**

Total Construction Management Time

	CONTINUOUS WORK		
	Days	**Weeks**	**Months**
Excavation	68	14	3.4

	Tons	Per Truck	Trucks
Excavation Rate	400	20	20.0
Excavation Rate	200	20	10.0

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	Approved	By	

BASE RATE : OU-1 Unrestricted Material Excavation

Unsaturated Excavations 7,518 CY

7,518 CY X 850 CY/Day = 8.8 Days

Saturated Excavations 13,489 CY

13,489 CY X 850 CY/Day = 16 Days

MODIFIED RATE

Assumptions

Standard Excavation Rate for 2.5 CY Bucket Excavator ~ 850 CY per 8 hr day or ~106 CY per hour

Assume 40% efficiency due to direct load, limited staging area, and remnant structures

Therefore excavation rate decreases to ~ 42 CY per hour or ~ 339 CY per 8 hour day

The excavation rate is based on 339 CY per day or ~610 tons per day

RS Means Heavy Construction 2009 Crew B-12S, B-20A (Labor Foreman Only)

Unit Cost Localization Factor (White Plains, N 1.136

	Excavation Rate CY	Total CY Excavated	Days Required
Unsaturated	339	7518	22
Saturated	169.5	13489	80
			102

Saturated Excavations	13489	80
Days of Dewatering		80

***Item 17 -* Unsaturated Excavation**

	Hr Rate	Hrs Day	Days	Costs
Excavator Hourly Rate	$253	8	22	$44,866
Dozer Hourly Rate	$175	8	22	$31,128
Operator Rate(2)	$145	8	22	$25,778
Laborer Rate (3)	$167	8	22	$29,627
Laborer Rate Forman	$59	8	22	$10,500
Excavation Total				$141,899
Total CY Excavated				7518
Cost per CY Excavated				**$18.87**

Item 19

Excavation Wall Stabilization

Depth	LF	Area
12	115	1380
15	190	2850
18	330	5940
Total S.F.		10170
"@ $45/S.F		$457,650

***Item 18 -* Saturated Excavation**

	Hr Rate	Hrs Day	Days	Costs
Excavator Hourly Rate	$253	8	80	$161,001
Dozer Hourly Rate	$175	8	80	$111,700
Operator Rate(2)	$145	8	80	$92,502
Laborer Rate (3)	$167	8	80	$106,315
Laborer Rate Forman	$59	8	80	$37,680
Excavation Total				$509,198
Total CY Excavated				13489
Cost per CY Excavated				**$37.75**

***Item 18a -* Deep Excavation**

Defined as 20-32 ft bgs Cost Surcharge 100% $100/CY

Total Construction Management Time

	CONTINUOUS WORK		
	Days	**Weeks**	**Months**
Excavation	102	20	5.1
Total CM	127	25	6

	Tons	**Per Truck**	**Trucks**
Excavation Rate	400	20	20.0
Excavation Rate	200	20	10.0

Table A-5
Detailed Cost Estimate for OU-2
Alternative 2 - NAPL Recovery
Clove and Maple MGP
Haverstraw, New York

Remedial Component	Unit	Unit Price	Quantity	Total Cost
COMMON COST COMPONENTS				
Preconstruction				
1 Engineering Design, Plans, Specs, Bid	Lump Sum	$ 50,000	1	$ 50,000
2 Permitting and Regulatory Submittals, and IC/EC	Lump Sum	$ 100,000	1	$ 100,000
3 Pre Construction Pilot Testing	Lump Sum	$ 100,000	1	$ 100,000
			Subtotal	$ 250,000
			% Total Costs	8%
Construction Management				
4 Construction Oversight	Day	$ 1,068	60	$ 64,080
5 Air Monitoring during construction	Day	$ 775	60	$ 46,500
6 Air Monitoring System (Continuous VOC monitoring)	Month	$ 30,000	2.0	$ 60,000
8 Site Survey (Preconstruction and Post-well installation)	Lump Sum	$ 5,000	1	$ 5,000
9 Completion Report	Lump Sum	$ 40,000	1	$ 40,000
10 Site Management Plan	Lump Sum	$ 20,000	5	$ 100,000
			Subtotal	$ 315,580
			% Total Costs	11%
General Conditions				
11 Mobilization/Demobilization, MNA Wells	Lump Sum	$ 68,070	1	$ 68,070
12 Site Preparation (fence and shrub removal)	Lump Sum	$ -	1	$ -
13 Temporary Offices for construction period +2 months	Month	$ 358	2	$ 716
14 Temporary Utilities	Month	$ 1,189	2	$ 2,378
			Subtotal	$ 71,164
			% Total Costs	2%
REMEDIAL COMPONENTS				
Containment and NAPL Recovery				
NAPL Recovery System	Lump Sum	$ 245,000	1	$ 245,000
			Subtotal	$ 245,000
			% Total Costs	8%
Long term monitoring and maintenance				
31 In Situ Treatment, MNA Monitoring, Reporting, and Maintenance (Assume I=5%)	Year	$ 60,000	30	$ 922,347
NAPL Recovery O&M	Year	$ 75,000	10	$ 579,130
Interest rate provided by NYSDEC			**Subtotal**	$1,501,477
NAPL Recovery System Capital Cost per Table 6a		**781744**	**% Total Costs**	50%
REMEDIAL COST SUMMARY				
Total Capital costs without contingency				$ 881,744
Total O & M costs				$ 1,501,477
Total Capital and O&M costs without contingency				$ 2,383,221
32 Allowance for undefined costs associated with utilities, subsurface structures, and extent of impacts.			25%	$ 595,805
			% TOTAL COSTS	20%
			TOTAL COST	**$ 2,979,026**

Table A-6

Detailed Cost Estimate for OU-2
Alternative 3 - Phase I - NAPL Recovery and West Street Single Family Residential Excavation
Clove and Maple MGP
Haverstraw, New York

Remedial Component	Unit	Unit Price	Quantity	Total Cost
COMMON COST COMPONENTS				
Preconstruction				
1 Engineering Design, Plans, Specs, Bid	Lump Sum	$ 200,000	1	$ 200,000
2 Permitting and Regulatory Submittals, and IC/EC	Lump Sum	$ 150,000	1	$ 150,000
3 Pre Construction Analytical Sampling (design excavation limits and pre-characterization)	Lump Sum	$ 100,000	1	$ 100,000
			Subtotal	$ 450,000
			% Total Costs	6%
Construction Management				
4 Construction Oversight	Day	$ 1,068	71	$ 75,828
5 Air Monitoring Labor during construction	Day	$ 775	47	$ 36,425
6 Air Monitoring System Rental and Lab (Continuous VOC monitoring)	Month	$ 30,000	3.0	$ 90,000
7 Geotechnical and Structural Evaluation and Survey (for Maple Avenue)	Lump Sum	$ 30,000	1	$ 30,000
8 Site Survey (Preconstruction and Post-Remediation)	Acre	$ 15,000	1	$ 15,000
9 Completion Report	Lump Sum	$ 40,000	1	$ 40,000
10 Site Management Plans for 4 Single Family Residences and Apartment Complex and Village	Each	$ 15,000	6	$ 90,000
10a Site Management Plans for 6 Single Family Residences	Each	$ 15,000	6	$ 90,000
			Subtotal	$ 467,253
			% Total Costs	7%
General Conditions				
11 Mobilization/Demobilization	Lump Sum	$ 68,070	1	$ 68,070
12 Site Preparation (fence and shrub removal)	Lump Sum	$ 13,220	1	$ 13,220
13 Temporary Offices for construction period +2 months	Month	$ 358	5	$ 1,790
13a Temporary relocation of 6 resident households for construction period	Month	$ 18,000	3	$ 54,000
14 Temporary Utilities	Month	$ 1,189	5	$ 5,945
			Subtotal	$ 143,025
			% Total Costs	2%
Removal of former MGP structures - NOT APPLICABLE				
15 Demolition of former gas holder concrete foundation	Square feet			$ -
16 Disposal Costs and Hauling of Bulky Waste	Ton			$ -
			Subtotal	$ -
			% Total Costs	0%
REMEDIAL COMPONENTS				
NAPL Recovery and In-Situ Groundwater Treatment				
NAPL Recovery System Capital Cost per Table 6a	Lump Sum	$ 781,744	1	$ 781,744
				$ -
			Subtotal	$ 781,744
			% Total Costs	11%
<u>West Street Single Family - Source and Part 375 Residential</u>				
17 Excavations to remove Unsaturated Soils	Cubic Yard	$ 19	1,976	$ 37,287
18 Excavations to remove Saturated Soils	Cubic Yard	$ 38	7,009	$ 264,590
18a Deep Excavation - 20-32ft	Cubic Yard	$ 100	-	$ -
19 Excavation Wall Stabilization (Soldier piles, Sheet piling, etc.)	Square Feet	$ 45	12,300	$ 553,500
20 Temporary Enclosure	Month	$ 70,000	0.0	$ -
20a Temporary Enclosure Movement	Each	$ 70,000	0.0	$ -
20b Temporary Enclosure Mob/Set-up/Break down/Demob	LS	$ 207,000	0.0	$ -
21 Air Handling System - monthly rental	Month	$ 17,700	0.0	$ -
22 Air Handling System - Mob./Demob./Carbon Changeout	Cubic Foot	$0.25	-	$ -
23 Backup Odor Suppressant	Drum	$ 440	50	$ 22,000
24 Dewatering Treatment System	Lump Sum	$ 70,500	1	$ 70,500
25 Water Disposal Costs	Gallon	$0.05	5,000,000	$ 250,000
26 Disposal Costs and Hauling of Bulky Waste	Ton	$ 119	-	$ -
27 Disposal Costs Hauling and Thermal Treatment	Ton	$ 90	15,579	$ 1,402,110
28 Backfill excavations	Cubic Yard	$ 45	8,984	$ 404,280
29 Topsoil placement and grading	Lump Sum	$ 50,000	1	$ 50,000
30 Seeding/ Paving and Landscaping	Lump Sum	$ 100,000	1	$ 100,000
			Subtotal	$ 3,154,267
			% Total Costs	45%
Operation, monitoring and maintenance				
31 Periodic Groundwater Monitoring, Reporting, and Maintenance	Year	$ 30,000	3	$ 90,000
32 NAPL Recovery O&M per Table 6a	Total	$ 579,130	1	$ 579,130
			Subtotal	$669,130
			% Total Costs	10%
Total Capital costs without contingency				$ 4,996,289
Total O & M costs				$ 579,130
Total Capital and O&M costs without contingency				$ 5,575,419
32 Allowance for undefined costs associated with utilities, subsurface structures, and extent of impacts.			25%	$ 1,393,855
			% TOTAL COSTS	20%
			TOTAL COST	**$ 6,969,274**

Table A-6
Detailed Cost Estimate for OU-2
Alternative 3 - Phase 2 - Apartment Complex and Maple Ave Single Family to Part 375 Residential
Clove and Maple MGP
Haverstraw, New York

Remedial Component	Unit	Unit Price	Quantity	Total Cost
COMMON COST COMPONENTS				
Preconstruction				
1 Engineering Design, Plans, Specs, Bid	Lump Sum	$ 450,000	1	$ 450,000
2 Permitting and Regulatory Submittals, and IC/EC	Lump Sum	$ 150,000	1	$ 150,000
3 Pre Construction Analytical Sampling (design excavation limits and pre-characterization)	Lump Sum	$ 100,000	1	$ 100,000
			Subtotal	$ 700,000
			% Total Costs	3%
Construction Management				
4 Construction Oversight	Day	$ 1,068	366	$ 390,888
5 Air Monitoring during construction	Day	$ 775	244	$ 189,100
6 Air Monitoring System (Continuous VOC monitoring)	Month	$ 30,000	12.0	$ 360,000
7 Geotechnical and Structural Evaluation and Survey (for Maple Avenue)	Lump Sum	$ 10,000	1	$ 10,000
8 Site Survey (Preconstruction and Post-Remediation)	Acre	$ 15,000	4	$ 60,000
9 Completion Report	Lump Sum	$ 100,000	1	$ 100,000
10 Site Management Plans Revisions for 4 Single Family Residences and Apartment Complex and Village	Each	$ 15,000	6	$ 90,000
10a Site Management Plan Revisions for 6 Single Family Residences	Each	$ 15,000	6	$ 90,000
			Subtotal	$ 1,289,988
			% Total Costs	5%
General Conditions				
11 Mobilization/Demobilization	Lump Sum	$ 68,070	1	$ 68,070
12 Site Preparation (fence and shrub removal)	Lump Sum	$ 13,220	1	$ 13,220
13 Temporary Offices for construction period +2 months	Month	$ 358	18	$ 6,444
14 Temporary Utilities	Month	$ 1,189	18	$ 21,402
			Subtotal	$ 109,136
			% Total Costs	0%
Removal of former MGP structures - NOT APPLICABLE				
15 Demolition of former gas holder concrete foundation	Square feet			$ -
16 Disposal Costs and Hauling of Bulky Waste	Ton			$ -
			Subtotal	$ -
			% Total Costs	0%
REMEDIAL COMPONENTS				
Apartment Complex and 111-117 Maple Ave - Source and Part 375 Residential				
17 Excavations to remove Unsaturated Soils	Cubic Yard	$ 19	19,007	$ 358,662
18 Excavations to remove Saturated Soils	Cubic Yard	$ 38	31,833	$ 1,201,696
18a Deep Excavation - 20-32ft	Cubic Yard	$ 100	-	$ -
19 Excavation Wall Stabilization Along Maple Ave (Soldier piles, Sheet piling, etc.)	Square Feet	$ 45	29,140	$ 1,311,300
19a Shoring Drainage Pipe	Square Feet	$ 60	8,920	$ 535,200
20 Temporary Enclosure	Month	$ 70,000	12.0	$ 840,000
20a Temporary Enclosure Movement	Each	$ 70,000	1.0	$ 70,000
20b Temporary Enclosure Mob/Set-up/Break down/Demob	LS	$ 207,000	1.0	$ 207,000
21 Air Handling System - monthly rental	Month	$ 17,700	16.0	$ 283,200
22 Air Handling System - Mob./Demob./Carbon Changeout	Cubic Foot	$0.25	1,260,000	$ 315,000
23 Backup Odor Suppressant	Drum	$ 440	20	$ 8,800
24 Dewatering Treatment System	Lump Sum	$ 70,500	1	$ 70,500
25 Water Disposal Costs	Gallon	$0.05	10,000,000	$ 500,000
26 Disposal Costs and Hauling of Bulky Waste (macadam)	Ton	$ 119	1,852	$ 219,852
27 Disposal Costs Hauling and Thermal Treatment	Ton	$ 90	85,890	$ 7,730,100
28 Backfill excavations	Cubic Yard	$ 45	50,839	$ 2,287,755
28a Replace Macadam	Square Feet	$ 4	80,000	$ 320,000
29 Topsoil placement and grading	Lump Sum	$ 60,000	1	$ 60,000
30 Seeding	Lump Sum	$ 15,000	1	$ 15,000
			Subtotal	$ 16,334,065
			% Total Costs	69%
Long term monitoring and maintenance				
31 Periodic MNA Monitoring, Reporting, and Maintenance assume I=5%	Year	$ -		$ -
In Situ Treatment of Groundwater	Year	$ 60,000	10	$ 463,304
Interest rate provided by NYSDEC			**Subtotal**	$463,304
			% Total Costs	2%
REMEDIAL COST SUMMARY				
Total Capital costs without contingency				$ 18,433,189
Total O & M costs				$ 463,304
Total Capital and O&M costs without contingency				$ 18,896,493
32 Allowance for undefined costs associated with utilities, subsurface structures, and extent of impacts.			25%	$ 4,724,123
			% TOTAL COSTS	20%
			TOTAL COST	**$ 23,620,616**

Phase 2 Would be completed in the future. The year of completion is not known.

A Present Value analysis based, for example, on Phase 2 being done 10 years in the future would be:

	Year	Rate	Future Cost	Present Value
Present Value of Future Cost	10	0.05	$ 23,620,616	$ 14,500,696.15

Table A-6a
Detailed Cost Estimate for OU-2
Alternatives 3 and 4 - NAPL Recovery Section
Clove and Maple MGP
Haverstraw, New York

Remedial Component	Unit	Unit Price	Quantity	Total Cost
COMMON COST COMPONENTS				
Preconstruction				
1 Engineering Design, Plans, Specs, Bid	Lump Sum	$ 50,000	1	$ 50,000
2 Permitting and Regulatory Submittals, and IC/EC	Lump Sum	$ 100,000	0	$ -
3 Pre Construction Pilot Testing	Lump Sum	$ 100,000	1	$ 100,000
			Subtotal	$ 150,000
			% Total Costs	11%
Construction Management				
4 Construction Oversight	Day	$ 1,068	60	$ 64,080
5 Air Monitoring during construction	Day	$ 775	60	$ 46,500
6 Air Monitoring System (Continuous VOC monitoring)	Month	$ 30,000	2.0	$ 60,000
8 Site Survey (Preconstruction and Post-well installation)	Lump Sum	$ 5,000	1	$ 5,000
9 Completion Report	Lump Sum	$ 40,000	1	$ 40,000
10 Site Management Plan	Lump Sum	$ 20,000	5	$ 100,000
			Subtotal	$ 315,580
			% Total Costs	23%
General Conditions				
11 Mobilization/Demobilization, MNA Wells	Lump Sum	$ 68,070	1	$ 68,070
12 Site Preparation (fence and shrub removal)	Lump Sum	$ -	1	$ -
13 Temporary Offices for construction period +2 months	Month	$ 358	2	$ 716
14 Temporary Utilities	Month	$ 1,189	2	$ 2,378
			Subtotal	$ 71,164
			% Total Costs	5%
REMEDIAL COMPONENTS				
Containment and NAPL Recovery				
NAPL Recovery System	Lump Sum	$ 245,000	1	$ 245,000
			Subtotal	$ 245,000
			% Total Costs	18%
Long term monitoring and maintenance				
31 Periodic MNA Monitoring, Reporting, and Maintenance (Assume I=5%)	Year	$ 50,000		$ -
In Situ Treatment of Groundwater	Year	$ 50,000	0	$ -
NAPL Recovery O&M	Year	$ 75,000	5	$ 579,130
Interest rate provided by NYSDEC			**Subtotal**	$579,130
			% Total Costs	43%
REMEDIAL COST SUMMARY				
Total Capital costs without contingency				$ 781,744
Total O & M costs				$ 579,130
Total Capital and O&M costs without contingency				$ 1,360,874
32 Allowance for undefined costs associated with utilities, subsurface structures, and extent of impacts.			0%	$ -
			% TOTAL COSTS	0%
			TOTAL COST	**$ 1,360,874**

Table A-7

Detailed Cost Estimate for OU-2

Alternative 4 - Phase I - NAPL Recovery , West Street Single Family Residential, MW32S Source Excavations

Clove and Maple MGP

Haverstraw, New York

Remedial Component	Unit	Unit Price	Quantity	Total Cost
COMMON COST COMPONENTS				
Preconstruction				
1 Engineering Design, Plans, Specs, Bid	Lump Sum	$ 350,000	1	$ 350,000
2 Permitting and Regulatory Submittals, and IC/EC	Lump Sum	$ 150,000	1	$ 150,000
3 Pre Construction Analytical Sampling (design excavation limits and pre-characterization)	Lump Sum	$ 100,000	1	$ 100,000
			Subtotal	$ 600,000
			% Total Costs	6%
Construction Management				
4 Construction Oversight	Day	$ 1,068	94	$ 100,392
5 Air Monitoring during construction	Day	$ 775	63	$ 48,825
6 Air Monitoring System (Continuous VOC monitoring)	Month	$ 30,000	3.0	$ 90,000
7 Geotechnical and Structural Evaluation and Survey (for Maple Avenue)	Lump Sum	$ 30,000	1	$ 30,000
8 Site Survey (Preconstruction and Post-Remediation)	Acre	$ 15,000	1	$ 15,000
9 Completion Report	Lump Sum	$ 40,000	1	$ 40,000
10 Site Management Plans for 4 Single Family Residences and Apartment Complex and Village	Each	$ 15,000	6	$ 90,000
10a Site Management Plans for 6 Single Family Residences	Each	$ 15,000	6	$ 90,000
			Subtotal	$ 504,217
			% Total Costs	5%
General Conditions				
11 Mobilization/Demobilization	Lump Sum	$ 68,070	1	$ 68,070
12 Site Preparation (fence and shrub removal)	Lump Sum	$ 13,220	1	$ 13,220
13 Temporary Offices for construction period +2 months	Month	$ 358	5	$ 1,790
13a Temporary relocation of 6 resident households for construction period	Month	$ 18,000	3	$ 54,000
14 Temporary Utilities	Month	$ 1,189	5	$ 5,945
			Subtotal	$ 143,025
			% Total Costs	2%
Removal of former MGP structures - NOT APPLICABLE				
15 Demolition of former gas holder concrete foundation	Square feet			$ -
16 Disposal Costs and Hauling of Bulky Waste	Ton			$ -
			Subtotal	$ -
			% Total Costs	0%
REMEDIAL COMPONENTS				
NAPL Recovery and In-Situ Groundwater Treatment				
NAPL Recovery System Capital Cost per Table 6a	Lump Sum	$ 781,744	1	$ 781,744
			Subtotal	$ 781,744
			% Total Costs	8%
<u>West Street Single Family and MW32s Area and Alleyway - Source and Part 375 Residential</u>				
17 Excavations to remove Unsaturated Soils	Cubic Yard	$ 19	2,857	$ 53,912
18 Excavations to remove Saturated Soils	Cubic Yard	$ 38	9,170	$ 346,168
18a Deep Excavation - 20-32ft	Cubic Yard	$ 100	-	$ -
19 Excavation Wall Stabilization (Soldier piles, Sheet piling, etc.)	Square Feet	$ 45	13,150	$ 591,750
19a Shoring Drainage Pipe	Square Feet	$ 60	2,720	$ 163,200
20 Temporary Enclosure (MW32S Excavation)	Month	$ 70,000	3.0	$ 210,000
20a Temporary Enclosure Movement	Each	$ 70,000	0.0	$ -
20b Temporary Enclosure Mob/Set-up/Break down/Demob	LS	$ 207,000	1.0	$ 207,000
21 Air Handling System - monthly rental	Month	$ 17,700	3.0	$ 53,100
22 Air Handling System - Mob./Demob./Carbon Changeout	Cubic Foot	$0.25	1,260,000	$ 315,000
23 Backup Odor Suppressant	Drum	$ 440	20	$ 8,800
24 Dewatering Treatment System	Lump Sum	$ 70,500	1	$ 70,500
25 Water Disposal Costs	Gallon	$0.05	5,000,000	$ 250,000
26 Disposal Costs and Hauling of Bulky Waste	Ton	$ 119	185	$ 21,985
27 Disposal Costs Hauling and Thermal Treatment	Ton	$ 90	20,790	$ 1,871,100
28 Backfill excavations	Cubic Yard	$ 45	12,026	$ 541,170
29 Topsoil placement and grading	Lump Sum	$ 50,000	1	$ 50,000
30 Seeding/ Paving and Landscaping	Lump Sum	$ 100,000	1	$ 100,000
			Subtotal	$ 4,853,684
			% Total Costs	51%
Operation, monitoring and maintenance				
31 Periodic Groundwater Monitoring, Reporting, and Maintenance	Year	$ 30,000	3	$ 90,000
32 NAPL Recovery O&M per Table 6a	Total	$ 579,130	1	$ 579,130
			Subtotal	$669,130
			% Total Costs	7%
REMEDIAL COST SUMMARY				
Total Capital costs without contingency				$ 6,882,670
Total O & M costs				$ 669,130
Total Capital and O&M costs without contingency				$ 7,551,800
32 Allowance for undefined costs associated with utilities, subsurface structures, and extent of impacts.			25%	$ 1,887,950
			% TOTAL COSTS	20%
			TOTAL COST	**$ 9,439,750**

Table A-7
Detailed Cost Estimate for OU-2
Alternative 4 - Phase 2 - Apartment Complex and Maple Ave Single Family to Part 375 Residential
Clove and Maple MGP
Haverstraw, New York

Remedial Component	Unit	Unit Price	Quantity	Total Cost
COMMON COST COMPONENTS				
Preconstruction				
1 Engineering Design, Plans, Specs, Bid	Lump Sum	$ 400,000	1	$ 400,000
2 Permitting and Regulatory Submittals, and IC/EC	Lump Sum	$ 150,000	1	$ 150,000
3 Pre Construction Analytical Sampling (design excavation limits and pre-characterization)	Lump Sum	$ 200,000	1	$ 100,000
			Subtotal	$ 650,000
			% Total Costs	3%
Construction Management				
4 Construction Oversight	Day	$ 1,068	346	$ 369,528
5 Air Monitoring during construction	Day	$ 775	231	$ 179,025
6 Air Monitoring System (Continuous VOC monitoring)	Month	$ 30,000	12.0	$ 360,000
7 Geotechnical and Structural Evaluation and Survey (for Maple Avenue)	Lump Sum	$ 10,000	1	$ 10,000
8 Site Survey (Preconstruction and Post-Remediation)	Acre	$ 15,000	4	$ 60,000
9 Completion Report	Lump Sum	$ 100,000	1	$ 100,000
10 Site Management Plan revisions for 4 Single Family Residences and Apartment Complex and	Each	$ 15,000	6	$ 90,000
10a Site Management Plan Revisions for 6 Single Family Residences	Each	$ 15,000	6	$ 90,000
			Subtotal	$ 1,258,553
			% Total Costs	6%
General Conditions				
11 Mobilization/Demobilization	Lump Sum	$ 68,070	1	$ 68,070
12 Site Preparation (fence and shrub removal)	Lump Sum	$ 13,220	1	$ 13,220
13 Temporary Offices for construction period +2 months	Month	$ 358	18	$ 6,444
14 Temporary Utilities	Month	$ 1,189	18	$ 21,402
			Subtotal	$ 109,136
			% Total Costs	0%
Removal of former MGP structures - NOT APPLICABLE				
15 Demolition of former gas holder concrete foundation	Square feet			$ -
16 Disposal Costs and Hauling of Bulky Waste	Ton			$ -
			Subtotal	$ -
			% Total Costs	0%
REMEDIAL COMPONENTS				
Apartment Complex and 111-117 Maple Ave - Source and Part 375 Residential				
17 Excavations to remove Unsaturated Soils	Cubic Yard	$ 19	17,490	$ 330,036
18 Excavations to remove Saturated Soils	Cubic Yard	$ 38	30,368	$ 1,146,392
18a Deep Excavation - 20-32ft	Cubic Yard	$ 100	-	$ -
19 Excavation Wall Stabilization (Soldier piles, Sheet piling, etc.)	Square Feet	$ 45	29,140	$ 1,311,300
19a Shoring Drainage Pipe	Square Feet	$ 60	6,200	$ 372,000
20 Temporary Enclosure	Month	$ 70,000	12.0	$ 840,000
20a Temporary Enclosure Movement	Each	$ 70,000	1.0	$ 70,000
20b Temporary Enclosure Mob/Set-up/Break down/Demob	LS	$ 207,000	1.0	$ 207,000
21 Air Handling System - monthly rental	Month	$ 17,700	12.0	$ 212,400
22 Air Handling System - Mob./Demob./Carbon Changeout	Cubic Foot	$0.25	1,260,000	$ 315,000
23 Backup Odor Suppressant	Drum	$ 440	20	$ 8,800
24 Dewatering Treatment System	Lump Sum	$ 70,500	1	$ 70,500
25 Water Disposal Costs	Gallon	$0.05	10,000,000	$ 500,000
26 Disposal Costs and Hauling of Bulky Waste (macadam)	Ton	$ 119	1,852	$ 219,852
27 Disposal Costs Hauling and Thermal Treatment	Ton	$ 90	80,896	$ 7,280,640
28 Backfill excavations	Cubic Yard	$ 45	47,857	$ 2,153,565
28a Replace Macadam	Square Feet	$ 4	50,000	$ 200,000
29 Topsoil placement and grading	Lump Sum	$ 60,000	1	$ 60,000
30 Seeding	Lump Sum	$ 15,000	1	$ 15,000
			Subtotal	$ 15,312,485
			% Total Costs	69%
Long term monitoring and maintenance				
31 Periodic MNA Monitoring, Reporting, and Maintenance assume I=5%	Year			$ -
In Situ Treatment of Groundwater	Year	$ 60,000	10	$ 463,304
Interest rate provided by NYSDEC			**Subtotal**	$463,304
			% Total Costs	2%
REMEDIAL COST SUMMARY				
Total Capital costs without contingency				$ 17,330,174
Total O & M costs				$ 463,304
Total Capital and O&M costs without contingency				$ 17,793,478
32 Allowance for undefined costs associated with utilities, subsurface structures, and extent of impacts.			25%	$ 4,448,370
			% TOTAL COSTS	20%
			TOTAL COST	**$ 22,241,848**

Phase 2 Would be completed in the future. The year of completion is not known.

A Present Value analysis based, for example, on Phase 2 being done 10 years in the future would be:

Present Value of Future Cost	Year	Rate	Future Cost	Present Value
	10	5%	$ 22,241,848	$ 13,654,270

Table A-8

Detailed Cost Estimate for OU-2
Alternative 5 - Total Removal Unrestricted
Clove and Maple MGP
Haverstraw, New York

Remedial Component	Unit	Unit Price	Quantity	Total Cost
COMMON COST COMPONENTS				
Preconstruction				
1 Engineering Design, Plans, Specs, Bid	Lump Sum	$ 400,000	1	$ 400,000
2 Permitting and Regulatory Submittals, and IC/EC	Lump Sum	$ 200,000	1	$ 200,000
3 Pre Construction Analytical Sampling (design excavation limits and pre-characterization)	Lump Sum	$ 200,000	1	$ 250,000
			Subtotal	$ 850,000
			% Total Costs	2%
Construction Management				
4 Construction Oversight	Day	$ 1,068	690	$ 736,920
5 Air Monitoring during construction	Day	$ 775	460	$ 356,500
6 Air Monitoring System (Continuous VOC monitoring)	Month	$ 30,000	23.0	$ 690,000
7 Geotechnical and Structural Evaluation and Survey (for Maple Avenue)	Lump Sum	$ 10,000	1	$ 10,000
8 Site Survey (Preconstruction and Post-Remediation)	Acre	$ 20,000	5	$ 100,000
9 Completion Report	Lump Sum	$ 100,000	1	$ 100,000
10 Site Management Plan	Lump Sum	$ 20,000	0	$ -
			Subtotal	$ 1,993,420
			% Total Costs	5%
General Conditions				
11 Mobilization/Demobilization	Lump Sum	$ 68,070	1	$ 68,070
12 Site Preparation (fence and shrub removal)	Lump Sum	$ 13,220	1	$ 13,220
13 Temporary Offices for construction period +2 months	Month	$ 358	34	$ 12,172
14 Temporary Utilities	Month	$ 1,189	34	$ 40,426
			Subtotal	$ 133,888
			% Total Costs	0%
Purchase, Demolition and Disposal of Apartment Complex and 111-117 Maple Ave				
15 Purchase of Apartment Complex and 111-117 Maple Ave	Lump Sum	$ 3,315,600	1	$ 3,315,600
16 Demolition and Disposal	Square Feet	$ 13	40,410	$ 525,330
			Subtotal	$ 3,840,930
			% Total Costs	9%
REMEDIAL COMPONENTS				
Total Removal - Unrestricted				
17 Excavations to remove Unsaturated Soils	Cubic Yard	$ 19	20,855	$ 393,534
18 NAPL Recovery System Capital Cost per Table 6a	Cubic Yard	$ 38	61,555	$ 2,323,701
18a Excavation of Maple Ave and utility replacement	Cubic Yard	$ 100	7,162	$ 716,200
19 Excavation Wall Stabilization Along Maple Ave (Soldier piles, Sheet piling, etc.)	Square Feet	$ 45	9,560	$ 430,200
19a Shoring Drainage Pipe	Square Feet	$ 60	8,920	$ 535,200
20 Temporary Enclosure	Month	$ 70,000	23.0	$ 1,610,000
20a Temporary Enclosure Movement	Each	$ 70,000	1.0	$ 70,000
20b Temporary Enclosure Mob/Set-up/Break down/Demob	LS	$ 207,000	1.0	$ 207,000
21 Air Handling System - monthly rental	Month	$ 17,700	23.0	$ 407,100
22 Air Handling System - Mob./Demob./Carbon Changeout	Cubic Foot	$0.25	1,260,000	$ 315,000
23 Backup Odor Suppressant	Drum	$ 440	20	$ 8,800
24 Dewatering Treatment System	Lump Sum	$ 70,500	1	$ 70,500
25 Water Disposal Costs	Gallon	$0.05	20,000,000	$ 1,000,000
26 Disposal Costs and Hauling of Bulky Waste (macadam)	Ton	$ 119	1,852	$ 219,852
27 Disposal Costs Hauling and Thermal Treatment	Ton	$ 90	154,251	$ 13,882,590
28 Backfill excavations	Cubic Yard	$ 45	89,572	$ 4,030,740
28a Replace Macadam	Square Feet	$ 4	80,000	$ 320,000
28b Replace Maple Ave Road Surface	Square Feet	$ 6	11,375	$ 69,160
29 Topsoil placement and grading	Lump Sum	$ 60,000	1	$ 60,000
30 Seeding	Lump Sum	$ 20,000	1	$ 20,000
			Subtotal	$ 26,689,577
			% Total Costs	63%
Post-remediation Confirmatory Monitoring				
31 Confirmatory Groundwater Monitoring	Year	$ 50,000	3	$ 136,162
assume I=5%			**Subtotal**	$136,162
Interest rate provided by NYSDEC			**% Total Costs**	0%
REMEDIAL COST SUMMARY				
Total Capital costs without contingency				$ 33,507,815
Total confirmatory monitoring costs				$ 136,162
Total Capital and O&M costs without contingency				$ 33,643,977
32 Allowance for undefined costs associated with utilities, subsurface structures, and extent of impacts.			25%	$ 8,410,994
			% TOTAL COSTS	20%
			TOTAL COST	**$ 42,054,972**

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OU-2 Mobilization	Checked		By
	Approved		By

	Rate	Units	Qty		Amount	Total
Temporary Utilities						
RS Means 2009 01 51 13.80	Rate	Units				$537
Heat, 24 hours 2-20X8 trailers	$66	CSF flr	3.2	=	$211	
Power for Job Duration	$52	CSF flr	3.2	#	$165	
Temp Const Water Bill	$68	Month	2.4	#	$160	
RS Means 2009 01 52 13.20						$845
Trailers, Funished (2-20X8)	$358	Month	2.4	=	$845	
RS Means 2009 01 52 13.40						$597
Telephone	$88	Month	2.4	=	$208	
Lights & HVAC	$165	Month	2.4	=	$389	
RS Means 2009 01 54 33						$1,769
Toilet Chemical (6410)	$750	#	2.4	=	$1,769	
						$3,748
Mobilization/Demobilization						
RS Means 2009 01 54 36.50 0100, 2500	Rate	Units				
Excavator, Mob up to 25 miles >150 HP	$420	ea	2	=	$840	
Fabric Enclosure Volume - 280'x130'x30'	+10%	per 5 miles	100%	=	$840	
Small Towed Equipment (4 pieces)	$318	ea	5	=	$1,590	
Tempoary Security (01 56 32)	$45	Hr	1440	=	$64,800	
					$68,070	
Site Preparations						
Temporary Fencing						
RS Means 2009 01 56 26.50						
Clain Link, 6' high, 11 ga	$11	LF	800	=	$8,920	
Minor Site Demolition						
RS Means 2009 02 41 13.33 1200						
Masonary Walls, Brick, Solid	$5	CF		=	$0	
Clear and Grub Site						
RS Means 2009 31 11 10.10 7040						
Tree Removal, congested area, Lift Truck 8"	$430	EA	10	=	$4,300	
					$13,220	

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Checked		By	
Approved		By	

Client: Orange & Rockland

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OU-2 General Notes

Item 20

Temporary Enclosure 130'x280" = 36400 total SF - Commercial

From Nyack Phase 1 - 280'x150' = 42,000 sf $600,000 3 mo

$173,333.33 per month

Mobilization and moving the tent during construction

Mobilization and Set up

Assume 2 crews to set up @ 3000 SF per day	12.1	Days
Assume 2 crews to break down @3000 SF per day	12.1	Days

Crane required to move tent in middle of project

Assume 1 crews to move tent in 1 days	1.0	Days

Item	Description	Qty	Unit	Unit Cost	Total
Item 20b	Mob/Demob Cost Transport	1	Lump Sum	$8,800	$8,800.00
Item 20b	Set Up/Break down Labor/Equip Costs	1	Lump Sum	$207,056	$207,056.27
Item 20a	Move Tent during project 1 crew 1 crane/op	1	Lump Sum	$70,000	$70,000

	Hr Rate	**Hrs Day**	**Days**	**Costs**
Crane Day Rate	$236	16	20	$75,600
Operator Rate	$43	16	20	$13,860
Laborer Rate (8)	$267	16	24	$103,667
Laborer Rate Forman	$36	16	24	$13,929
Setup Total				$207,056

Items 21, 22

Air Handling System

Air Handling System Rental	Month	$17,700.00
Fabric Enclosure Volume - 280'x130'x30'	CF	1,260,000
Fabric Enclosure Volume - 220'x120'x30'	CF	
Fabric Enclosure Volume - 220'x140'x30'	CF	
Unit price based on a ratio of CF of air compared to 2005 quote from Sprung.		$0.25

Items 24,25

Dewatering Disposal

Reference:
O&R Contract # LS-02292-4-22,
RAI Pay App 3, 31-Mar-05,
Creamer Environmental,
Job# 05-0258 - Haverstraw IRM

Temporary Water Treatment Plant Mob/Setup - LS - $70,500

Water Treatment and Discharge - $0.05/Gal

Item 27

Disposal Cost Hauling and Thermal Treatment $90/Ton per Item 24 reference

Item 28

Imported Backfill Costs, placement and compaction

$45 per CY - Reference Recent invoices from GEI Projects.

Item 29

Topsoil and Seeding Costs

Topsoil Placement and Grading RS Means 2009 32 91 19.13 0800	$4.94	per S.Y.
Hydro-seeding RS Means 2009 32 92 19.14 4200	$50.00	per M.S.F

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OU-2 - Alternative 3 - Phase I

BASE RATE : OU2 Source and Residential Material Excavation on Individual Properties

Unsaturated Excavations 1,976 CY

1,976 CY X 850 CY/Day = 2.3 Days

Saturated Excavations 7,009 CY

7,009 CY X 850 CY/Day = 8 Days

MODIFIED RATE

Assumptions

Standard Excavation Rate for 2.5 CY Bucket Excavator ~ 850 CY per 8 hr day or ~106 CY per hour

Assume 40% efficiency due to direct load, limited staging area, and remnant structures

Therefore excavation rate decreases to ~ 42 CY per hour or ~ 339 CY per 8 hour day

The excavation rate is based on 339 CY per day or ~610 tons per day

RS Means Heavy Construction 2009 Crew B-12S, B-20A (Labor Foreman Only)

Unit Cost Localization Factor (White Plains, NY) 1.136

	Excavation Rate CY	Total CY Excavated	Days Required
Unsaturated	339	1976	6
Saturated	169.5	7009	41
			47
Saturated Excavations		7009	41
Days of Dewatering			41

Fabric Enclosure Volume - 280'x130'x30'

	Hr Rate	Hrs Day	Days	Costs
Excavator Hourly Rate	$253	8	6	$11,792
Dozer Hourly Rate	$175	8	6	$8,181
Operator Rate(2)	$145	8	6	$6,775
Laborer Rate (3)	$167	8	6	$7,787
Laborer Rate Forman	$59	8	6	$2,760
Excavation Total				$37,296
Total CY Excavated				1976
Cost per CY Excavated				**$18.87**

Item : 0

Excavation Wall Stabilization

Depth		LF	Area
A	17	280	4760
B	12	70	840
C	10	370	3700
E	15	100	1500
F	15	100	1500
Total S.F.			12300
"@ $45/S.F			$553,500

Item 18 - **Saturated Excavation**

	Hr Rate	Hrs Day	Days	Costs
Excavator Hourly Rate	$253	8	41	$83,657
Dozer Hourly Rate	$175	8	41	$58,040
Operator Rate(2)	$145	8	41	$48,065
Laborer Rate (3)	$167	8	41	$55,242
Laborer Rate Forman	$59	8	41	$19,579
Excavation Total				$264,584
Total CY Excavated				7009
Cost per CY Excavated				**$37.75**

Total Construction Management Time

CONTINUOUS WORK

	Days	Weeks	Months
Excavation	47	9	2.4
Total CM	71	14	4

	Tons	Per Truck	Trucks
Excavation Rate	400	20	20.0
Excavation Rate	200	20	10.0

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Client: Orange & Rockland
Subject: Haverstraw Clove & Maple
OU-2 - Alternative 3 - Phase II

BASE RATE : OU2 Restricted Residential on Apartment Complex

Unsaturated Excavations 19,007 CY
19,007 CY X 850 CY/Day = 22.4 Days
Saturated Excavations 31,883 CY
31,883 CY X 850 CY/Day = 38 Days

MODIFIED RATE

Assumptions

Standard Excavation Rate for 2.5 CY Bucket Excavator ~ 850 CY per 8 hr day or ~106 CY per hour
Assume 30-40% efficiency due to direct load, limited staging area, and remnant structures
Therefore excavation rate decreases to ~ 32 CY per hour or ~ 255 CY per 8 hour day
The excavation rate is based on 255 CY per day or ~400 tons per day
RS Means Heavy Construction 2009 Crew B-12S, B-20A (Labor Foreman Only)
Unit Cost Localization Factor (White Plains, NY) 1.136

	Excavation Rate CY	Total CY Excavated	Days Required
Unsaturated	339	19007	56
Saturated	169.5	31883	188
			244
Saturated Excavations		31883	188
Days of Dewatering			188

***Item 17 -* Unsaturated Excavation**

	Hr Rate	Hrs Day	Days	Costs
Excavator Hourly Rate	$253	8	56	$113,431
Dozer Hourly Rate	$175	8	56	$78,697
Operator Rate(2)	$145	8	56	$65,171
Laborer Rate (3)	$167	8	56	$74,903
Laborer Rate Forman	$59	8	56	$26,547
Excavation Total				$358,749
Total CY Excavated				19,007
Cost per CY Excavated				**$18.87**

Item 19

Excavation Wall Stabilization

Depth	LF	Area
11	160	1760
14	150	2100
10	120	1200
Fab A 14	860	12040
Fab B 14	860	12040
Total S.F.		29140
"@ $45/S.F		$1,311,300

***Item 18 -* Saturated Excavation**

	Hr Rate	Hrs Day	Days	Costs
Excavator Hourly Rate	$253	8	188	$380,546
Dozer Hourly Rate	$175	8	188	$264,018
Operator Rate(2)	$145	8	188	$218,639
Laborer Rate (3)	$167	8	188	$251,290
Laborer Rate Forman	$59	8	188	$89,063
Excavation Total				$1,203,556
Total CY Excavated				31,833
Cost per CY Excavated				**$37.81**

Item 19a

Shoring Drainage Pipe

Depth	LF	Area
17	280	4760
6	160	960
14	100	1400
10	180	1800
Total S.F.		8920
"@ $60/S.F		$535,200

Total Construction Management Time

CONTINUOUS WORK

	Days	Weeks	Months
Excavation	244	49	12.2
Total CM	366	73	18

	Tons	Per Truck	Trucks
Excavation Rate	400	20	20.0
Excavation Rate	200	20	10.0

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Approved		By	

Client: Orange & Rockland

Subject: Haverstraw Clove & Maple

OU-2 Alternative #4 - Phase I

BASE RATE : OU2 MW32S Source and Residential Material Excavation on Individual Properties

Unsaturated Excavations 2,857 CY

2,857 CY X 850 CY/Day = 3.4 Days

Saturated Excavations 9,170 CY

9,170 CY X 850 CY/Day = 11 Days

MODIFIED RATE

Assumptions

Standard Excavation Rate for 2.5 CY Bucket Excavator ~ 850 CY per 8 hr day or ~106 CY per hour

Assume 40% efficiency due to direct load, limited staging area, and remnant structures

Therefore excavation rate decreases to ~ 42 CY per hour or ~ 339 CY per 8 hour day

The excavation rate is based on 339 CY per day or ~610 tons per day

RS Means Heavy Construction 2009 Crew B-12S, B-20A (Labor Foreman Only)

Unit Cost Localization Factor (White Plains, NY) 1.136

	Excavation Rate CY	Total CY Excavated	Days Required
Unsaturated	339	2857	8
Saturated	169.5	9170	54
			63
Saturated Excavations		9170	54
Days of Dewatering			54

Fabric Enclosure Volume - 280'x130'x30'

	Hr Rate	Hrs Day	Days	Costs
Excavator Hourly Rate	$253	8	8	$17,050
Dozer Hourly Rate	$175	8	8	$11,829
Operator Rate(2)	$145	8	8	$9,796
Laborer Rate (3)	$167	8	8	$11,259
Laborer Rate Forman	$59	8	8	$3,990
Excavation Total				$53,925
Total CY Excavated				2857
Cost per CY Excavated				**$18.87**

Item : 0

Excavation Wall Stabilization

Depth		LF	Area
A	17	140	2380
B	12	70	840
C	10	370	3700
E	15	100	1500
F	15	100	1500
MW32	17	190	3230
Total S.F.			13150
"@ $45/S.F			$591,750

***Item 18 -* Saturated Excavation**

	Hr Rate	Hrs Day	Days	Costs
Excavator Hourly Rate	$253	8	54	$109,450
Dozer Hourly Rate	$175	8	54	$75,935
Operator Rate(2)	$145	8	54	$62,884
Laborer Rate (3)	$167	8	54	$72,275
Laborer Rate Forman	$59	8	54	$25,616
Excavation Total				$346,160
Total CY Excavated				9170
Cost per CY Excavated				**$37.75**

Item 19a

Shoring Drainage Pipe

Depth		LF	Area
A	17	160	2720
B	12		0
C1	10		0
C2	15		0
D	15		0
Total S.F.			2720
"@ $45/S.F			$122,400

Total Construction Management Time

CONTINUOUS WORK

	Days	Weeks	Months
Excavation	63	13	3.1
Total CM	94	19	5

	Tons	Per Truck	Trucks
Excavation Rate	400	20	20.0
Excavation Rate	200	20	10.0

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OU-2 Alternative 4 - Phase II	Checked	By	
	Approved	By	

BASE RATE : Apartment Source

Unsaturated Excavations 17,490 CY

17,490 CY X 850 CY/Day = 20.6 Days

Saturated Excavations 30,368 CY

30,368 CY X 850 CY/Day = 36 Days

MODIFIED RATE

Assumptions

Standard Excavation Rate for 2.5 CY Bucket Excavator ~ 850 CY per 8 hr day or ~106 CY per hour

Assume 40% efficiency due to direct load, limited staging area, and remnant structures

Therefore excavation rate decreases to ~ 42 CY per hour or ~ 339 CY per 8 hour day

The excavation rate is based on 339 CY per day or ~610 tons per day

RS Means Heavy Construction 2009 Crew B-12S, B-20A (Labor Foreman Only)

Unit Cost Localization Factor (White Plains, NY) 1.136

	Excavation Rate CY	Total CY Excavated	Days Required
Unsaturated	339	17490	52
Saturated	169.5	30368	179
			231

Saturated Excavations	30368	179
Days of Dewatering		179

***Item 17 -* Unsaturated Excavation**

	Hr Rate	Hrs Day	Days	Costs
Excavator Hourly Rate	$253	8	52	$104,378
Dozer Hourly Rate	$175	8	52	$72,416
Operator Rate(2)	$145	8	52	$59,969
Laborer Rate (3)	$167	8	52	$68,925
Laborer Rate Forman	$59	8	52	$24,428
Excavation Total				$330,116
Total CY Excavated				17,490
Cost per CY Excavated				**$18.87**

Item 19

Excavation Wall Stabilization

Depth	LF	Area
11	160	1760
14	150	2100
10	120	1200
Fab 14	860	12040
Fab 14	860	12040
Total S.F.		29140
"@ $45/S.F		$1,311,300

***Item 18 -* Saturated Excavation**

	Hr Rate	Hrs Day	Days	Costs
Excavator Hourly Rate	$253	8	179	$362,464
Dozer Hourly Rate	$175	8	179	$251,472
Operator Rate(2)	$145	8	179	$208,250
Laborer Rate (3)	$167	8	179	$239,349
Laborer Rate Forman	$59	8	179	$84,831
Excavation Total				$1,146,366
Total CY Excavated				30,368
Cost per CY Excavated				**$37.75**

Item 19a

Shoring Drainage Pipe

Depth	LF	Area
17	120	2040
6	160	960
14	100	1400
10	180	1800
Total S.F.		6200
"@ $60/S.F		$372,000

Total Construction Management Time

CONTINUOUS WORK

	Days	Weeks	Months
Excavation	231	46	11.5
Total CM	346	69	17.3

	Tons	Per Truck	Trucks
Excavation Rate	400	20	20.0
Excavation Rate	200	20	10.0

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Subject: Haverstraw Clove & Maple OU-2 Alternative 5 Total Removal Unrestricted	Approved	By	

BASE RATE : Apartment Source

Unsaturated Excavations 23,260 CY

23,260 CY X 850 CY/Day = 27.4 Days

Saturated Excavations 66,311 CY

66,311 CY X 850 CY/Day = 78 Days

MODIFIED RATE

Assumptions

Standard Excavation Rate for 2.5 CY Bucket Excavator ~ 850 CY per 8 hr day or ~106 CY per hour

Assume 40% efficiency due to direct load, limited staging area, and remnant structures

Therefore excavation rate decreases to ~ 42 CY per hour or ~ 339 CY per 8 hour day

The excavation rate is based on 339 CY per day or ~610 tons per day

RS Means Heavy Construction 2009 Crew B-12S, B-20A (Labor Foreman Only)

Unit Cost Localization Factor (White Plains, N 1.136

	Excavation Rate CY	Total CY Excavated	Days Required
Unsaturated	339	23260	69
Saturated	169.5	66311	391
			460
Saturated Excavations		66311	391
Days of Dewatering			391

Fabric Enclosure Volume - 280'x130'x30'

	Hr Rate	Hrs Day	Days	Costs
Excavator Hourly Rate	$253	8	69	$138,812
Dozer Hourly Rate	$175	8	69	$96,306
Operator Rate(2)	$145	8	69	$79,753
Laborer Rate (3)	$167	8	69	$91,663
Laborer Rate Forman	$59	8	69	$32,487
Excavation Total				$439,022
Total CY Excavated				23,260
Cost per CY Excavated				**$18.87**

Item 0

Excavation Wall Stabilization

Depth	LF	Area
11	160	1760
14	150	2100
10	120	1200
25	180	4500
Total S.F.		9560
"@ $45/S.F		$430,200

***Item 18 -* Saturated Excavation**

	Hr Rate	Hrs Day	Days	Costs
Excavator Hourly Rate	$253	8	391	$791,469
Dozer Hourly Rate	$175	8	391	$549,110
Operator Rate(2)	$145	8	391	$454,731
Laborer Rate (3)	$167	8	391	$522,639
Laborer Rate Forman	$59	8	391	$185,235
Excavation Total				$2,503,183
Total CY Excavated				66,311
Cost per CY Excavated				**$37.75**

Item 19a

Shoring Drainage Pipe

Depth	LF	Area
17	280	4760
6	160	960
14	100	1400
10	180	1800
Total S.F.		8920
"@ $60/S.F		$535,200

Total Construction Management Time

CONTINUOUS WORK

	Days	Weeks	Months
Excavation	460	92	23.0
Total CM	690	138	34

	Tons	Per Truck	Trucks
Excavation Rate	400	20	20.0
Excavation Rate	200	20	10.0

Maple Ave

Excavation - $100/CY

Pavement base - Crushed 3/4 inch 9inches deep

32.11.23.23.0200 - 12.60/SY

Base Course **$6.08** **per s.f.**

32.22.26.13.0550 - 25.50/SY

Binder

32.12.16.13.0120 - 9/SY

Wearing Course

32.12.16.13.0340 - 7.60/SY

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Subject:	Haverstraw Clove & Maple	Approved		By	
	OU-2 Alternative 5 Total Removal Unrestricted Purchase and Demolition				

Demolition Costs Jul-10

Building	L	W	sq ft	# of Floors	unit cost $/sf	total
111 - 117 Maple	75	30	2250	2	$13.00	$58,500
2	72	35	2520	2	$13.00	$65,520
3	77	35	2695	2	$13.00	$70,070
4	154	35	5390	2	$13.00	$140,140
5	90	35	3150	2	$13.00	$81,900
6	120	35	4200	2	$13.00	$109,200

Demolition and Disposal of demolition debris
$13 per SF

Total **$525,330**

Demolition and disposal complete unit costs from
Capital Industries Demolition Service in Yonkers, NY at (914) 368-7923.

House Number	Street	Property Type	Tax Map Section 27.62 Lot Number	Estimated Property Value (July 22, 2010)
111	Maple Ave	Private Res	21	$159,700
113	Maple Ave	Private Res	20	$195,800
115	Maple Ave	Private Res	19	$195,800
117	Maple Ave	Private Res	18	$159,700
119 - 125	Maple Ave	Apt Comp	17.4	$353,700
127 - 143	Maple Ave	Apt Comp	17.3	$1,602,900
120	West St	Apt Comp	17.1	$240,000
130	West St	Apt Comp	17.1	$408,000
			Total	**$3,315,600**

Source: Town of Haverstraw
Assessors Office
David G. Adams - Assessor
(845) 942-3718
dgassessor@aol.com

Haverstraw Town Hall
One Rosman Road
Garnerville, NY 10923

Demolition Costs Jul-10

Building	L	W	sq ft	# of Floors	unit cost $/sf	total
1 111 - 117 Maple	75	30	2250	2		$58,500.00
2	72	35	2520	2		$65,520.00
3	77	35	2695	2		$70,070.00
4	154	35	5390	2		$140,140.00
5	90	35	3150	2		$81,900.00
6	120	35	4200	2		$109,200.00

Demolition and Disposal of demolition debris $13 per SF

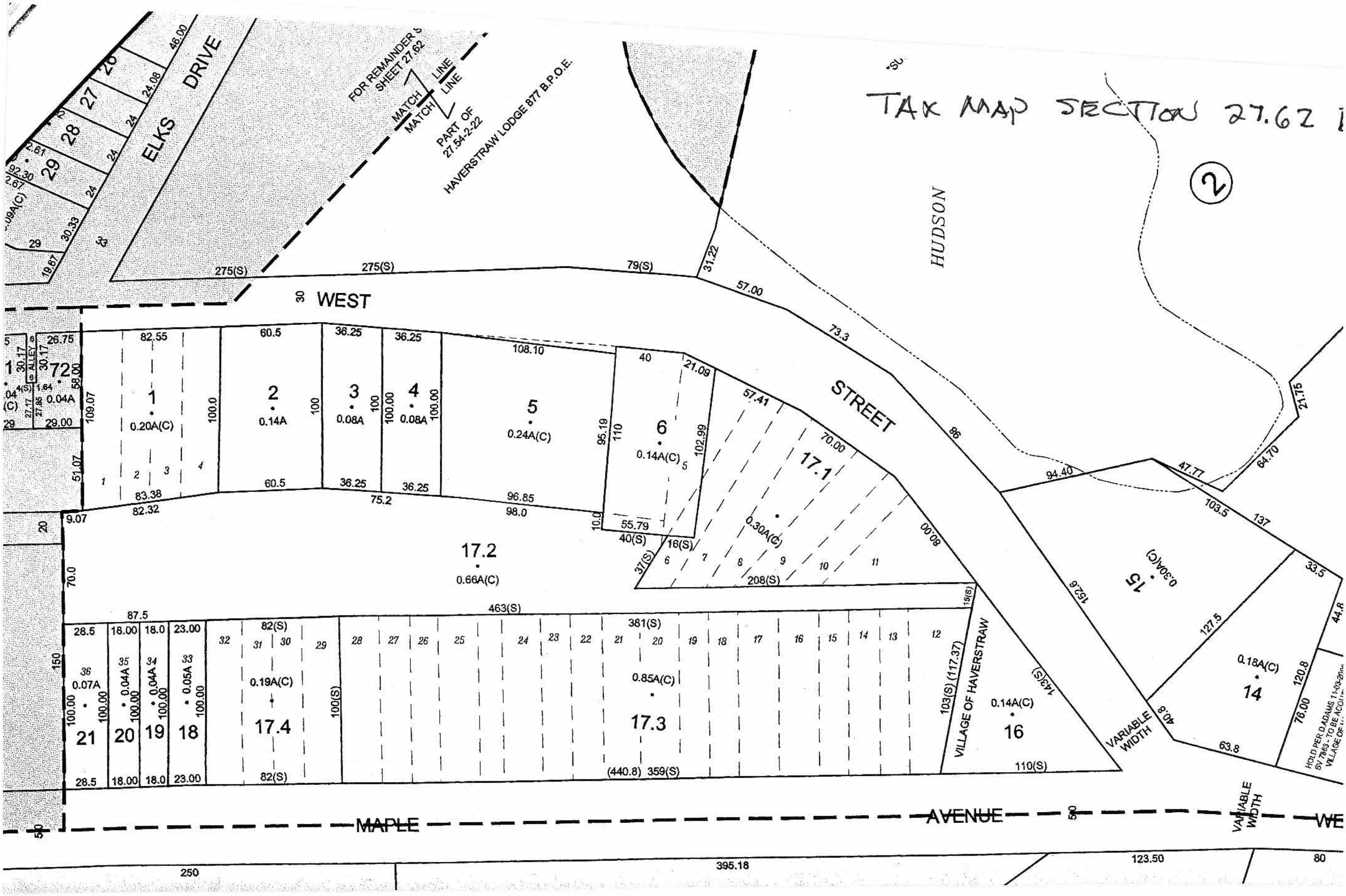
Total **$525,330**

Demolition and disposal complete unit costs from Capital Industries Demolition Service, Yonkers, NY (914) 368-7923.

House Number	Street	Property Type	Tax Map Section 27.62 Lot Number	Estimated Property Value (July 22, 2010)
111	Maple Ave	Private Res	21	$159,700.00
113	Maple Ave	Private Res	20	$195,800.00
115	Maple Ave	Private Res	19	$195,800.00
117	Maple Ave	Private Res	18	$159,700.00
119 - 125	Maple Ave	Apt Comp	17.4	$353,700.00
127 - 143	Maple Ave	Apt Comp	17.3	$1,602,900.00
120	West St	Apt Comp	17.1	$240,000.00
130	West St	Apt Comp	17.1	$408,000.00
			Total	**$ 3,315,600.00**

Source: Town of Haverstraw
Assessors Office
David G. Adams - Assessor
(845) 942-3718
dgassessor@aol.com

Haverstraw Town Hall
One Rosman Road
Garnerville, NY 10923


TAX MAP SECTION 27.62
2
WEST STREET
MAPLE AVENUE
ELKS DRIVE
HUDSON
FOR REMAINDER SEE SHEET 27.62
MATCH LINE
PART OF 27.54-2-22
HAVERSTRAW LODGE 877 B.P.O.E.
VILLAGE OF HAVERSTRAW
VARIABLE WIDTH
1
0.20A(C)
2
0.14A
3
0.08A
4
0.08A
5
0.24A(C)
6
0.14A(C)
17.1
0.30A(C)
17.2
0.66A(C)
17.3
0.85A(C)
17.4
0.19A(C)
16
0.14A(C)
15
0.30A(C)
14
0.18A(C)
18
0.05A
19
0.04A
20
0.04A
21
0.07A
72
0.04A
26
27
28
29

House Number	Street	Lot Number	Assessed Value
111	Maple Avenue	21	159700
113	Maple Avenue	20	195800
115	Maple Avenue	19	195800
117	Maple Avenue	18	159700
119	Maple Avenue	17.4	
121	Maple Avenue	17.4	353700
123	Maple Avenue	17.4	
125	Maple Avenue	17.4	
127	Maple Avenue	17.3	
129	Maple Avenue	17.3	
131	Maple Avenue	17.3	
133	Maple Avenue	17.3	1602900
135	Maple Avenue	17.3	
137	Maple Avenue	17.3	
139	Maple Avenue	17.3	
141	Maple Avenue	17.3	
143	Maple Avenue	17.3	
120	Maple Avenue	17.2	240000
130	West Street	17.1	408000

Appendix B

Remedial Alternative Volume Estimates

Table 1.1 - ALT 3 OU-1 Commercial: Source Material, then 500 ppm forTPAH and Commercial SCOs for BTEX to 15 feet maximum

	See Figure B-2					Hot Spot					Water	Volume Unsat		Volume Sat		Volume Total	
	L	W		Areas ft2	Depths ft	Volume ft3	Volume yd3	Depth to Water	@ Well		Sat Thickness	yd3	tons	yds	tons	yds	tons
Holder	85	55	rec	4,675	22	102,850	3,809	7.7	MW-3	Sat Excavations	14	1,333	2,000	2,476	4,457	3,809	6,457
Tar Well	115	38.5	Trap	4,428	18	79,695	2,952	7.43	MW-2	Sat Excavations	11	1,218	1,828	1,733	3,120	2,952	4,947
MW-02	65	14	rec	910	18	16,380	607	7.43	MW-2	Sat Excavations	11	250	376	356	641	607	1,017
Surface tar	25	30	rec	750	3	2,250	83	7.43	MW-2	Unsat Only	0	83	125	0	0	83	125
North Side	150	14	rec	2,100	15	31,500	1,167	7.7	MW-3	Sat Excavations	7	599	898	568	1,022	1,167	1,920
East Side	8	28	rec	224	8	1,792	66	7.7	MW-4	Sat Excavations	0	64	96	2	4	66	100
South Side	122	33.5	Trap	4,087	15	61,305	2,271	7.43	MW-2	Sat Excavations	8	1,125	1,687	1,146	2,063	2,271	3,750
South Side	80	8	rec	640	15	9,600	356	7.43	MW-2	Sat Excavations	8	176	264	179	323	356	587
West	8	26	rec	208	15	3,120	116	7.43	MW-2	Sat Excavations	8	57	86	58	105	116	191
Swale Area	40	35	rec	1,400	8	11,200	415	7.7	MW-3	Sat Excavations	0	399	599	16	28	415	627
TOTALS				19,422		319,692	11,840					5,305	7,958	6,535	11,763	11,840	19,721

Table 1.2 - ALT 4 OU-1 Part 375 Residential: Source Material, then Restricted Residential SCOs for PAH and BTEX to 15 feet maximum

	See Figure B-2					Hot Spot					Water	Volume Unsat		Volume Sat		Volume Total	
	L	W		Areas ft2	Depths ft	Volume ft3	Volume yd3	Depth to Water	@ Well		Sat Thickness	yd3	tons	yds	tons	yds	tons
Holder	85	55	rec	4,675	22	102,850	3,809	7.7	MW-3	Sat Excavations	14	1,333	2,000	2,476	4,457	3,809	6,457
Tar Well	115	38.5	Trap	4,428	18	79,695	2,952	7.43	MW-2	Sat Excavations	11	1,218	1,828	1,733	3,120	2,952	4,947
MW-02	65	14	rec	910	18	16,380	607	7.43	MW-2	Sat Excavations	11	250	376	356	641	607	1,017
Surface tar	25	30	rec	750	5	3,750	139	7.43	MW-2	Unsat Only	0	139	208	0	0	139	208
North Side	150	14	rec	2,100	15	31,500	1,167	7.7	MW-3	Sat Excavations	7	599	898	568	1,022	1,167	1,920
East Side	8	28	rec	224	15	3,360	124	7.7	MW-4	Sat Excavations	7	64	96	61	109	124	205
South Side	122	33.5	Trap	4,087	15	61,305	2,271	7.43	MW-2	Sat Excavations	8	1,125	1,687	1,146	2,063	2,271	3,750
South Side	80	8	rec	640	15	9,600	356	7.43	MW-2	Sat Excavations	8	176	264	179	323	356	587
West	8	26	rec	208	15	3,120	116	7.43	MW-2	Sat Excavations	8	57	86	58	105	116	191
Swale Area	40	35	rec	1,400	10	14,000	519	7.7	MW-3	Sat Excavations	2	399	599	119	215	519	814
North Side	65	20	rec	1,300	15	19,500	722	7.7	MW-3	Sat Excavations	7	371	556	351	633	722	1,189
East Side	22	72	rec	1,584	10	15,840	587	7.43	MW-2	Sat Excavations	3	436	654	151	271	587	925
South Side	195	12	rec	2,340	15	35,100	1,300	7.43	MW-2	Sat Excavations	8	644	966	656	1,181	1,300	2,147
South Side	70	8	rec	560	15	8,400	311	7.43	MW-2	Sat Excavations	8	154	231	157	283	311	514
TOTALS				25,206		404,400	14,978					6,966	10,449	8,012	14,422	14,978	24,870

Table 1.3 - ALT 5 OU-1 Part 375 Unrestricted: Unrestricted SCOs for PAH and BTEX with no depth limit

	See Figure B-3					Hot Spot					Water	Volume Unsat		Volume Sat		Volume Total	
	L	W		Areas ft2	Depths ft	Volume ft3	Volume yd3	Depth to Water	@ Well		Sat Thickness	yd3	tons	yds	tons	yds	tons
Holder SB 119	85	55	rec	4,675	25	116,875	4,329	7.7	MW-3	Sat Excavations	17	1,333	2,000	2,995	5,392	4,329	7,392
Tar Well SB 16	115	38.5	Trap	4,428	32	141,680	5,247	7.43	MW-2	Sat Excavations	25	1,218	1,828	4,029	7,252	5,247	9,080
MW-02	65	14	rec	910	32	29,120	1,079	7.43	MW-2	Sat Excavations	25	250	376	828	1,491	1,079	1,866
Surface tar	25	30	rec	750	5	3,750	139	7.43	MW-2	Unsat Only	0	139	208	0	0	139	208
North Side	140	25	rec	3,500	18	63,000	2,333	7.7	MW-3	Sat Excavations	10	998	1,497	1,335	2,403	2,333	3,901
NE Side	72	15	rec	1,080	18	19,440	720	7.43	MW-2	Sat Excavations	11	297	446	423	761	720	1,207
West	8	95	rec	760	18	13,680	507	7.7	MW-3	Sat Excavations	10	217	325	290	522	507	847
South Side	165	15	rec	2,475	15	37,125	1,375	7.43	MW-2	Sat Excavations	8	681	1,022	694	1,249	1,375	2,271
Center	120	70	triangle	4,200	23	96,600	3,578	7.43	MW-2	Sat Excavations	16	1,156	1,734	2,422	4,360	3,578	6,093
East Side	90	20	rec	1,800	12	21,600	800	8.87	MW-9	Sat Excavations	3	591	887	209	376	800	1,263
East Side	25	15	rec	375	12	4,500	167	8.87	MW-9	Sat Excavations	3	123	185	43	78	167	263
Swale Area	45	40	rec	1,800	11	19,800	733	7.7	MW-3	Sat Excavations	3	513	770	220	396	733	1,166
TOTALS				26,753		567,170	21,006					7,518	11,277	13,489	24,279	21,006	35,556

TABLE 2.2a

ALT 3 - PHASE I - West Street Single Family Residences to Part 375 Residential. See Figure B-4

See Figure B-1

Cell #	L	W		Areas ft2	Depths ft		Volume ft3	Volume yd	Depth to W	@ Well			Volume Unsat yd3	tons	Volume Sat yds	tons	Volume Total yds	tons
A	145	40	rec	5,800	17		98,600	3,652	2.04	MW-32S	Sat Excavations	15	438	657	3,214	5,785	3,652	6,442
B	35	35	rec	1,225	13		15,925	590	4.97	MW-29S	Sat Excavations	8	225	338	364	656	590	994
C	135	35	rec	4,725	13		61,425	2,275	4.97	MW-29S	Sat Excavations	8	870	1,305	1,405	2,529	2,275	3,834
D	30	25	rec	750	13		9,750	361	4.97	MW-29S	Sat Excavations	8	138	207	223	402	361	609
E	65	35	rec	2,275	15		34,125	1,264	2.04	MW-32S	Sat Excavations	13	172	258	1,092	1,966	1,264	2,223
F	70	25	rec	1,750	13		22,750	843	2.04	MW-32S	Sat Excavations	13	132	198	710	1,279	843	1,477
TOTALS				16,525			242,575	8,984					1,976	2,963	7,009	12,616	8,984	15,579

Excavation	Unsat	500	tons		5.9269	29.28899
	Sat	300	tons		23	
Trucks	30 Cu yds/truck			16.6667		

TABLE 2.2b

ALT 3 - PHASE 2- Post Demolition - Maple Avenue Single Family Residences,(111-117 Maple Ave), Apartment Complex and Alleyway to Part 375 Residential. See Figure B-4

Cell #	L	W		Areas ft2	Depths ft		Volume ft3	Volume yd	Depth to W	@ Well			Volume Unsat yd3	tons	Volume Sat yds	tons	yds	tons
1	155	20	trap	3,100	17		52,700	1,952	2.04	MW-32S	Sat Excavations	15	234	351	1,718	3,092	1,952	3,443
2	155	85	rec	13,175	12		158,100	5,856	2.04	MW-32S	Sat Excavations	10	995	1,493	4,860	8,748	5,856	10,241
Maple Ave A	85	50	rec	4,250	15		63,750	2,361	3.04	MW-32S	Sat Excavations	12	479	718	1,883	3,389	2,361	4,106
Maple Ave B	110	60	rec	6,600	**15**		99,000	3,667	5.71	MW-20S	Sat Excavations	9	1,396	2,094	2,271	4,088	3,667	6,181
3	70	80	rec	5,600	**15**		84,000	3,111	6.71	MW-20S	Sat Excavations	8	1,392	2,088	1,719	3,095	3,111	5,182
4	160	60	rec	9,600	11		105,600	3,911	5.71	MW-20S	Sat Excavations	5	2,030	3,045	1,881	3,386	3,911	6,431
5	90	40	rec	3,600	15		54,000	2,000	4.97	MW-29S	Sat Excavations	10	663	994	1,337	2,407	2,000	3,401
6	125	80	rec	10,000	13		130,000	4,815	4.97	MW-29S	Sat Excavations	8	1,841	2,761	2,974	5,353	4,815	8,114
7	140	60	rec	8,400	14		117,600	4,356	5.71	MW-20S	Sat Excavations	8	1,776	2,665	2,579	4,642	4,356	7,307
8	135	60	rec	8,100	10		81,000	3,000	5.71	MW-20S	Sat Excavations	4	1,713	2,570	1,287	2,317	3,000	4,886
9	140	80	tri	5,600	16		89,600	3,319	6.4	MW-60	Sat Excavations	10	1,327	1,991	1,991	3,584	3,319	5,575
10	85	65	rec	5,525	12		66,300	2,456	6.4	MW-60	Sat Excavations	6	1,310	1,964	1,146	2,063	2,456	4,027
11	80	25	rec	2,000	6		12,000	444	6.4	MW-60	Unsat Only	0	444	667	0	0	444	667
12	80	80	rec	6,400	17		108,800	4,030	4.97	MW-29S	Sat Excavations	12	1,178	1,767	2,852	5,133	4,030	6,900
13	85	55	rec	4,675	10		46,750	1,731	6.4	MW-60	Sat Excavations	4	1,108	1,662	623	1,122	1,731	2,784
14	45	30	rec	1,350	17		22,950	850	4.97	MW-29S	Sat Excavations	12	249	373	602	1,083	850	1,455
MW32S	148	32	rec	4,736	17		80,512	2,982	4.97	MW-29S	Sat Excavations	12	872	1,308	2,110	3,798	2,982	5,106
TOTALS	TOTALS			102,711			1,372,662	50,839					19,007	28,510	31,833	57,299	50,839	85,809

111- 117 Maple Ave is Maple Ave A and Maple Avenue B:	6,028	CY
Apartment Complex	44,812	CY
Total	50,839	

TABLE 2.3a

ALT 4 - PHASE I - Apartment Complex Excavate MW32S Area Source Material, Alleyway, and West Street Single Family Residences to Part 375 Residential. See Figure B-5

													Volume Unsat		Volume Sat			
Cell #	L	W		Areas ft2	Depths ft		Volume ft3	Volume yd	Depth to W	@ Well			yd3	tons	yds	tons	yds	tons
A	145	40	rec	5,800	17		98,600	3,652	2.04	MW-32S	Sat Excavations	15	438	657	3,214	5,785	3,652	6,442
B	35	35	rec	1,225	13		15,925	590	4.97	MW-29S	Sat Excavations	8	225	338	364	656	590	994
C	135	35	rec	4,725	13		61,425	2,275	4.97	MW-29S	Sat Excavations	8	870	1,305	1,405	2,529	2,275	3,834
D	30	25	rec	750	13		9,750	361	4.97	MW-29S	Sat Excavations	8	138	207	223	402	361	609
E	65	35	rec	2,275	15		34,125	1,264	2.04	MW-32S	Sat Excavations	13	172	258	1,092	1,966	1,264	2,223
F	75	25	rec	1,875	13		24,375	903	2.04	MW-32S	Sat Excavations	11	142	213	761	1,370	903	1,583
MW32S	148	32	rec	4,736	17		80,512	2,982	4.97	MW-29S	Sat Excavations	12	872	1,308	2,110	3,798	2,982	5,106
TOTALS	TOTALS			21,386			324,712	12,026					2,857	4,285	9,170	16,505	12,026	20,790

The volume of the excavation in MW32S and Alleyway is the
difference between Alt 3 Phase 1 and Alt 4 Phase 1: 3,042 CY

TABLE 2.3b

ALT 4 - PHASE 2 - Excavate Remaining Apartment Complex and 111-117 Maple Ave. to Part 375 Residential Levels. See Figure B-5

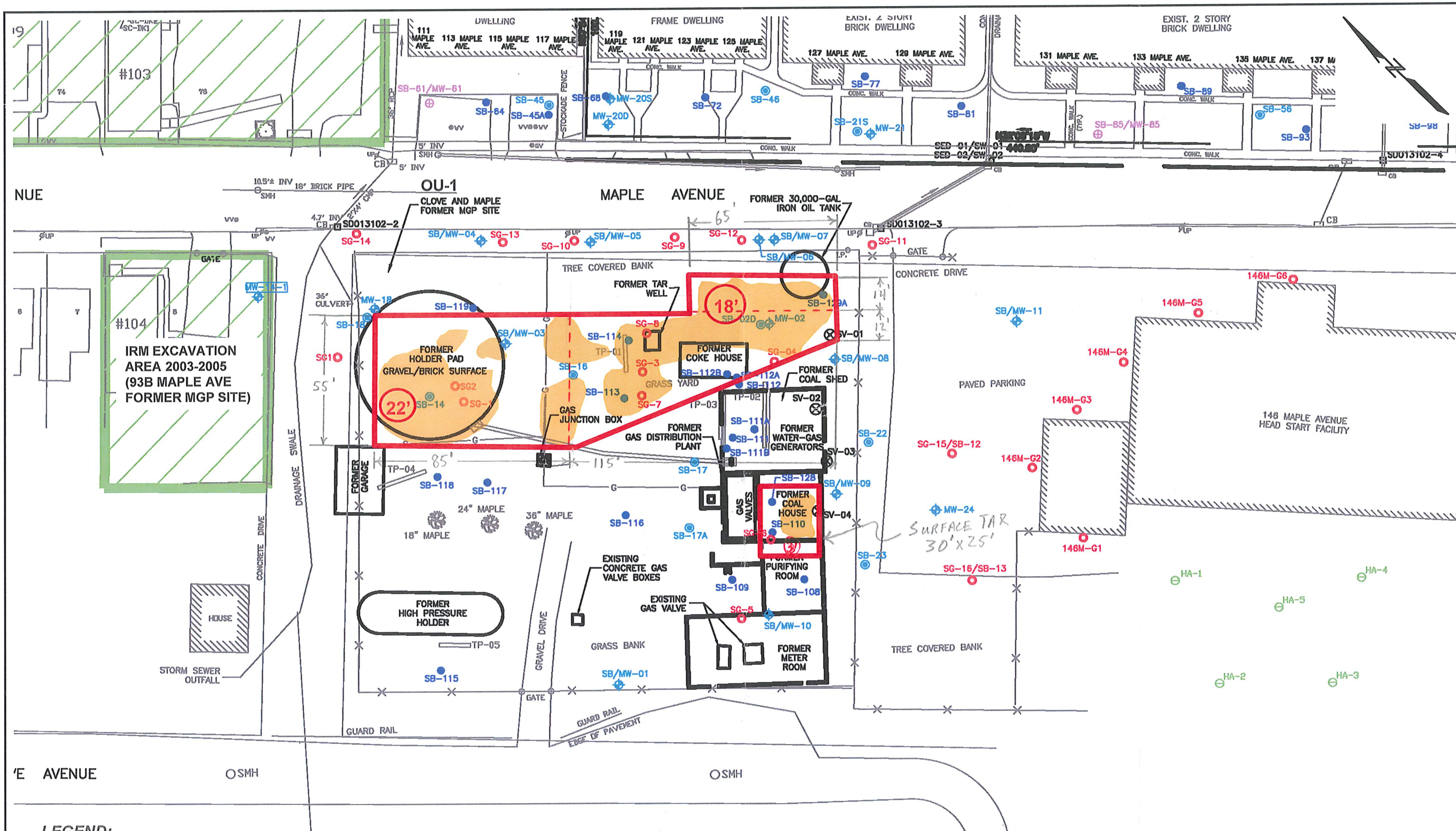
													Volume Unsat		Volume Sat			
Cell #	L	W		Areas ft2	Depths ft		Volume ft3	Volume yd	Depth to W	@ Well			yd3	tons	yds	tons	yds	tons
1	155	20	trap	3,100	17		52,700	1,952	2.04	MW-32S	Sat Excavations	15	234	351	1,718	3,092	1,952	3,443
2	155	85	rec	13,175	12		158,100	5,856	1.04	MW-32S	Sat Excavations	11	507	761	5,348	9,627	5,856	10,388
Maple Ave A	85	50	rec	4,250	15		63,750	2,361	2.04	MW-32S	Sat Excavations	13	321	482	2,040	3,672	2,361	4,154
Maple Ave B	110	60	rec	6,600	**15**		99,000	3,667	5.71	MW-20S	Sat Excavations	9	1,396	2,094	2,271	4,088	3,667	6,181
3	70	80	rec	5,600	**15**		84,000	3,111	6.71	MW-20S	Sat Excavations	8	1,392	2,088	1,719	3,095	3,111	5,182
4	160	60	rec	9,600	11		105,600	3,911	5.71	MW-20S	Sat Excavations	5	2,030	3,045	1,881	3,386	3,911	6,431
5	90	40	rec	3,600	15		54,000	2,000	4.97	MW-29S	Sat Excavations	10	663	994	1,337	2,407	2,000	3,401
6	125	80	rec	10,000	13		130,000	4,815	4.97	MW-29S	Sat Excavations	8	1,841	2,761	2,974	5,353	4,815	8,114
7	140	60	rec	8,400	14		117,600	4,356	5.71	MW-20S	Sat Excavations	8	1,776	2,665	2,579	4,642	4,356	7,307
8	135	60	rec	8,100	10		81,000	3,000	5.71	MW-20S	Sat Excavations	4	1,713	2,570	1,287	2,317	3,000	4,886
9	140	80	tri	5,600	16		89,600	3,319	6.4	MW-60	Sat Excavations	10	1,327	1,991	1,991	3,584	3,319	5,575
10	85	65	rec	5,525	12		66,300	2,456	6.4	MW-60	Sat Excavations	6	1,310	1,964	1,146	2,063	2,456	4,027
11	80	25	rec	2,000	6		12,000	444	6.4	MW-60	Unsat Only	0	444	667	0	0	444	667
12	80	80	rec	6,400	17		108,800	4,030	4.97	MW-29S	Sat Excavations	12	1,178	1,767	2,852	5,133	4,030	6,900
13	85	55	rec	4,675	10		46,750	1,731	6.4	MW-60	Sat Excavations	4	1,108	1,662	623	1,122	1,731	2,784
14	45	30	rec	1,350	17		22,950	850	4.97	MW-29S	Sat Excavations	12	249	373	602	1,083	850	1,455
TOTALS	TOTALS			97,975			1,292,150	47,857					17,490	26,234	30,368	54,662	47,857	80,896

111- 117 Maple Ave is Maple Ave A and Maple Avenue B:	6,028	CY
Apartment Complex	41,830	CY
Total	47,857	

TABLE 2.4
OU-2 Part 375 Unrestricted, total removal: Assumes Demolition and Redevelopment of Apartment Building Property. See Figure B-5

													Volume Unsat		Volume Sat		Volume Total		Vol
Cell #	L	W		Areas ft2	Depths ft		Volume ft3	Volume yd	Depth to W	@ Well			yd3	tons	yds	tons	yds	tons	Subtotal
A	145	40	rec	5,800	21		121,800	4,511	2.04	MW-32S	Sat Excavations	19	438	657	4,073	7,331	4,511	7,989	
B	35	35	rec	1,225	21		25,725	953	4.97	MW-29S	Sat Excavations	16	225	338	727	1,309	953	1,647	
C	135	35	rec	4,725	21		99,225	3,675	4.97	MW-29S	Sat Excavations	16	870	1,305	2,805	5,049	3,675	6,354	
D	30	25	rec	750	21		15,750	583	4.97	MW-29S	Sat Excavations	16	138	207	445	802	583	1,009	
E	65	35	rec	2,275	21		47,775	1,769	2.04	MW-32S	Sat Excavations	19	172	258	1,598	2,876	1,769	3,133	
F	70	25	rec	1,750	21		36,750	1,361	2.04	MW-32S	Sat Excavations	13	132	198	1,229	2,212	1,361	2,410	
																			12,853
Maple Ave A	85	50	rec	4,250	17		72,250	2,676	2.04	MW-32S	Sat Excavations	15	321	482	2,355	4,239	2,676	4,720	
Maple Ave B	110	60	rec	6,600	27		178,200	6,600	5.71	MW-20S	Sat Excavations	21	1,396	2,094	5,204	9,368	6,600	11,461	
																			9,276
MW32S	148	32	rec	4,736	21		99,456	3,684	4.97	MW-29S	Sat Excavations	16	872	1,308	2,812	5,061	3,684	6,369	
1	155	20	rec	3,100	21		65,100	2,411	2.04	MW-32S	Sat Excavations	19	234	351	2,177	3,918	2,411	4,270	
2	155	85	rec	13,175	17		223,975	8,295	2.04	MW-32S	Sat Excavations	15	995	1,493	7,300	13,140	8,295	14,633	
3	70	80	rec	5,600	**17**		95,200	3,526	6.71	MW-20S	Sat Excavations	10	1,392	2,088	2,134	3,842	3,526	5,929	
4	160	60	rec	9,600	17		163,200	6,044	5.71	MW-20S	Sat Excavations	11	2,030	3,045	4,014	7,226	6,044	10,271	
5	90	40	rec	3,600	17		61,200	2,267	4.97	MW-29S	Sat Excavations	12	663	994	1,604	2,887	2,267	3,881	
6	125	80	rec	10,000	17		170,000	6,296	4.97	MW-29S	Sat Excavations	12	1,841	2,761	4,456	8,020	6,296	10,781	
7	140	60	rec	8,400	17		142,800	5,289	5.71	MW-20S	Sat Excavations	11	1,776	2,665	3,512	6,322	5,289	8,987	
8	135	60	rec	8,100	17		137,700	5,100	5.71	MW-20S	Sat Excavations	11	1,713	2,570	3,387	6,097	5,100	8,666	
9	140	80	tri	5,600	17		95,200	3,526	6.4	MW-60	Sat Excavations	11	1,327	1,991	2,199	3,957	3,526	5,948	
10	85	65	rec	5,525	15		82,875	3,069	6.4	MW-60	Sat Excavations	9	1,310	1,964	1,760	3,168	3,069	5,132	
11	80	25	rec	2,000	17		34,000	1,259	6.4	MW-60	Sat Excavations	11	474	711	785	1,413	1,259	2,124	
12	80	80	rec	6,400	21		134,400	4,978	4.97	MW-29S	Sat Excavations	16	1,178	1,767	3,800	6,839	4,978	8,607	
13	85	55	rec	4,675	21		98,175	3,636	6.4	MW-60	Sat Excavations	15	1,108	1,662	2,528	4,550	3,636	6,213	
14	45	30	rec	1,350	18		24,300	900	4.97	MW-29S	Sat Excavations	13	249	373	652	1,173	900	1,545	
																			60,281
Maple Ave Rd	325	35	rec	11,375	17		193,375	7,162	5.71	MW-20S	Sat Excavations	11	2,406	3,608	4,756	8,562	7,162	12,170	
TOTALS	TOTALS			130,611			2,418,431	89,572					23,260	34,890	66,311	119,360	89,572	154,251	

Maple Ave excavation	7,162	CY
All other soils	82,409	CY
Total	89,572	



LEGEND:

- APPROXIMATE LIMITS OF SOURCE MATERIAL EXCAVATION
- 22' APPROXIMATE DEPTH OF EXCAVATION
- APPROXIMATE EXTENT OF SOURCE MATERIAL FROM EVS 3D MODEL

NOTES:

1. NOT FOR BIDDING OR CONSTRUCTION
2. BASE MAP FROM PLATE 2, 1/28/2009, CMX REMEDIAL INVESTIGATION REPORT, MAY 2009

0 40 80

SCALE, FEET

CLOVE AND MAPLE FORMER MGP SITE HAVERSTRAW, NEW YORK	GEI Consultants	OU-1 SOURCE MATERIAL
ORANGE AND ROCKLAND UTILITIES, INC.	Project 091950-1	January 2010 Figure B-1

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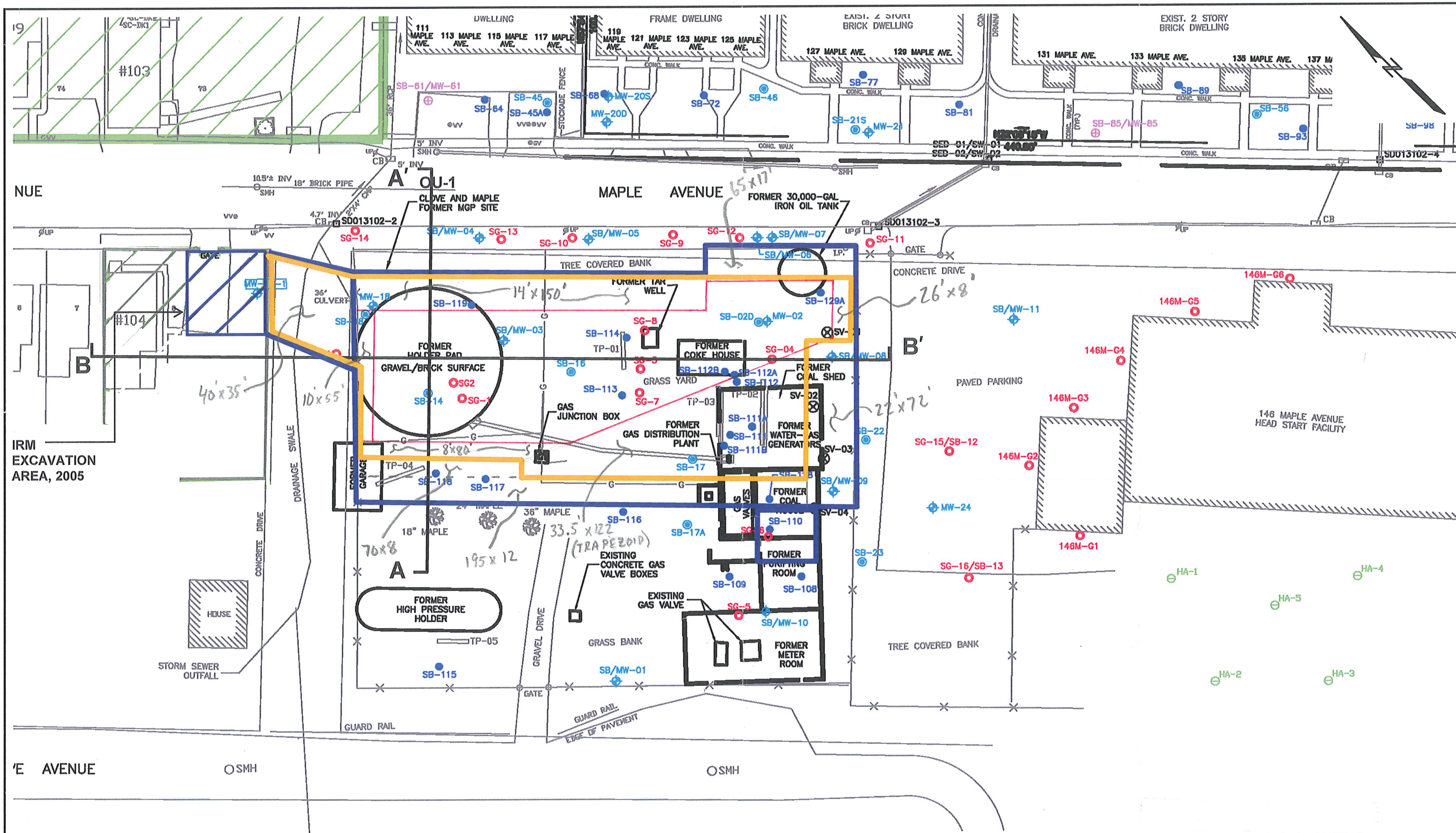

LEGEND:

- APPROXIMATE LIMITS OF EXCAVATION FOR PART 375 RESIDENTIAL CLEANUP
- APPROXIMATE LIMITS OF EXCAVATION FOR COMMERCIAL CLEANUP

NOTES:

1. NOT FOR BIDDING OR CONSTRUCTION
2. BASE MAP FROM PLATE 2, 1/28/2009, CMX REMEDIAL INVESTIGATION REPORT, MAY 2009

CLOVE AND MAPLE FORMER MGP SITE
HAVERSTRAW, NEW YORK

ORANGE AND ROCKLAND UTILITIES, INC.

GEI Consultants

Project 091950-1

OU-1 ALTERNATIVES 3 AND 4 COMMERCIAL CLEANUP AND PART 375 RESIDENTIAL

January 2010 Figure B-2

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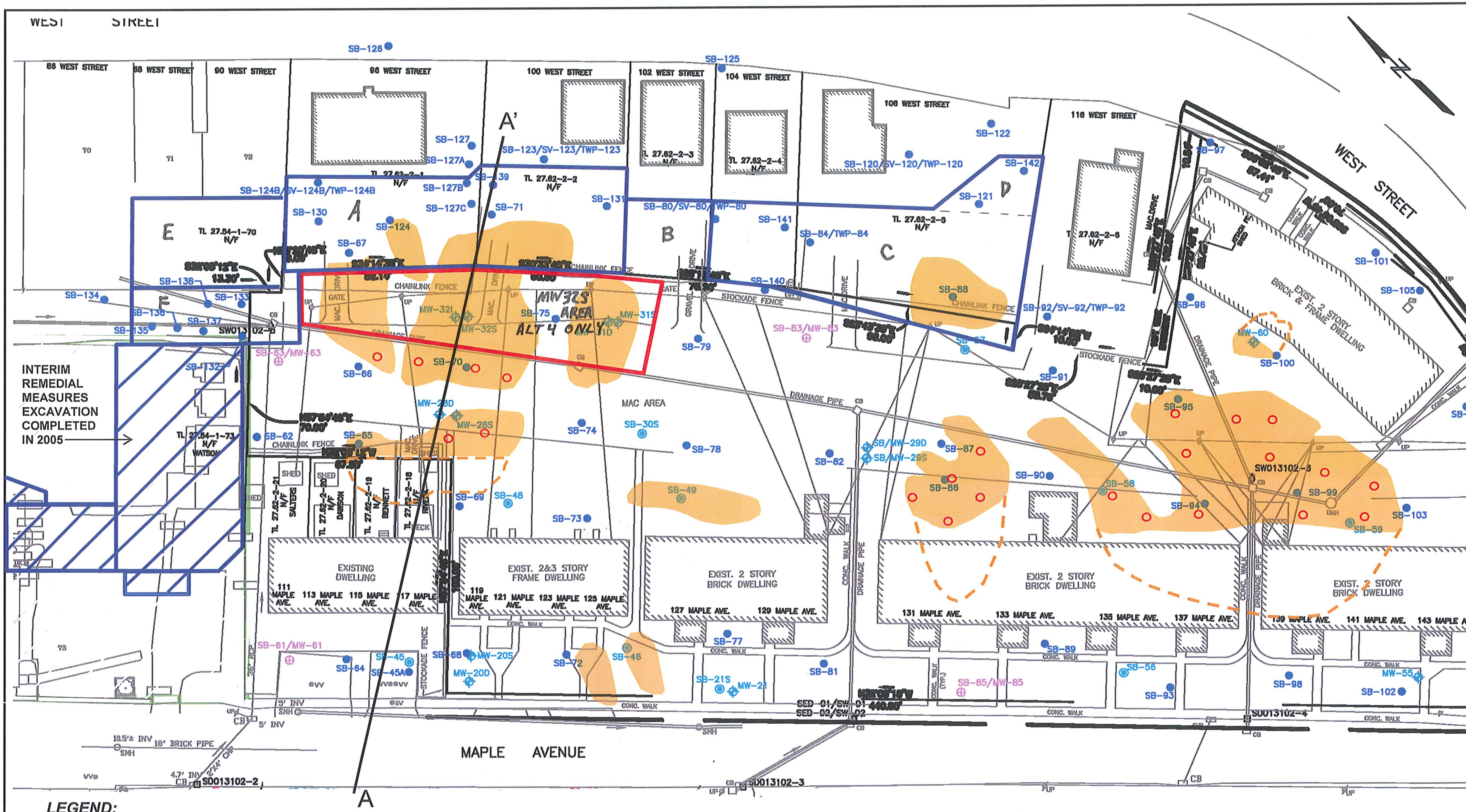


LEGEND:

- APPROXIMATE LIMITS FOR PART 375 RESIDENTIAL CLEANUP
- EXCAVATION OF SOURCE MATERIAL
- APPROXIMATE EXTENT OF SOURCE MATERIAL (GREATER THAN 0.2 FEET IN THICKNESS) FROM EVS 3D MODEL
- EXTENT OF POTENTIAL SOURCE MATERIAL BENEATH BUILDINGS
- NAPL RECOVERY AREA. LOCATION OF RECOVERY WELLS TO BE DETERMINED DURING DESIGN.

NOTES:

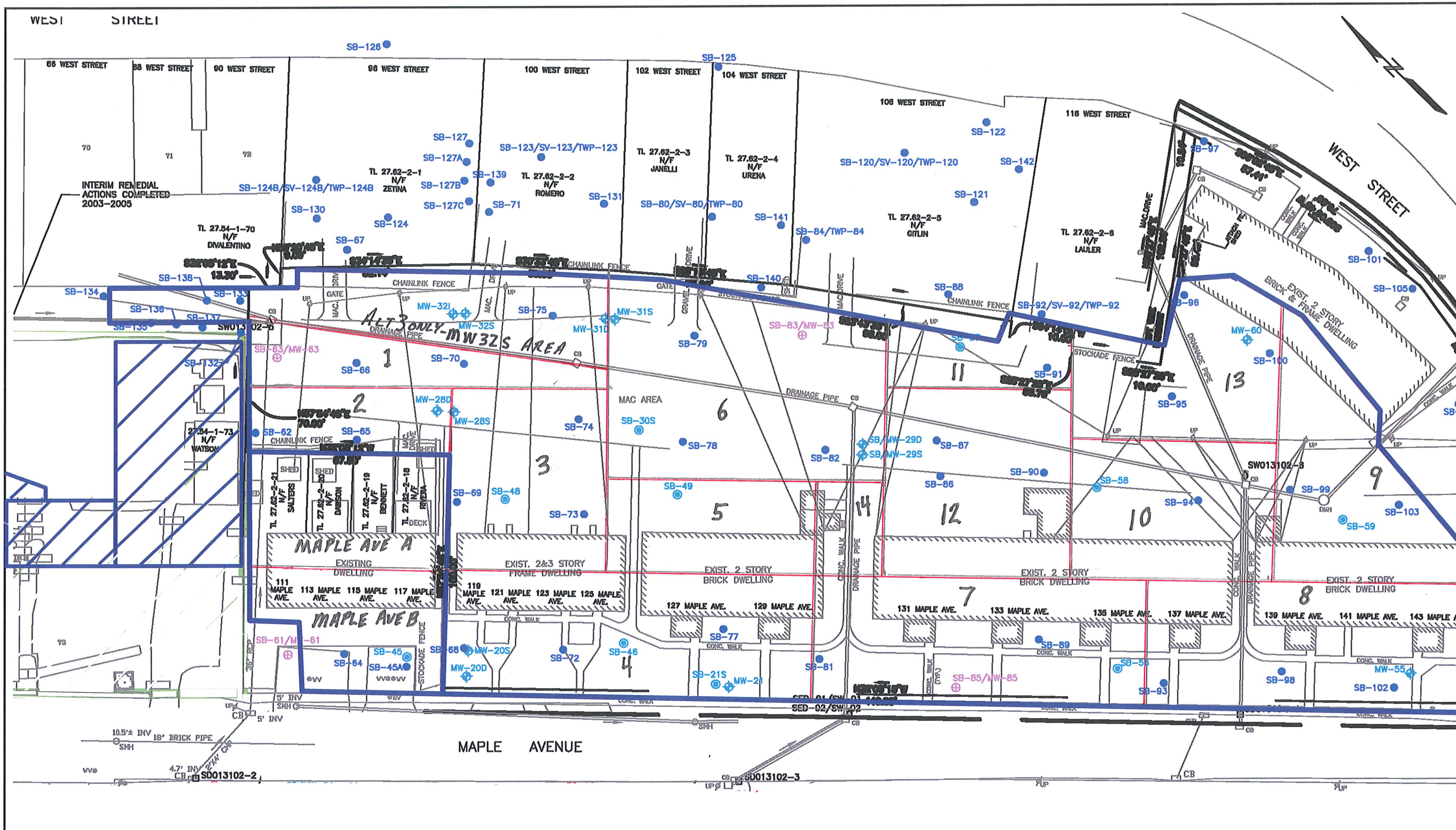
1. NOT FOR BIDDING OR CONSTRUCTION
2. BASE MAP FROM PLATE 2, 1/28/2009, CMX REMEDIAL INVESTIGATION REPORT, MAY 2009
3. EXISTING DWELLINGS ON WEST STREET APPROXIMATE FROM AIR PHOTOS
4. IRM EXCAVATION LIMITS APPROXIMATE, BASED ON FIGURE 3, RECORD EXCAVATION PLAN, GEI IRM CERTIFICATION REPORT, 93B MAPLE AVE, MARCH 31, 2006.

0 40 80

SCALE, FEET

CLOVE AND MAPLE FORMER MGP SITE HAVERSTRAW, NEW YORK	GEI Consultants	OU-2 ALTERNATIVE 3 & 4 PHASE 1 Volume Estimate
ORANGE AND ROCKLAND UTILITIES, INC.	Project 091950-1	January 2010 Figure B-3

I:\GEI\ORANGE & ROCKLAND\HAVERSTRAW\RIR\ OU1 AND OU2 F-Plate 2-Site Layout 1-28-09.dwg \Oct 22, 2009



LEGEND:

APPROXIMATE LIMITS OF EXCAVATION FOR PART 375 RESIDENTIAL CLEANUP OBJECTIVES

NOTES:

1. NOT FOR BIDDING OR CONSTRUCTION
2. BASE MAP FROM PLATE 2, 1/28/2009, CMX REMEDIAL INVESTIGATION REPORT, MAY 2009

0 40 80

SCALE, FEET

CLOVE AND MAPLE FORMER MGP SITE
HAVERSTRAW, NEW YORK

ORANGE AND ROCKLAND UTILITIES, INC.

GEI Consultants

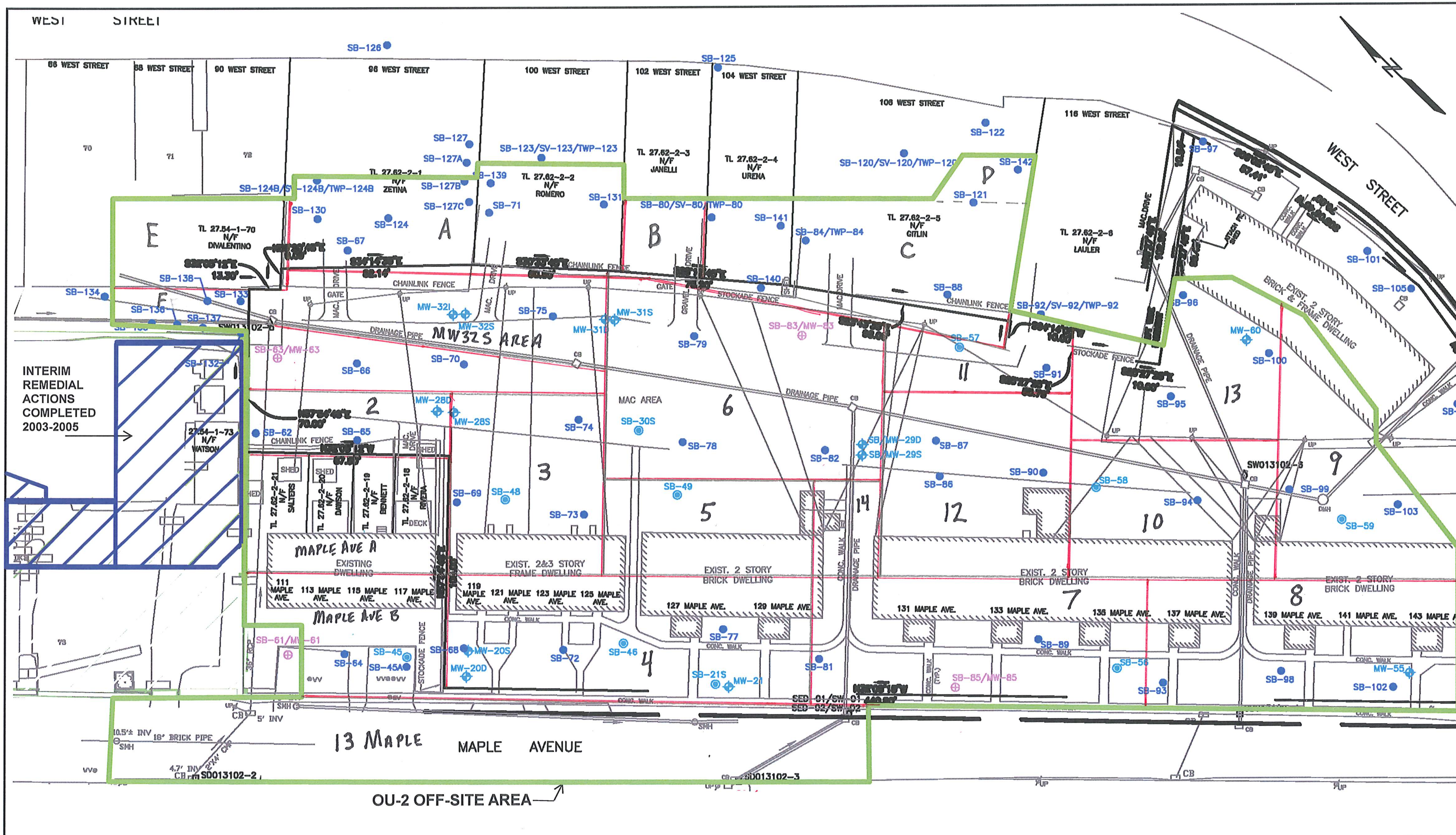
Project 091950-1

OU-2 ALTERNATIVES 3 AND 4
PHASE 2 - VOLUME ESTIMATES

January 2010

Figure B-4

I:\GEI\ORANGE & ROCKLAND\HAVERSTRAW\RIR\ OU1 AND OU2 F-Plate 2-Site Layout 1-28-09.dwg \Oct 22, 2009



LEGEND:

APPROXIMATE LIMITS OF EXCAVATION FOR PART 375 UNRESTRICTED CLEANUP OBJECTIVES

NOTES:

1. NOT FOR BIDDING OR CONSTRUCTION
2. BASE MAP FROM PLATE 2, 1/28/2009, CMX REMEDIAL INVESTIGATION REPORT, MAY 2009

0 40 80

SCALE, FEET

CLOVE AND MAPLE FORMER MGP SITE
HAVERSTRAW, NEW YORK

ORANGE AND ROCKLAND UTILITIES, INC.

GEI Consultants

Project 091950-1

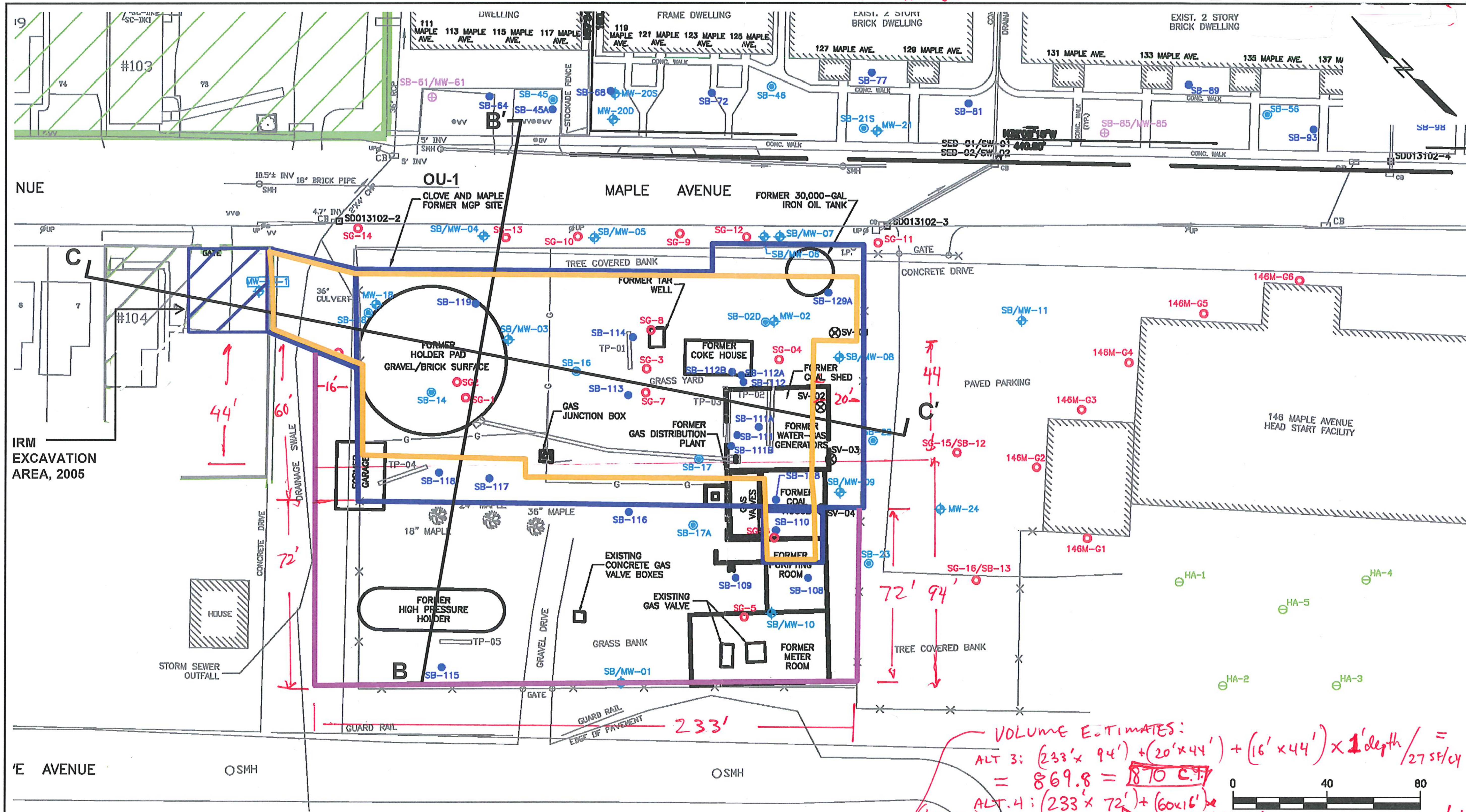
OU-2 ALTERNATIVE 5 - PART 375 UNRESTRICTED SOIL CLEANUP OBJECTIVES VOLUME ESTIMATES

January 2010

Figure B-5

I:\GEI\ORANGE & ROCKLAND\HAVERSTRAW\RIR\ OU1 AND OU2 F-Plate 2-Site Layout 1-28-09.dwg \Oct 22, 2009

SURFACE SOIL VOLUME ESTIMATE



VOLUME ESTIMATES:

ALT 3: (233' x 94') + (20' x 44') + (16' x 44') x 1' depth / 27 SF/CY = 869.8 = 870 C.Y.

ALT. 4: (233' x 72') + (60 x 16') x 2' depth / 27 SF/CY = 1314 = 1300 C.Y. (+ALT 3)

LEGEND:

- APPROXIMATE LIMITS OF EXCAVATION FOR PART 375 COMMERCIAL CLEANUP (ALTERNATIVE 3)
- APPROXIMATE LIMITS OF EXCAVATION FOR PART 375 RESIDENTIAL CLEANUP (ALTERNATIVE 4)
- APPROXIMATE LIMITS OF REMOVAL OF SURFACE SOIL AND PLACEMENT OF CLEAN SOIL: 1 FOOT FOR ALTERNATIVE 3, OR 2 FEET FOR ALTERNATIVE 4

NOTES:

1. NOT FOR BIDDING OR CONSTRUCTION
2. BASE MAP FROM PLATE 2, 1/28/2009, CMX REMEDIAL INVESTIGATION REPORT, MAY 2009

CLOVE AND MAPLE FORMER MGP SITE
HAVERSTRAW, NEW YORK

ORANGE AND ROCKLAND UTILITIES, INC.

GEI Consultants

Project 091950-1

OU-1 ALTERNATIVES 3 AND 4
SURFACE SOIL VOLUMES

August 2010

Figure B-6

I:\GEI\ORANGE & ROCKLAND\HAVERSTRAW\RIR\ OU1 AND OU2 F-Plate 2-Site Layout 1-28-09.dwg \Oct 22, 2009